FICEM

FEDERACIÓN INTERAMERICANA
DEL CEMENTO

Contexto

Net **Z**ero **FICEM**

Desafíos **NZ**

Herramientas **FICEM**

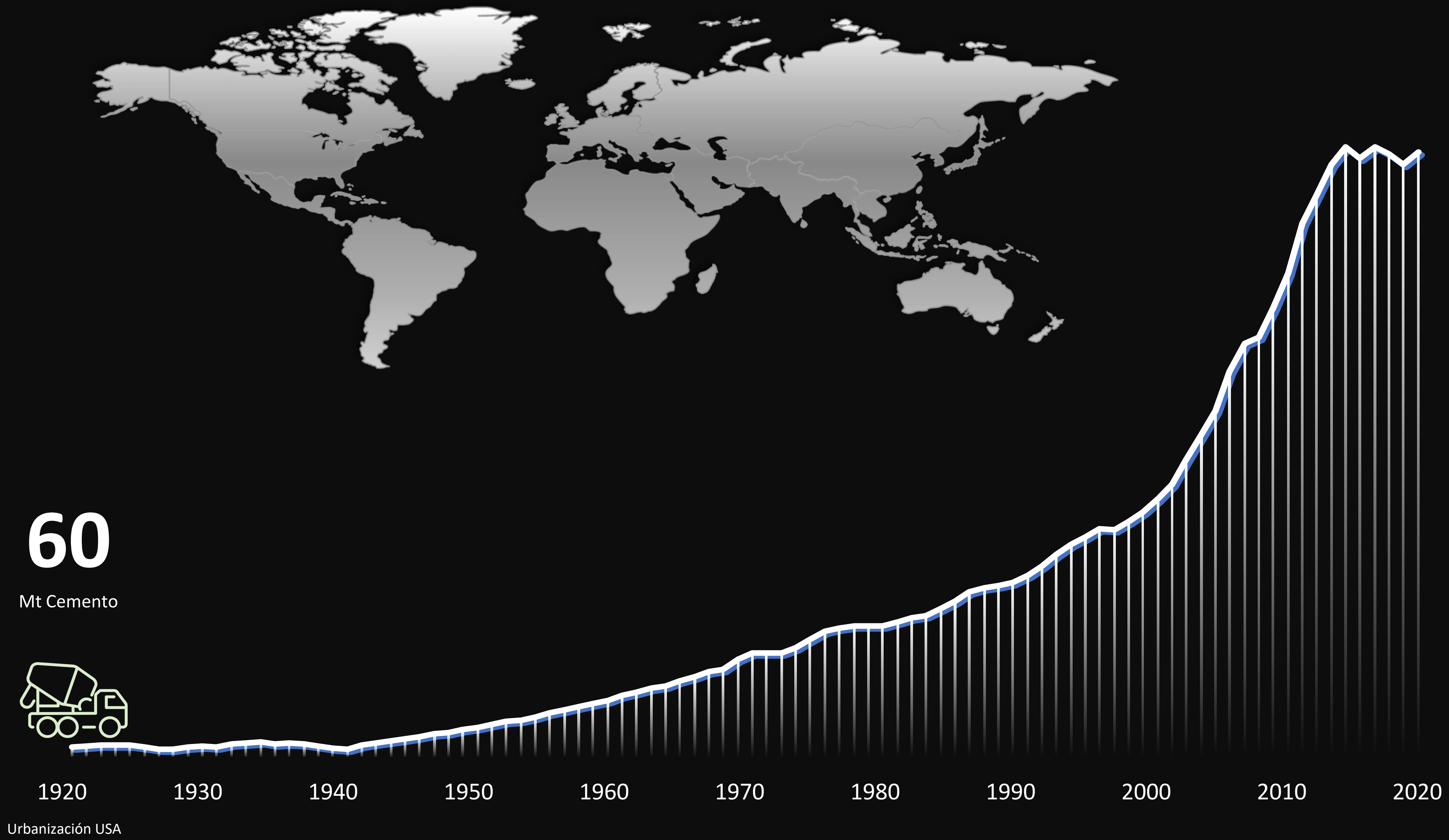
Contexto

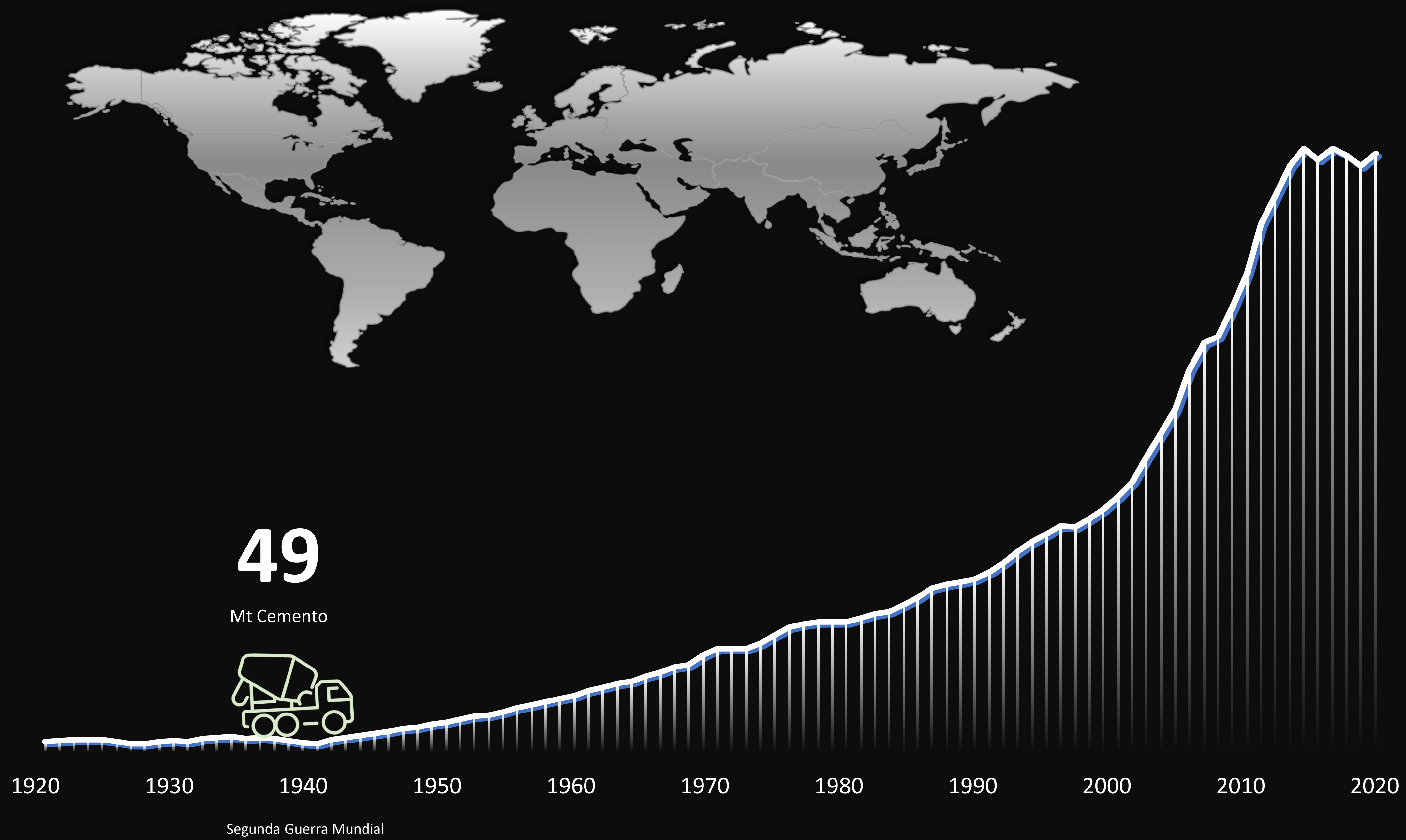
7.900 M habitantes

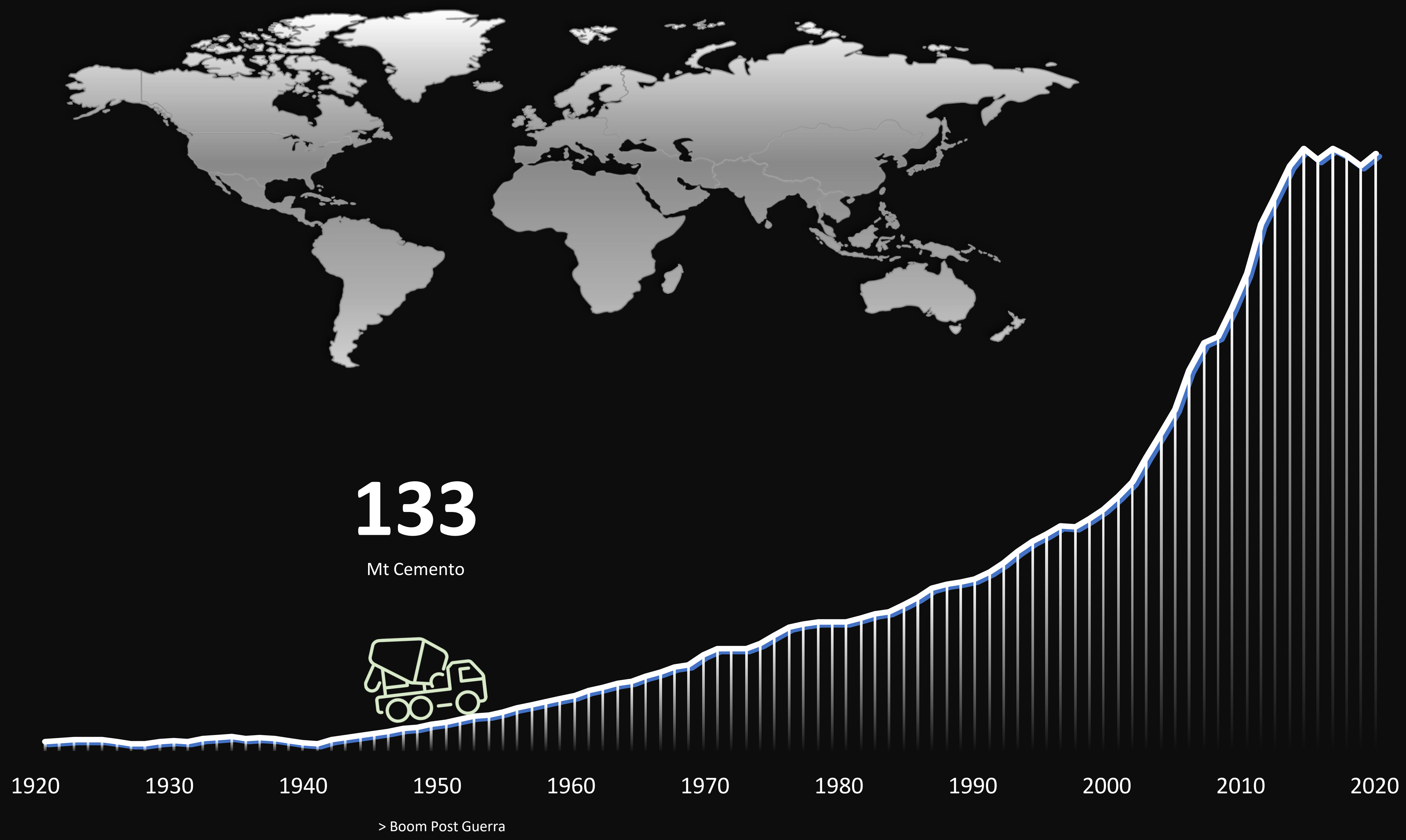
Contexto

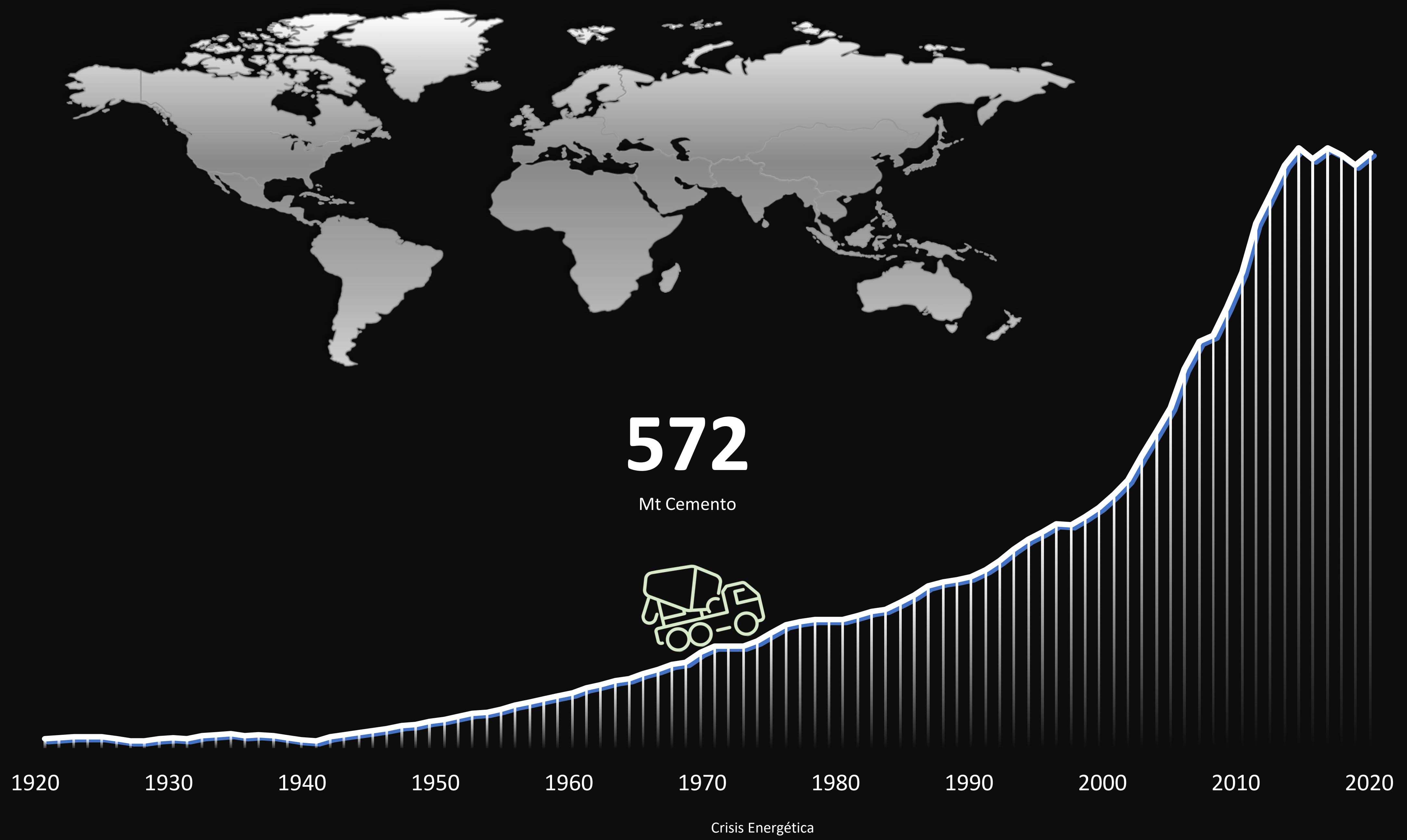
60

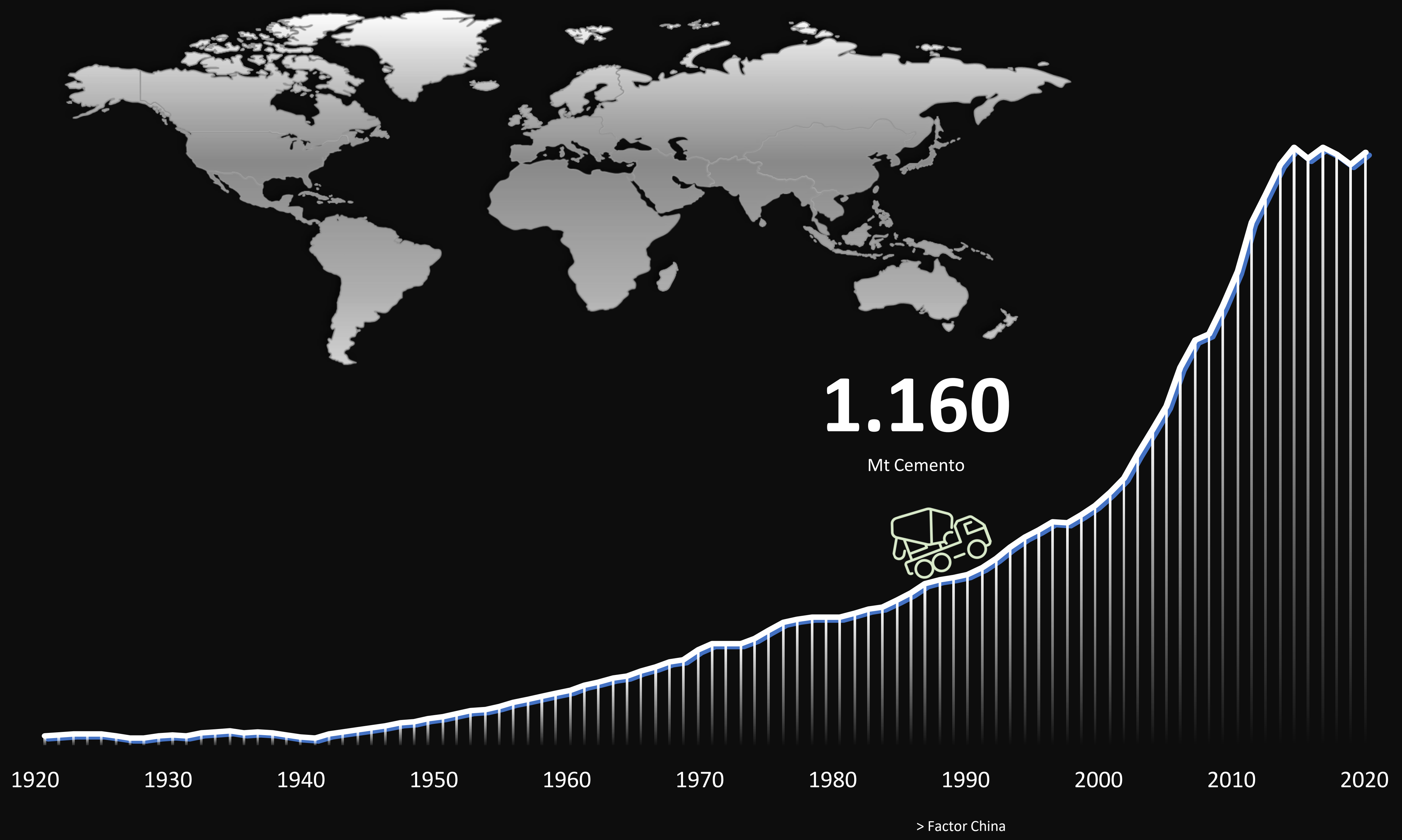
Mt Cemento

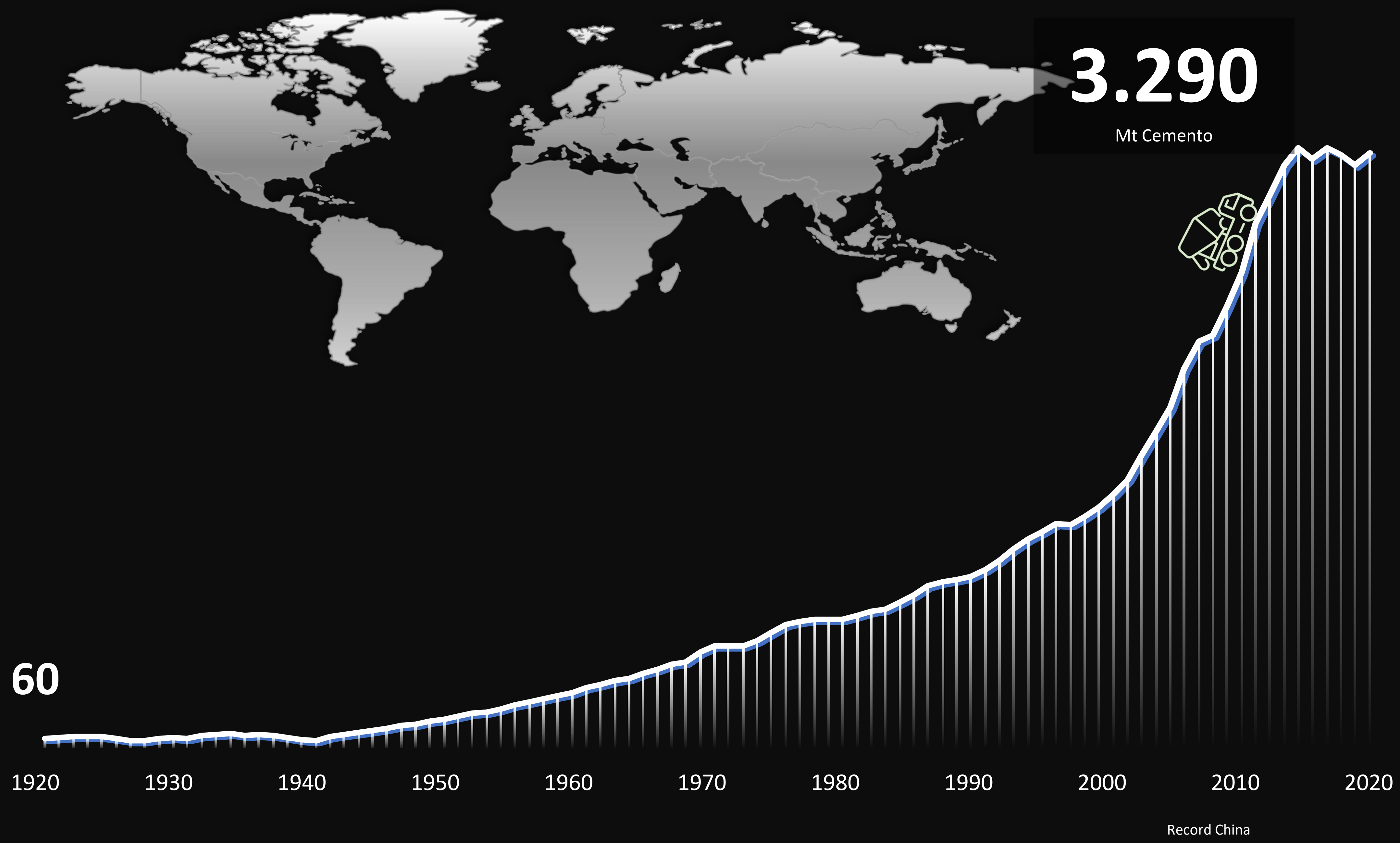

60
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Urbanización USA


49
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Segunda Guerra Mundial

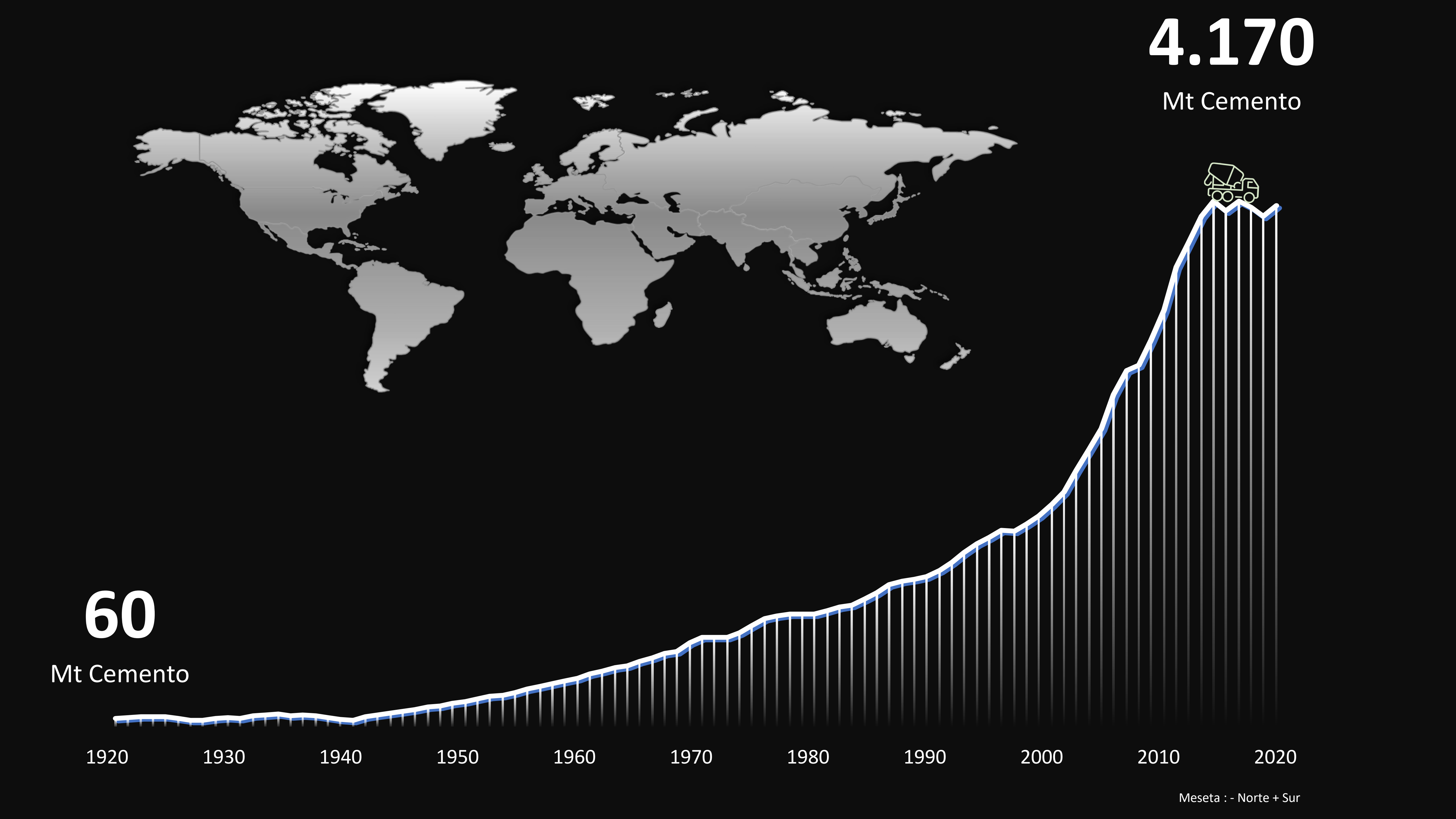

133
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
> Boom Post Guerra

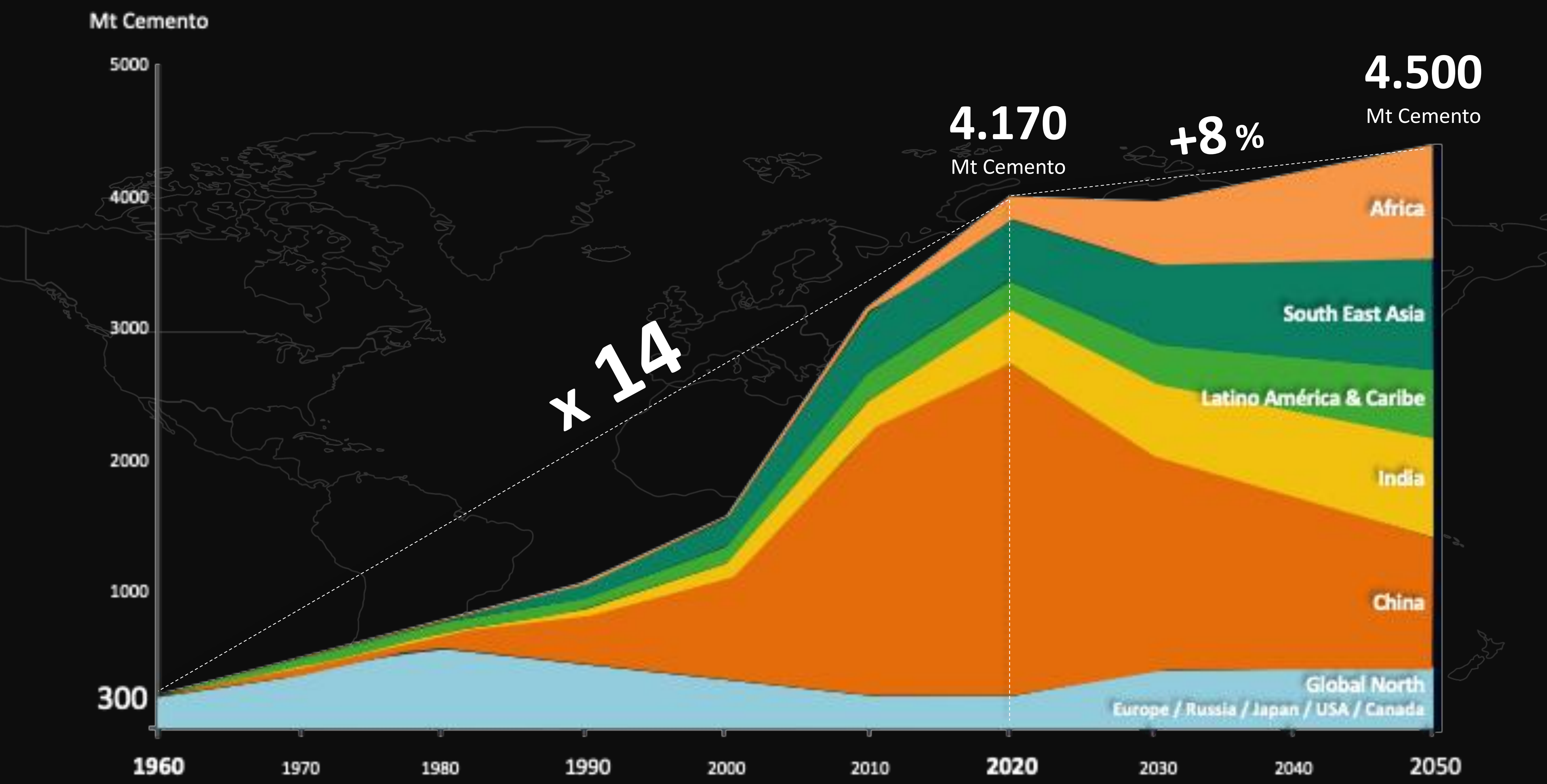

572
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Crisis Energética


1.160
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
> Factor China

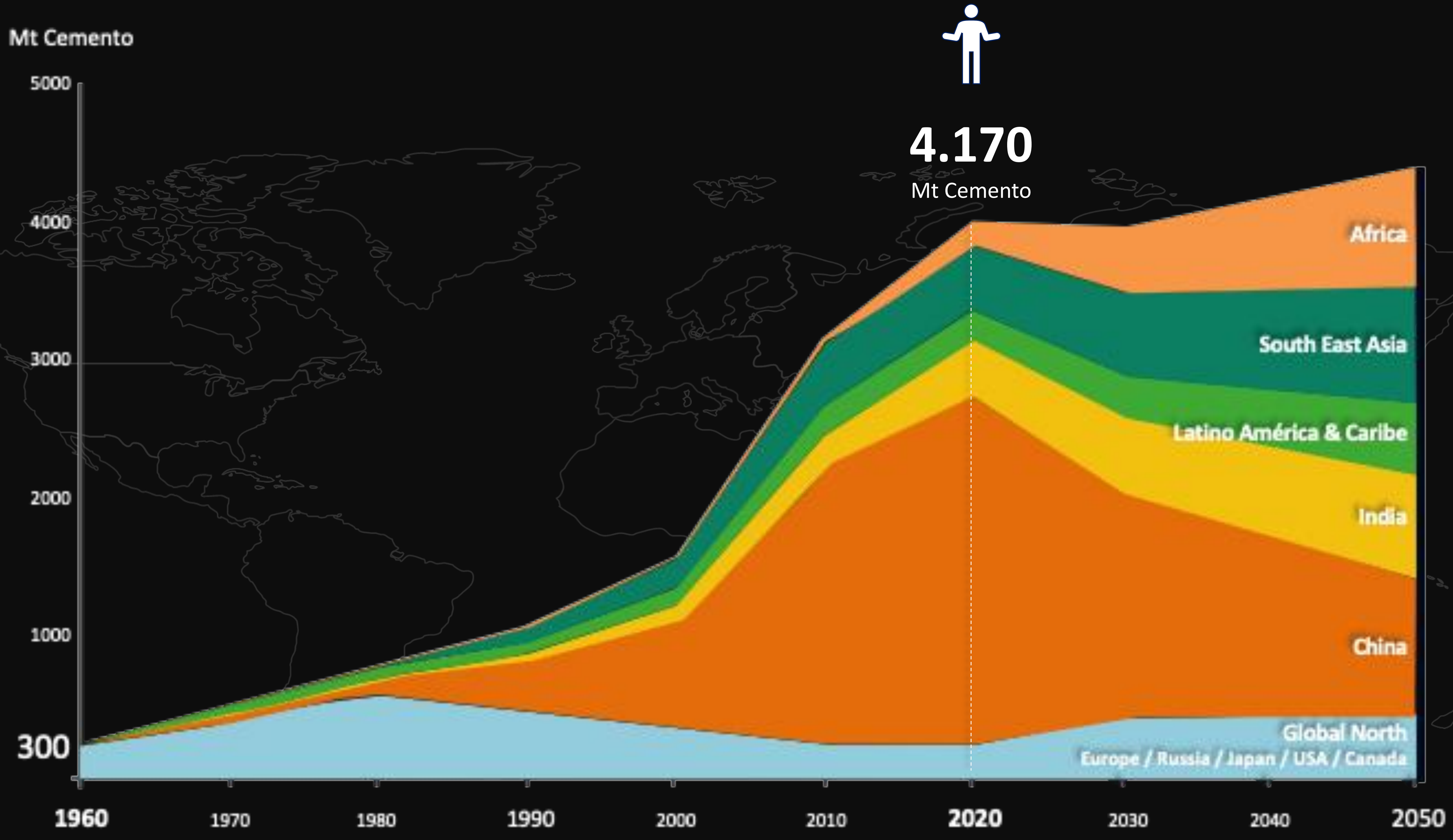


3.290
Mt Cemento
60
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Record China

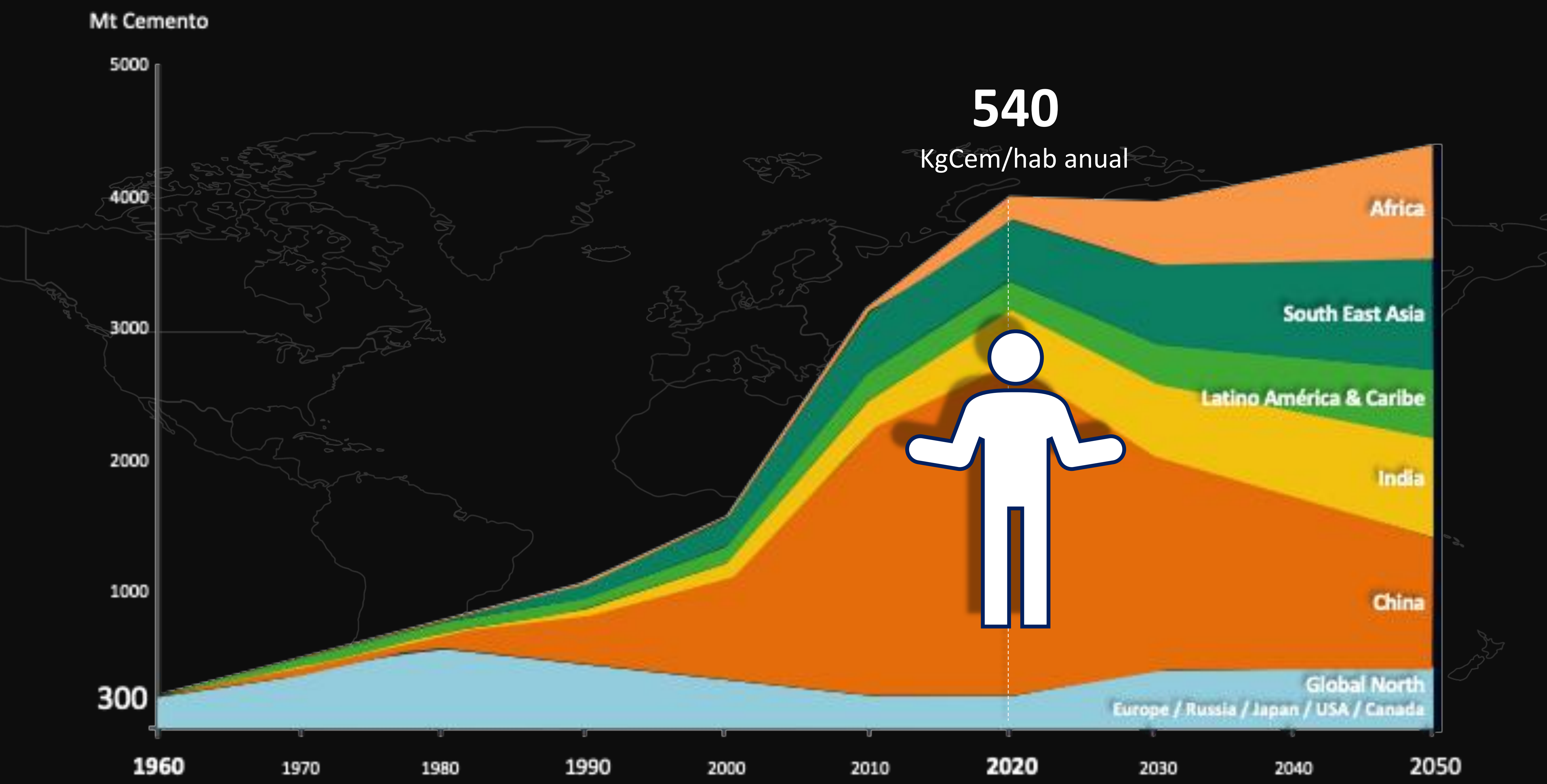

4.170
Mt Cemento
60
Mt Cemento
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Meseta : - Norte + Sur

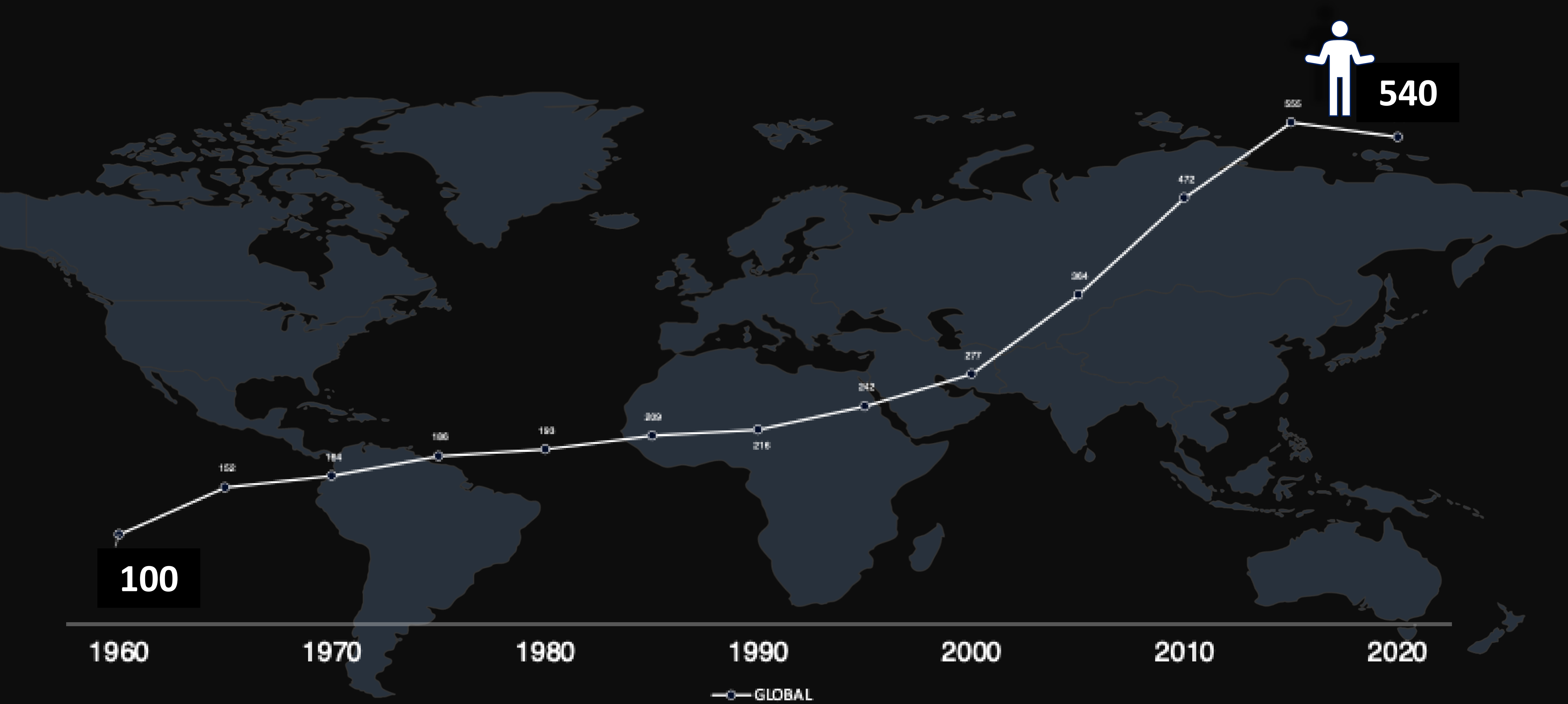


Mt Cemento
5000
4000
3000
2000
1000
300
4.170
Mt Cemento
+8 %
4.500
Mt Cemento
x 14
Africa
South East Asia
Latino América & Caribe
India
China
Global North
Europe / Russia / Japan / USA / Canada
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050

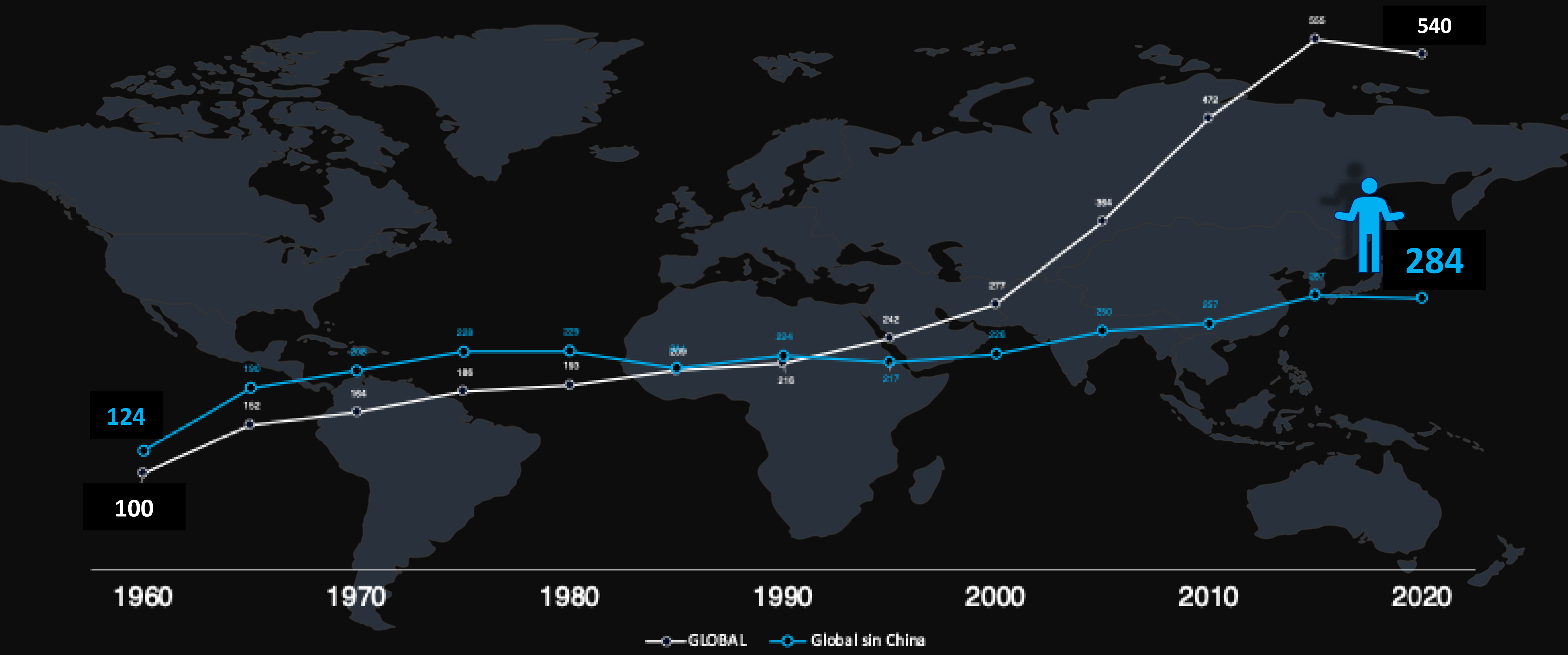


Mt Cemento
5000
4000
3000
2000
1000
300
4.170
Mt Cemento
Africa
South East Asia
Latino América & Caribe
India
China
Global North
Europe / Russia / Japan / USA / Canada
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050

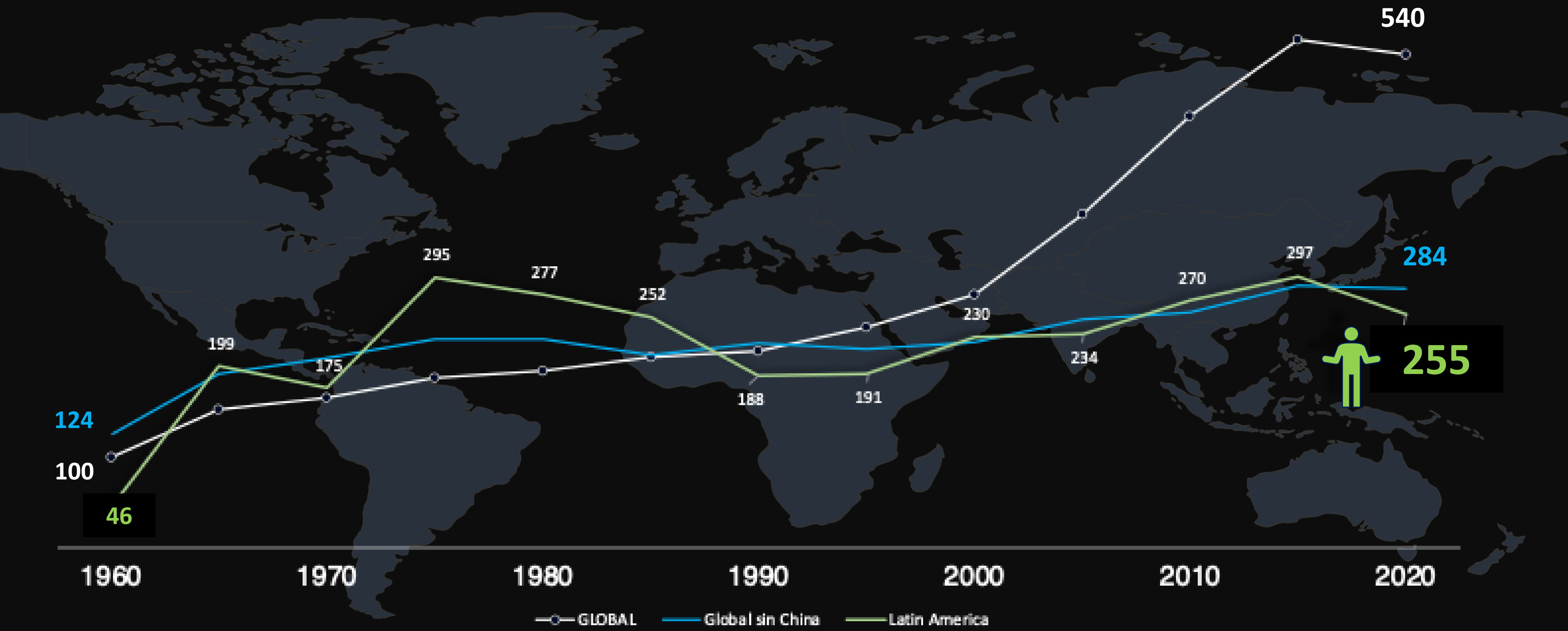

Mt Cemento
5000
4000
3000
2000
1000
300
540
KgCem/hab anual
Africa
South East Asia
Latino América & Caribe
India
China
Global North
Europe / Russia / Japan / USA / Canada
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050



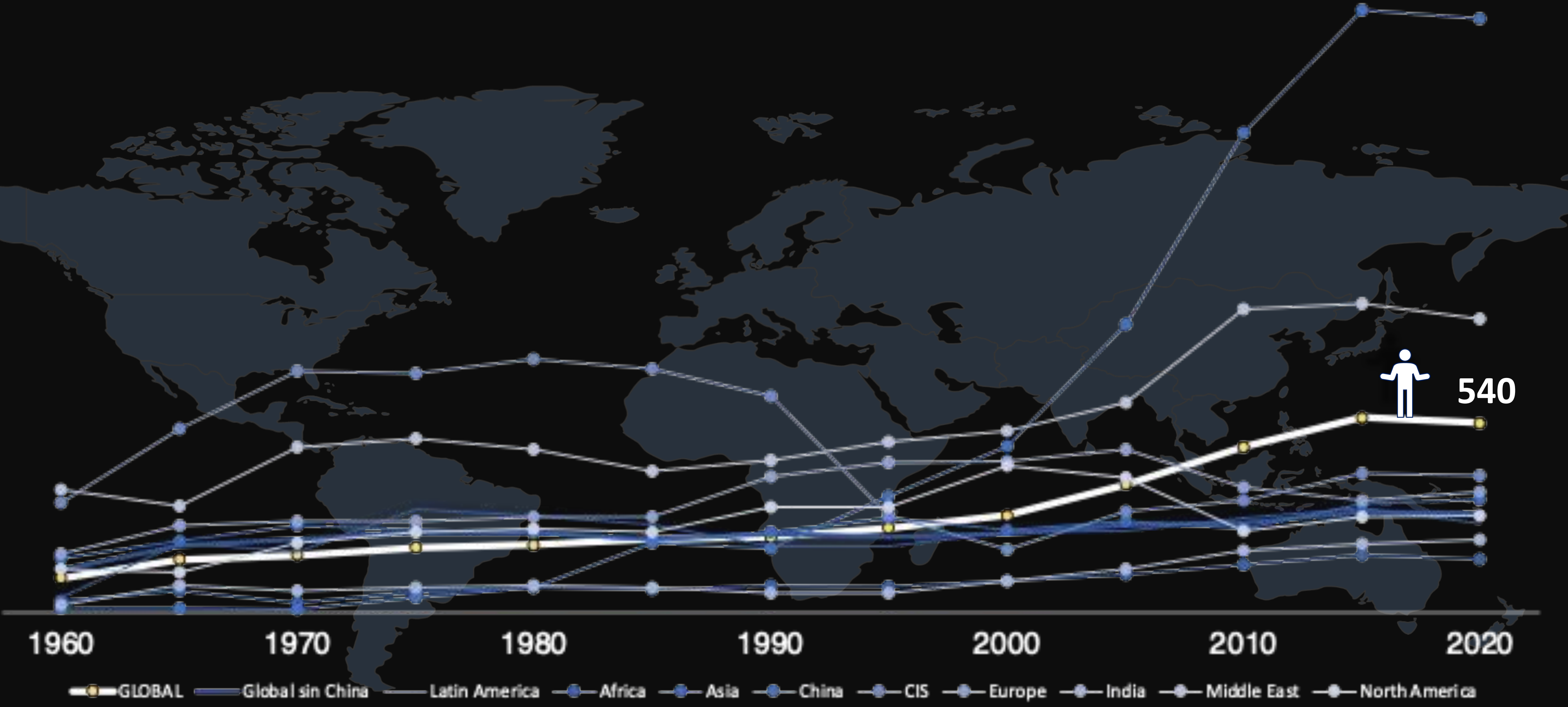
KILOGRAMOS CEMENTO / HABITANTES



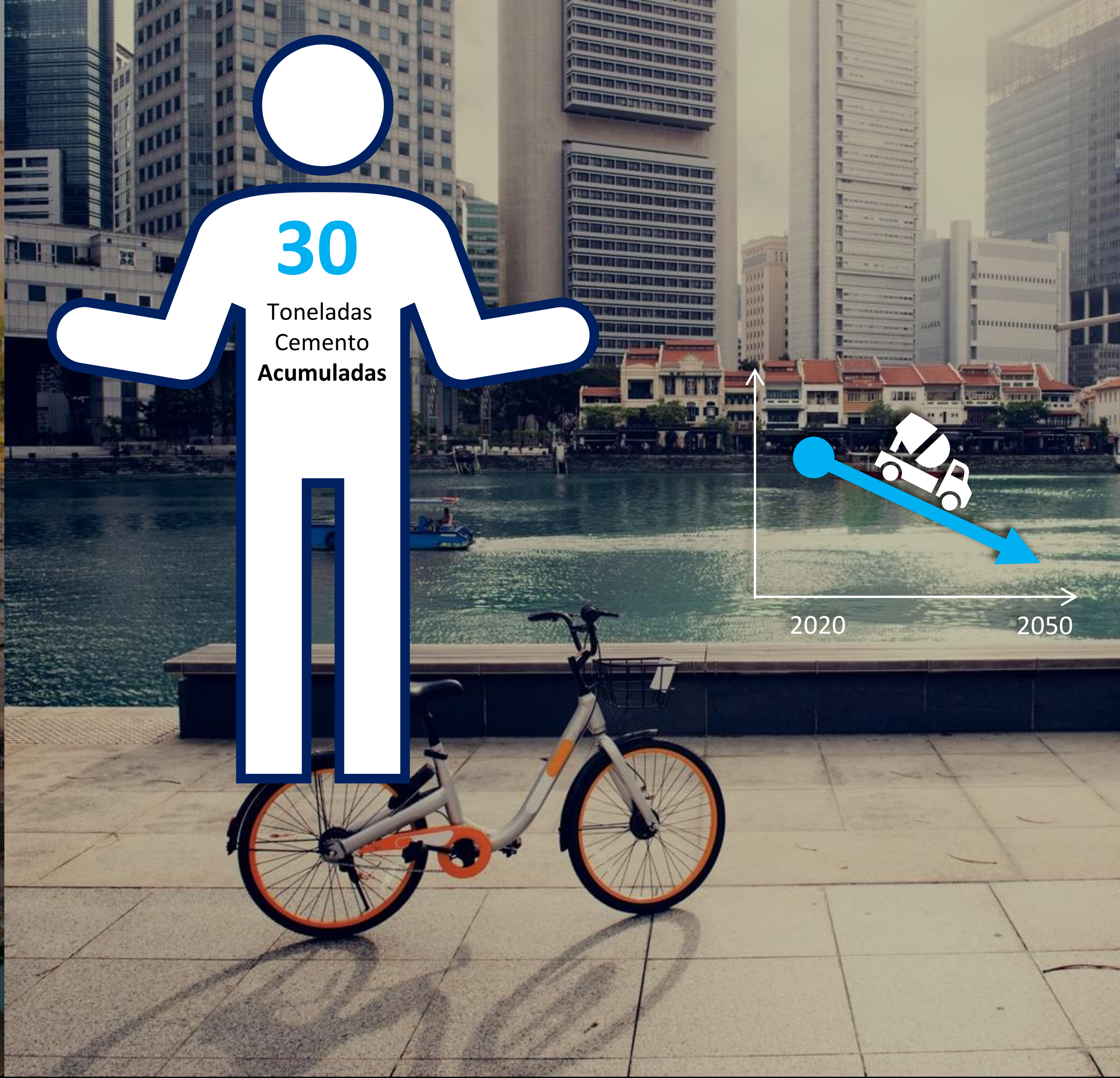
KILOGRAMOS CEMENTO / HABITANTES



KILOGRAMOS CEMENTO / HABITANTES

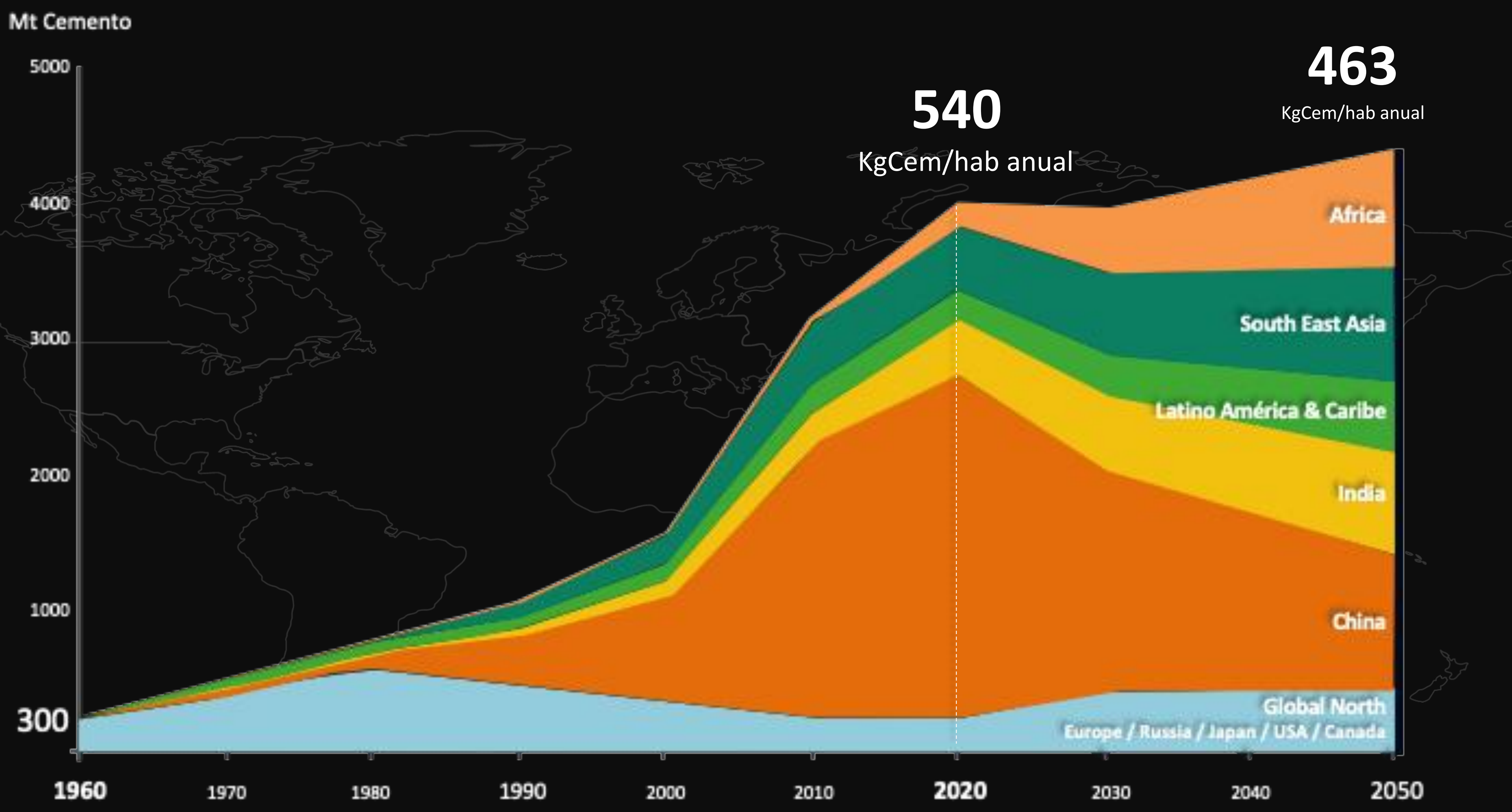


KILOGRAMOS CEMENTO / HABITANTES



540

KgCem/hab anual



Mt Cemento
5000
4000
3000
2000
1000
300
540
KgCem/hab anual
463
KgCem/hab anual
Africa
South East Asia
Latino América & Caribe
India
China
Global North
Europe / Russia / Japan / USA / Canada
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050

1990	2020	2050
1.160	**4.170**	**4.500**
Mt Cemento	**Mt Cemento**	**Mt Cemento**
219	**540**	**463**
KgCem/hab anual	KgCem/hab anual	KgCem/hab anual

75%

El material mas utilizado después del agua

Contexto

75%

75%

Producción de Cemento
Roadmap NET ZERO

23

Países

75%

Producción de Cemento
Roadmap NET ZERO

23

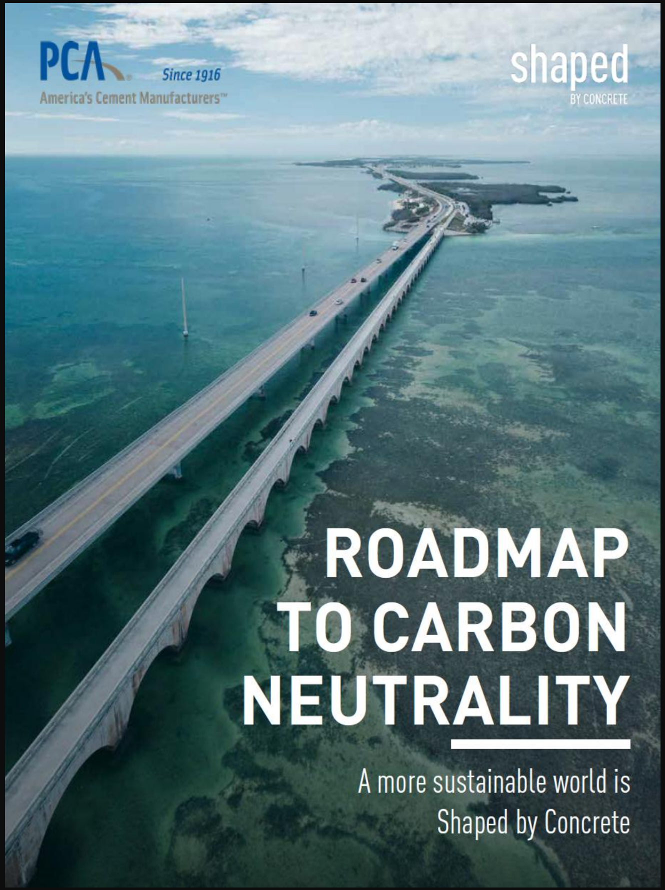
Países NZ

2

Regiones NZ

1

Global NZ



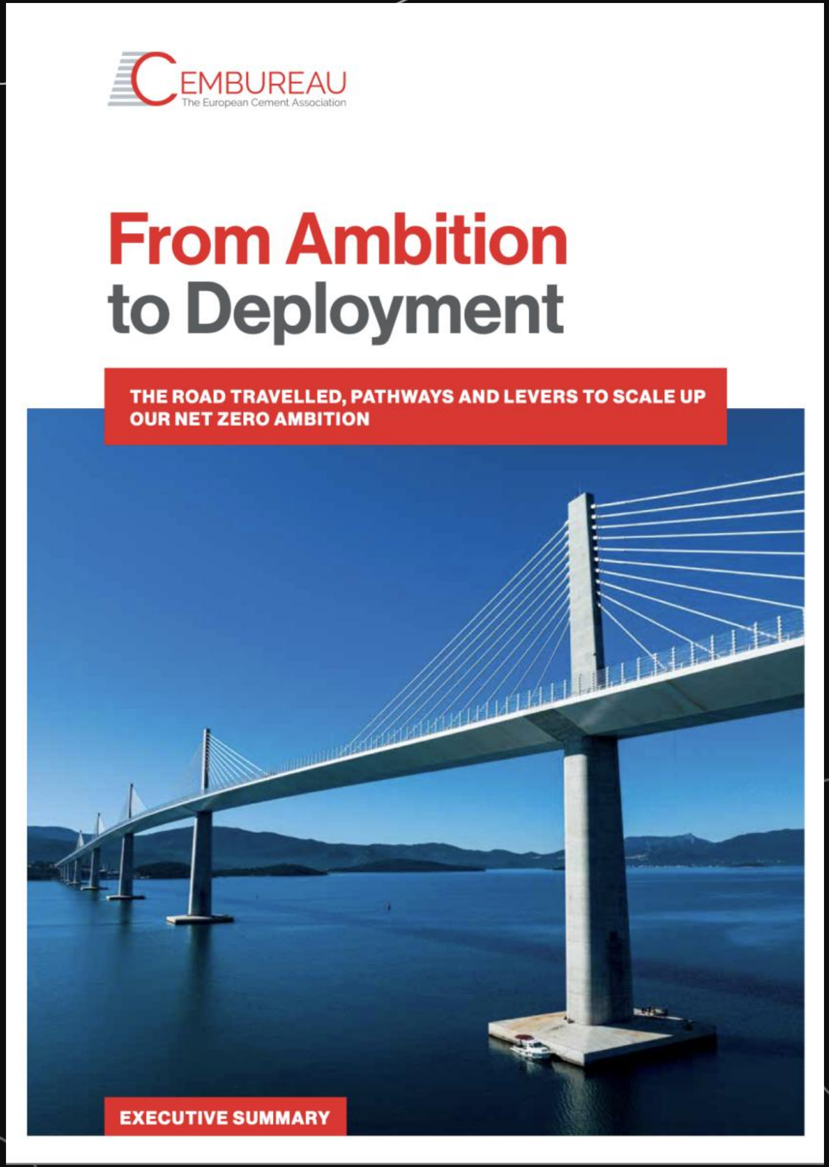
2% producción mundial

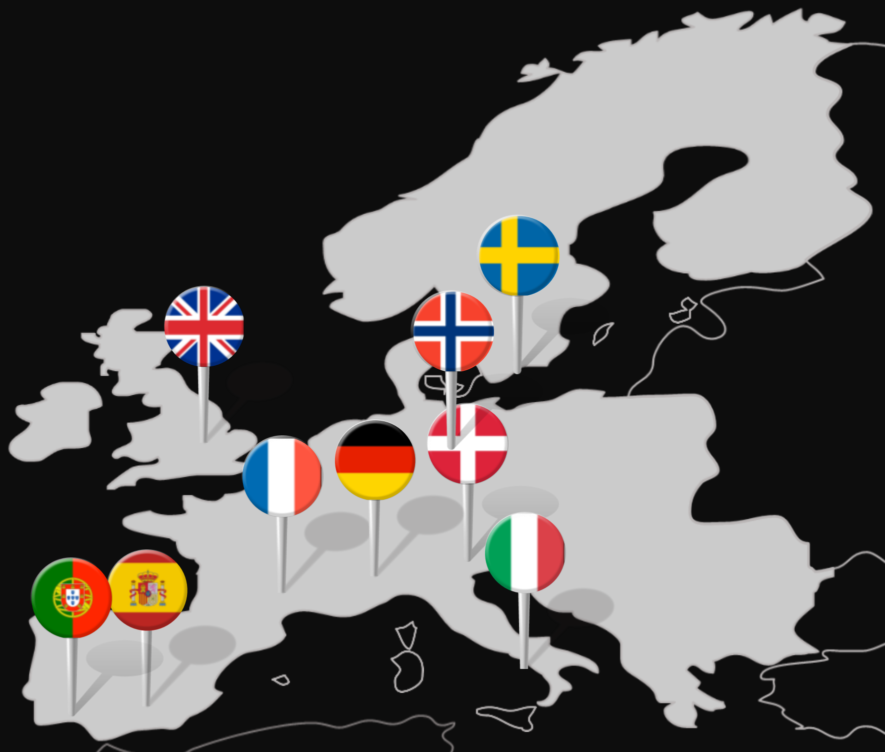
276 kgcem/hab

100 Mt Cemento **+64%**

95% Factor Clínker **75%**

14% Coprocesamiento **50%**





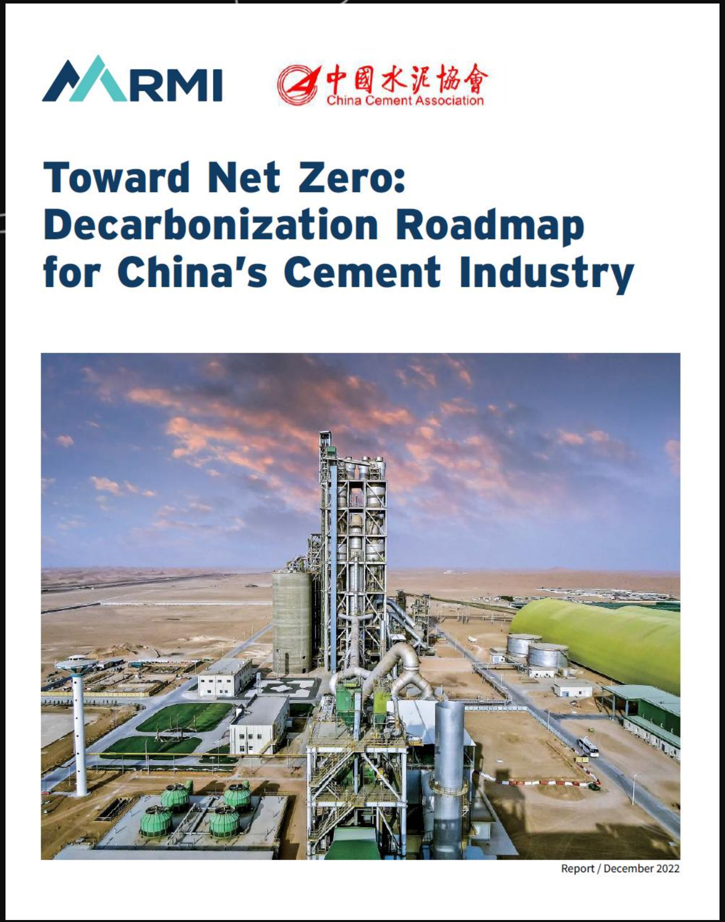
4% producción mundial

343 kgcem/hab

187 Mt Cemento **+20%**

77% Factor Clínker **65%**

46% Coprocesamiento **90%**

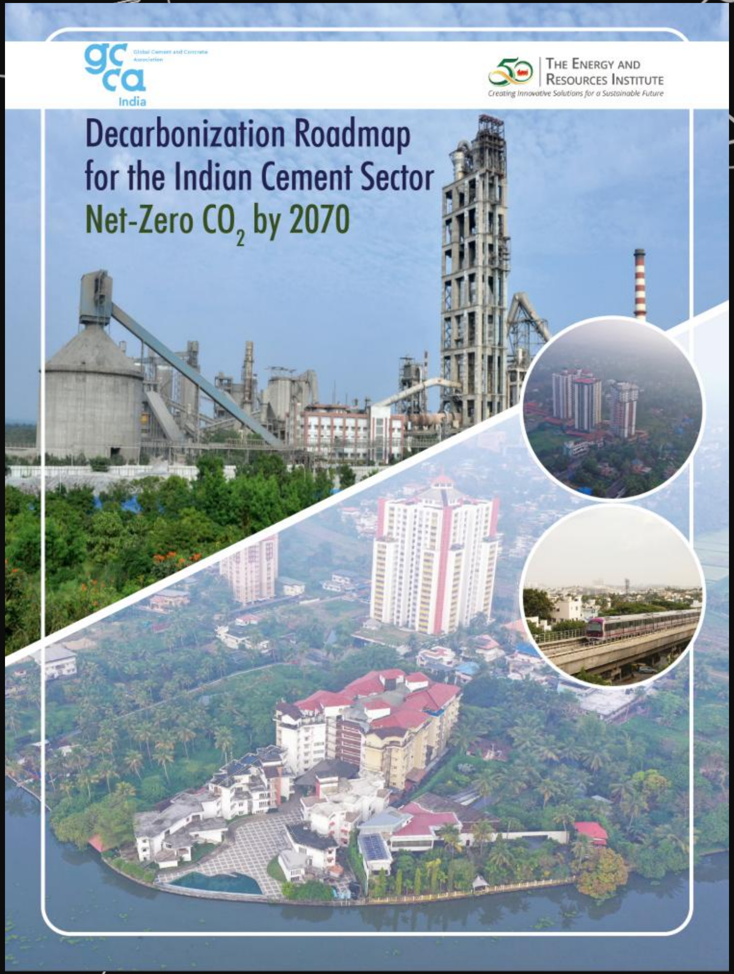


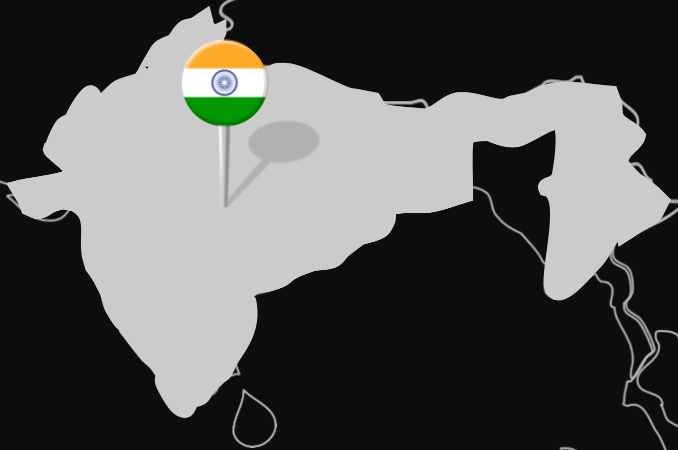
RMI
中國水泥協會
China Cement Association

Toward Net Zero: Decarbonization Roadmap for China's Cement Industry

Report / December 2022

57% producción mundial
1,684 kgcem/hab
2.377 Mt Cemento **-28%**
70% Factor Clínker **65%**
2% Coprocesamiento **53%**





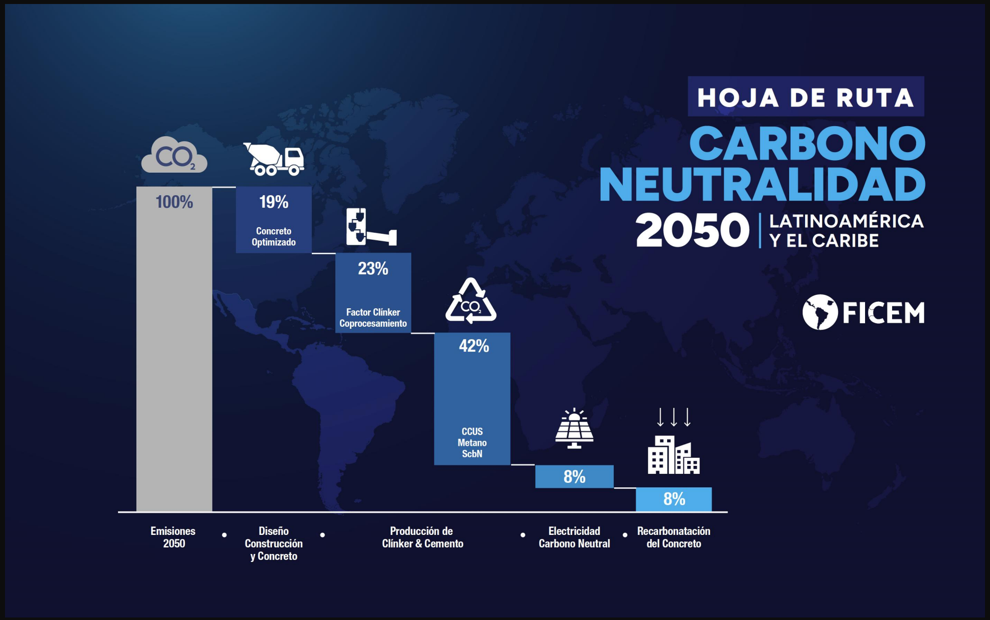
7% producción mundial

233 kgcem/hab

280 Mt Cemento **+400%**

75% Factor Clínker **56%**

5% Coprocesamiento **50%**



5% producción mundial

255 kgcem/hab

196 Mt Cemento **+70%**

67% Factor Clínker **60%**

12% Coprocesamiento **53%**

75%

Roadmap NET ZERO

50% NZ

1 Reducir Contenido Clinker

2 Uso de Combustibles Alternativos

3 Uso eficiente Cemento & Concreto

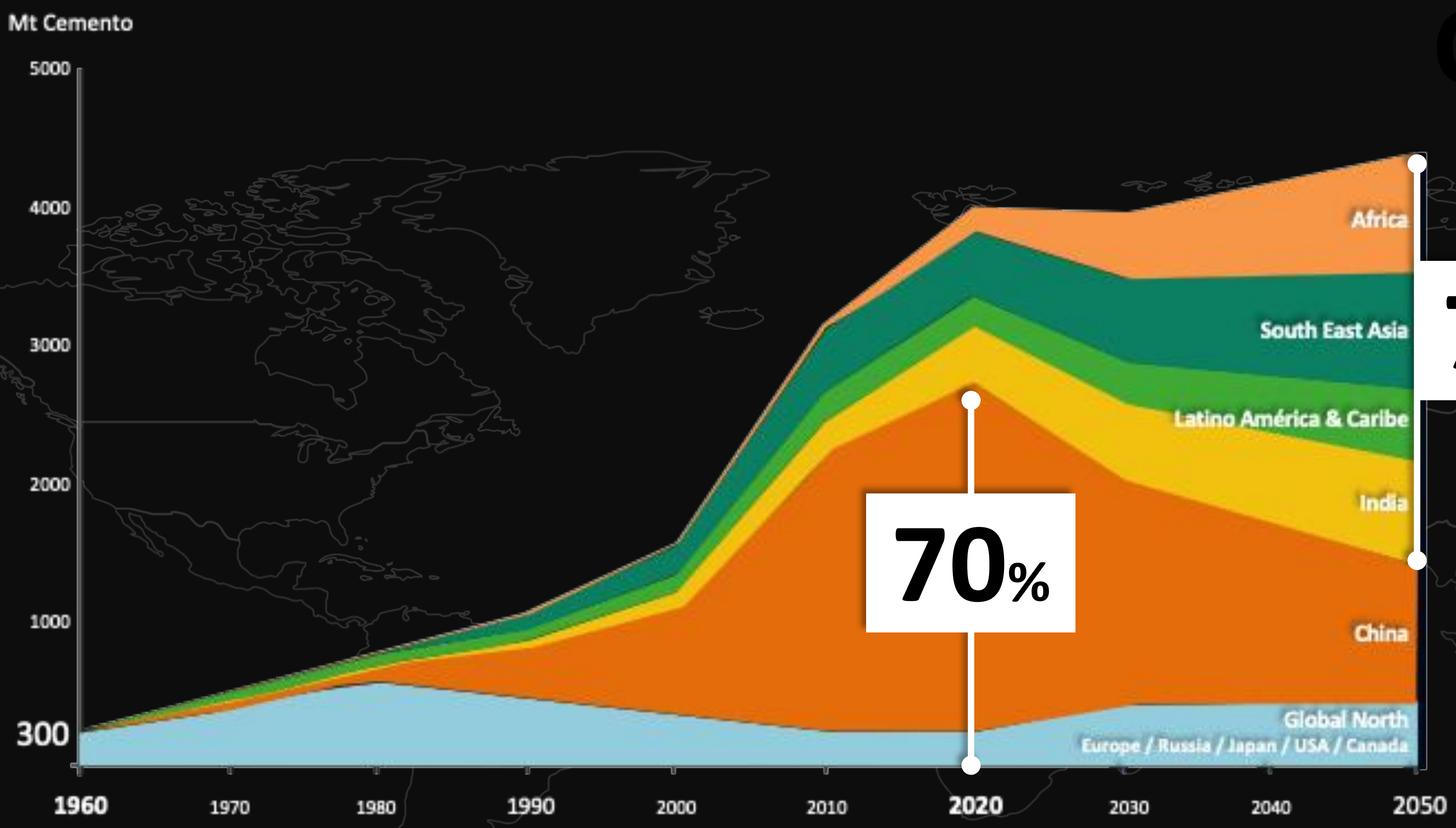
50% NZ

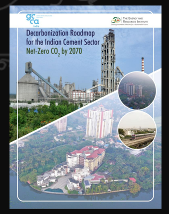
4 Remoción & Evitar CO_2e

5 Innovación & Financiamiento

6 Certeza Jurídica

Contexto

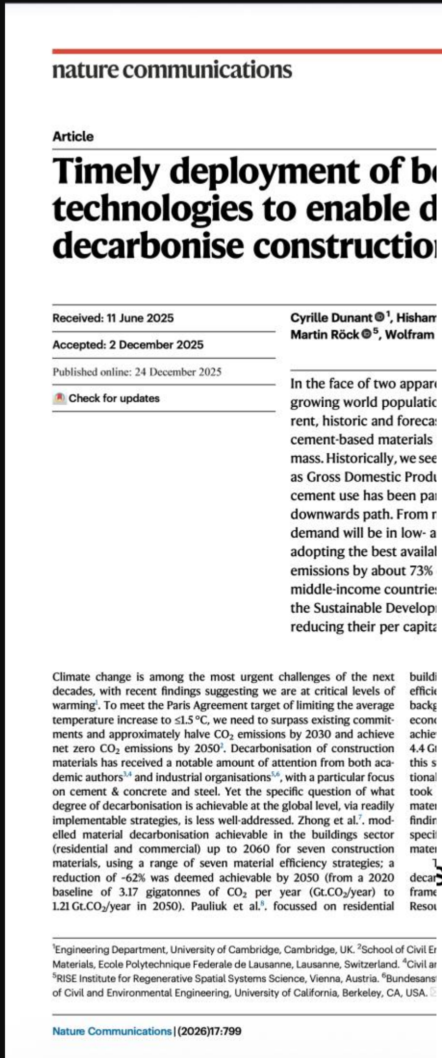




75%

Roadmap NET ZERO

Contexto



nature communications

Article

Timely deployment of b
technologies to enable d
decarbonise constructio

Received: 11 June 2025

Accepted: 2 December 2025

Published online: 24 December 2025

Check for updates

Cyrille Dunant [1], Hisham
Martin Röck [5], Wolfram

In the face of two appar
growing world populatic
rent, historic and foreca
cement-based materials
mass. Historically, we see
as Gross Domestic Produ
cement use has been pa
downwards path. From r
demand will be in low- a
adopting the best availal
emissions by about 73%
middle-income countrie
the Sustainable Develop
reducing their per capita

Climate change is among the most urgent challenges of the next decades, with recent findings suggesting we are at critical levels of warming[1]. To meet the Paris Agreement target of limiting the average temperature increase to ≤1.5 °C, we need to surpass existing commitments and approximately halve CO_2 emissions by 2030 and achieve net zero CO_2 emissions by 2050[2]. Decarbonisation of construction materials has received a notable amount of attention from both academic authors[3,4] and industrial organisations[5,6], with a particular focus on cement & concrete and steel. Yet the specific question of what degree of decarbonisation is achievable at the global level, via readily implementable strategies, is less well-addressed. Zhong et al.[7]. modelled material decarbonisation achievable in the buildings sector (residential and commercial) up to 2060 for seven construction materials, using a range of seven material efficiency strategies; a reduction of ~62% was deemed achievable by 2050 (from a 2020 baseline of 3.17 gigatonnes of CO_2 per year (Gt.CO_2/year) to 1.21 Gt.CO_2/year in 2050). Pauliuk et al.[8]. focussed on residential

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backg
econ
achie
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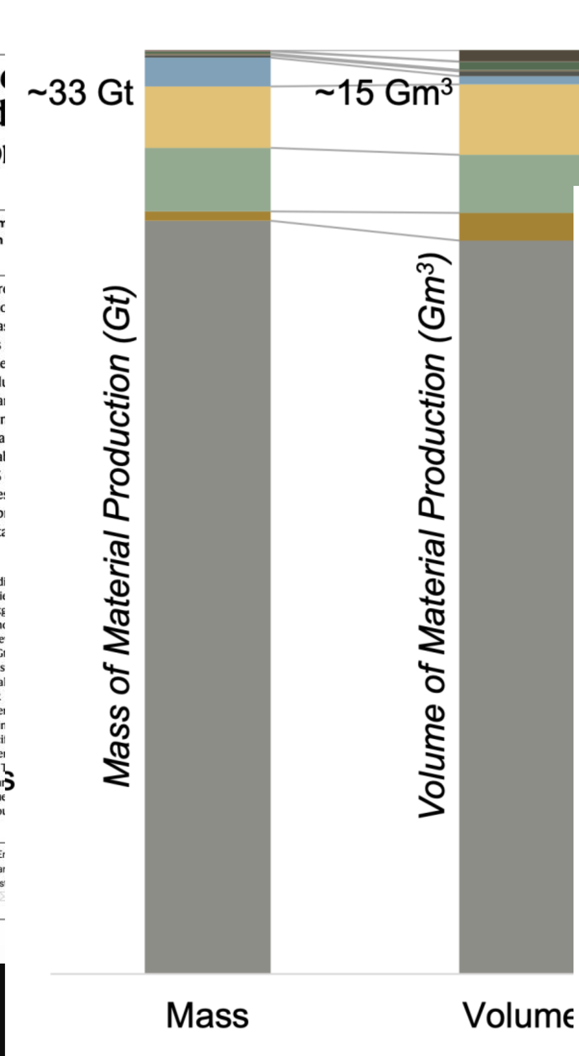
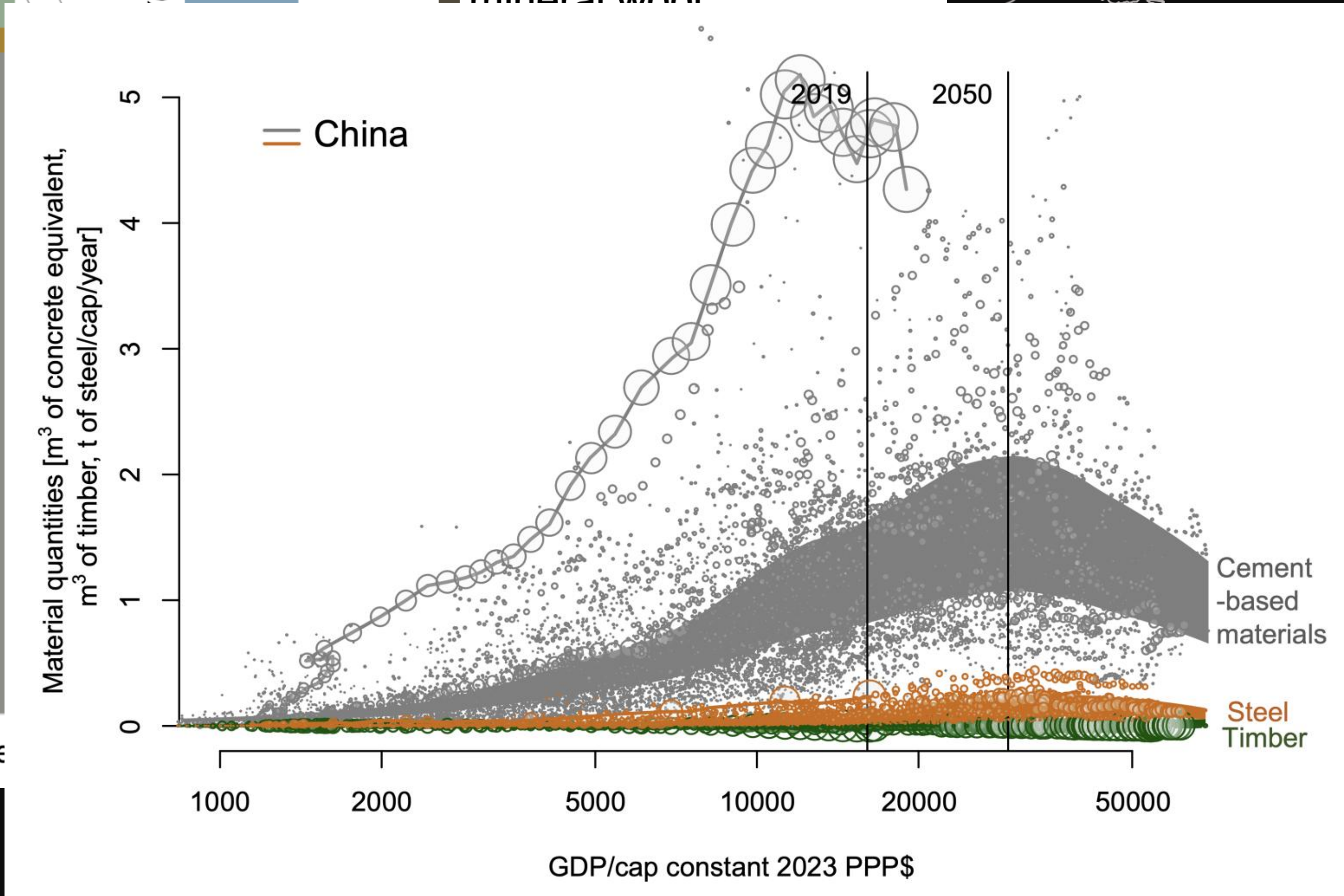
tional
took
mate
findin
speci
mate

decar
frame
Resou

[1]Engineering Department, University of Cambridge, Cambridge, UK. [2]School of Civil E
Materials, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland. [4]Civil a
[5]RISE Institute for Regenerative Spatial Systems Science, Vienna, Austria. [6]Bundesans
of Civil and Environmental Engineering, University of California, Berkeley, CA, USA.

Nature Communications | (2026)17:799





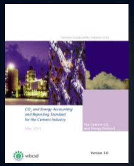
Contexto

Net **Z**ero **FICEM**

Desafíos **NZ**

Herramientas **FICEM**

Net Zero FICEM

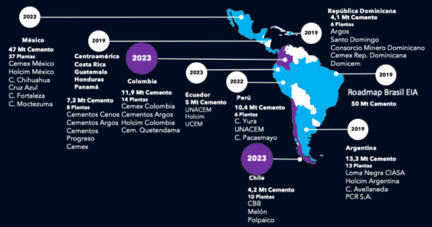


2010

Impulsamos
GNR
Números Correctos

2015

Desarrollo
Hojas Rutas 2030
x País

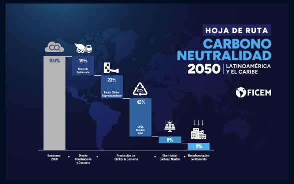


2021

Representamos LAC
Roadmap GCCA
NZ 2050

Posición
FICEM
Net Zero

2022



2024

Lanzamiento
Roadmap
FICEM 2050
Net Zero

2025

FICEM en Acción
Certeza Jurídica
Financiamiento
Calculadora 4C
Hojas de Ruta 2050 x País
Acelerar el Conocimiento
Difusión

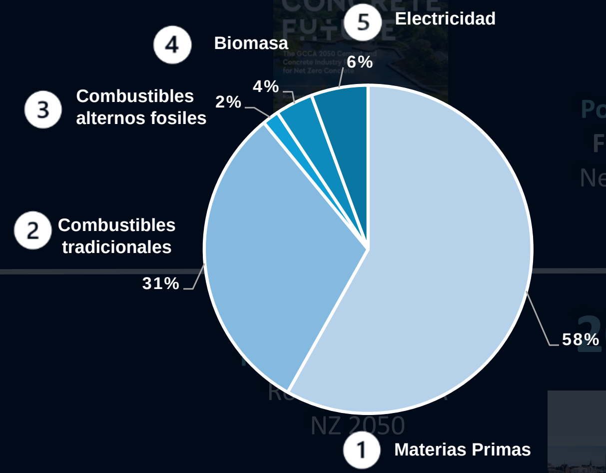
Net Zero FICEM

2010

Impulsamos
GNR
Números Correctos

Desarrollo
Hojas Rutas 2030
x País

2015



NZ 2050

Posición FICEM
Net Zero

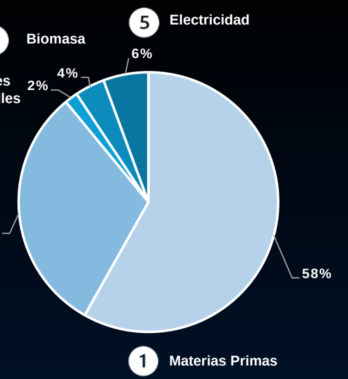
2022

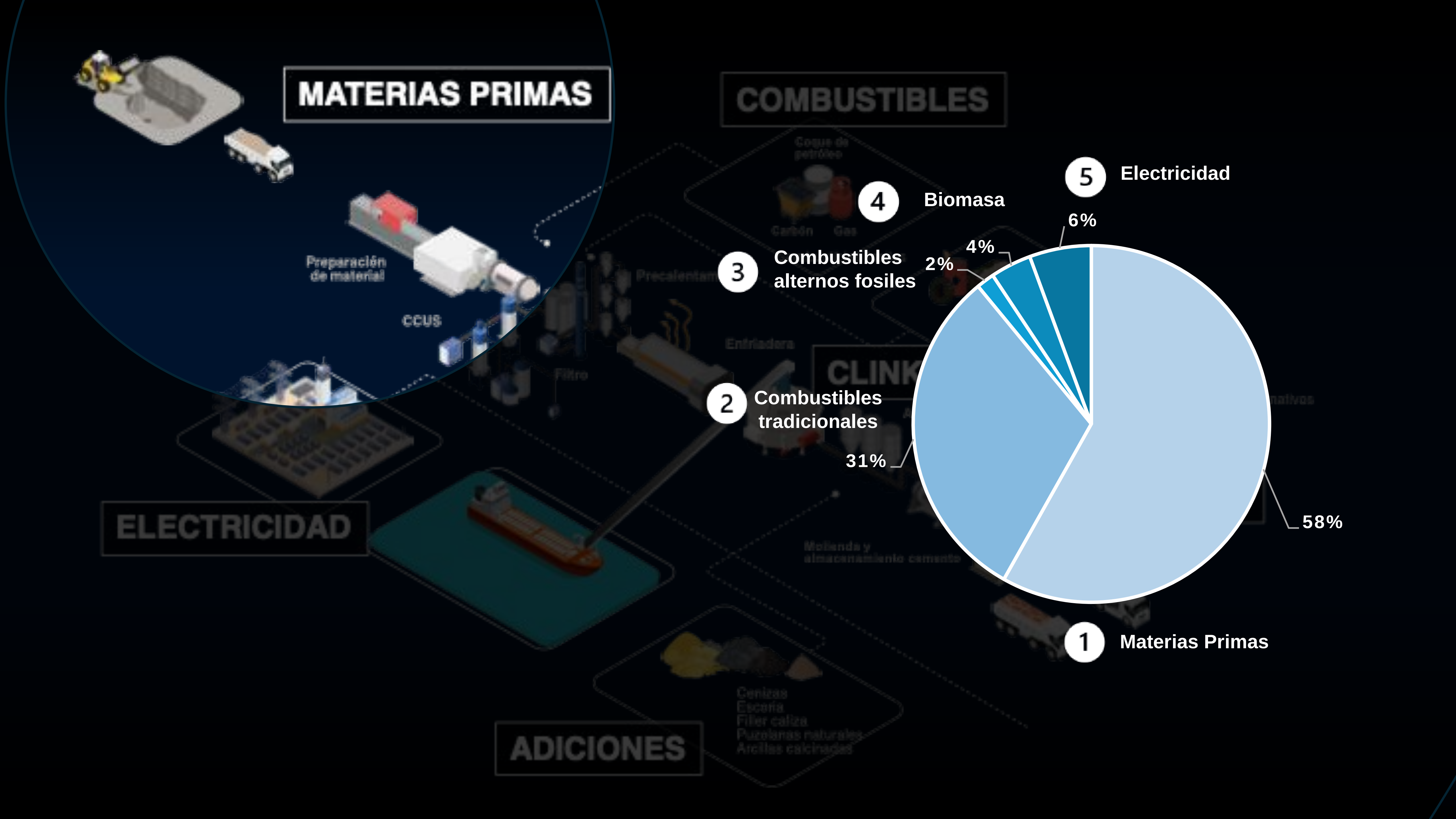
Net Zero

FICEM en Acción
Certeza Jurídica
Financiamiento
Calculadora 4C
Hojas de Ruta 2050 x País
Acelerar el Conocimiento
Difusión

2025


MATERIAS PRIMAS
COMBUSTIBLES
Coque de petróleo
Carbón
Gas
Combustibles fosiles
Preparación de material
Precalentamiento
CCUS
Enfriadora
Filtro
CLINKER
Adiciones
Combustibles alternativos
CEMENTO
ELECTRICIDAD
Molienda y almacenamiento cemento
Cenizas
Escoria
Filler caliza
Puzolanas naturales
Arcillas calcinadas
ADICIONES


5 Electricidad
4 Biomasa
6%
4%
2%
3 Combustibles alternos fosiles
2 Combustibles tradicionales
31%
58%
1 Materias Primas


MATERIAS PRIMAS
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CCUS
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Coque de petróleo
Carbón
Gas
Enfriadera
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ELECTRICIDAD
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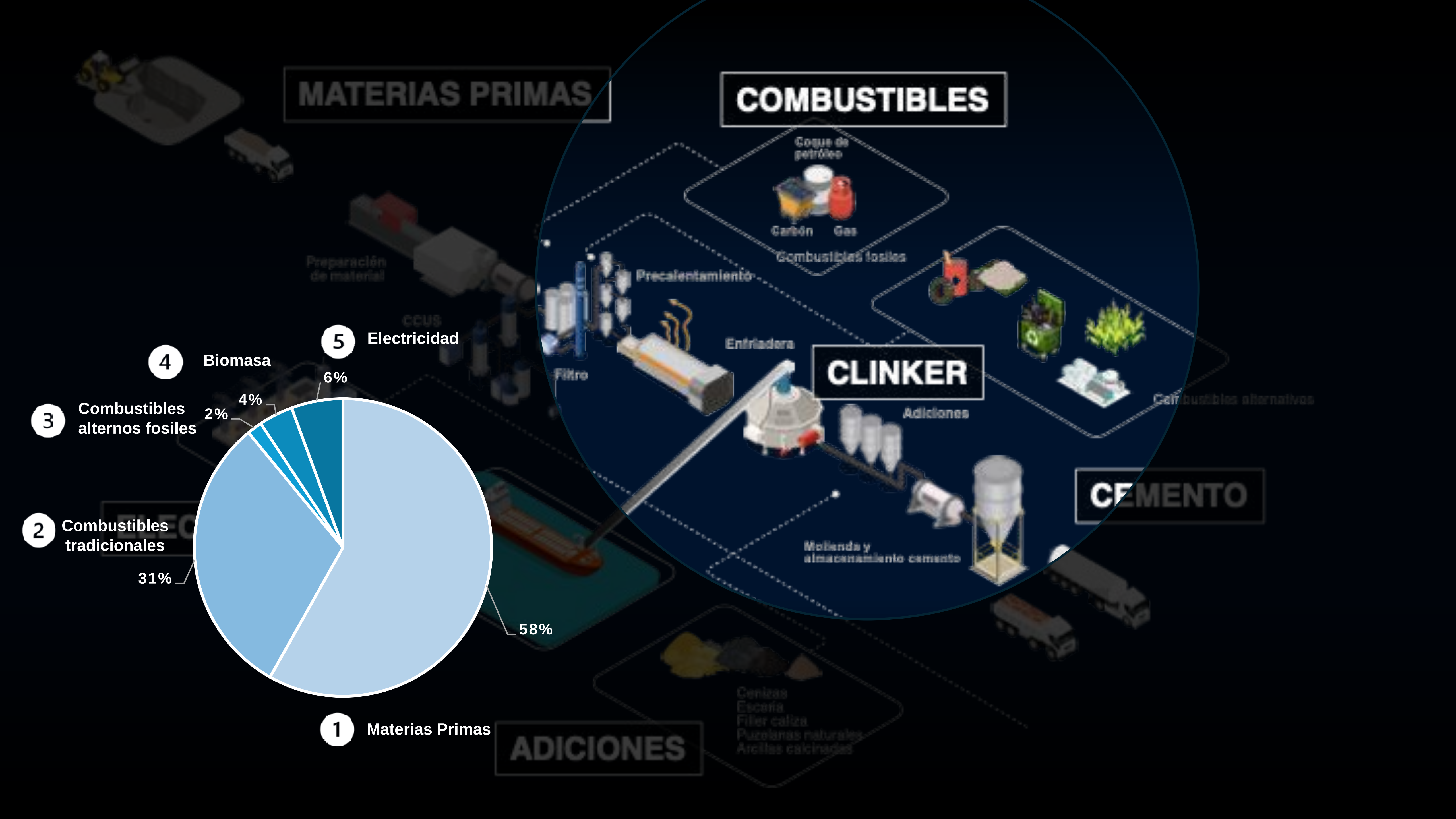

MATERIAS PRIMAS
Preparación de material
CCUS
COMBUSTIBLES
Coque de petróleo
Carbón
Gas
Combustibles fosiles
Precalentamiento
Filtro
Enfriadera
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Carbón
Gas
Combustibles fosiles
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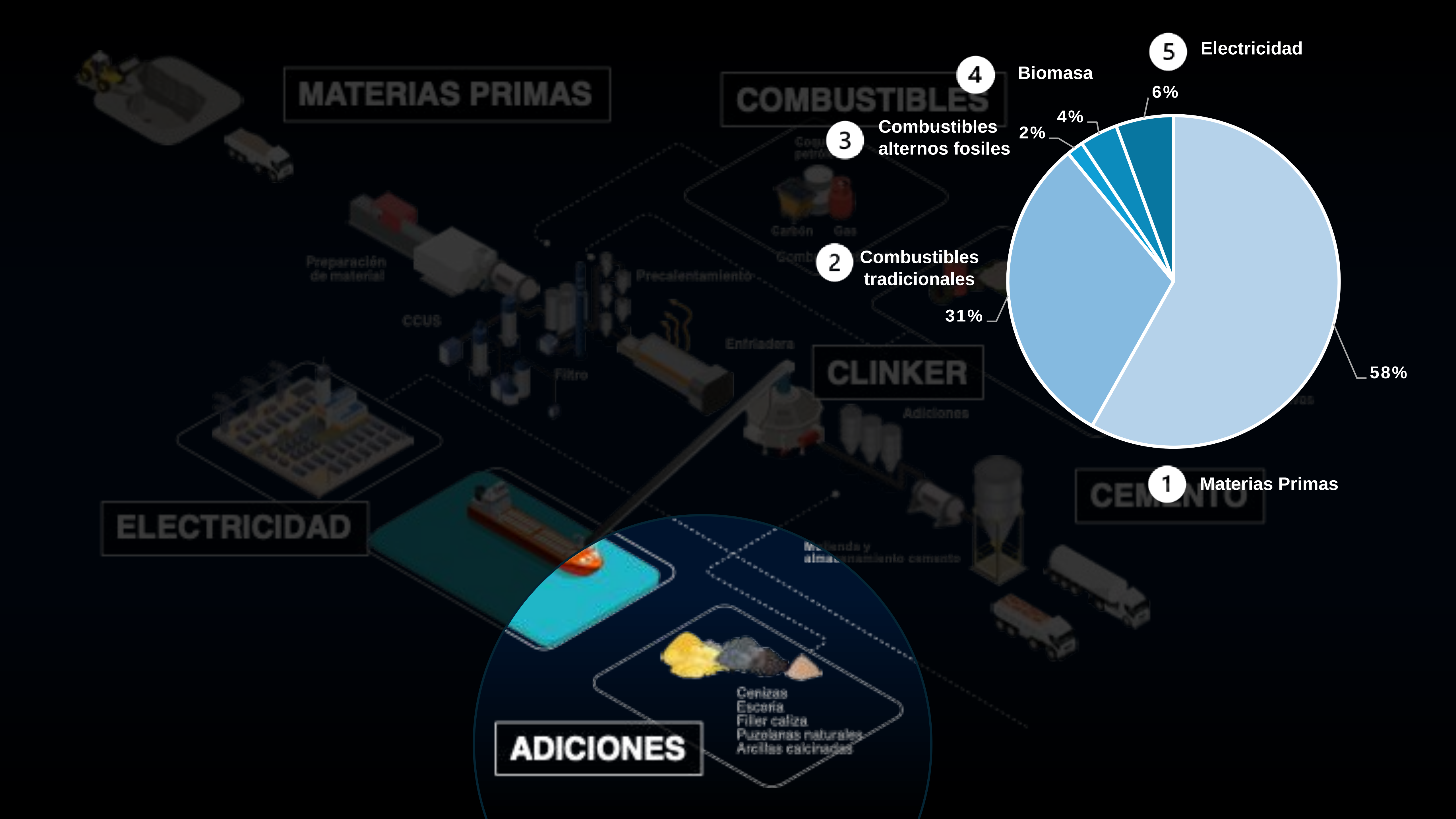

MATERIAS PRIMAS
COMBUSTIBLES
ELECTRICIDAD
CLINKER
ADICIONES
Preparación de material
CCUS
Precalentamiento
Enfriadora
Filtro
Carbón
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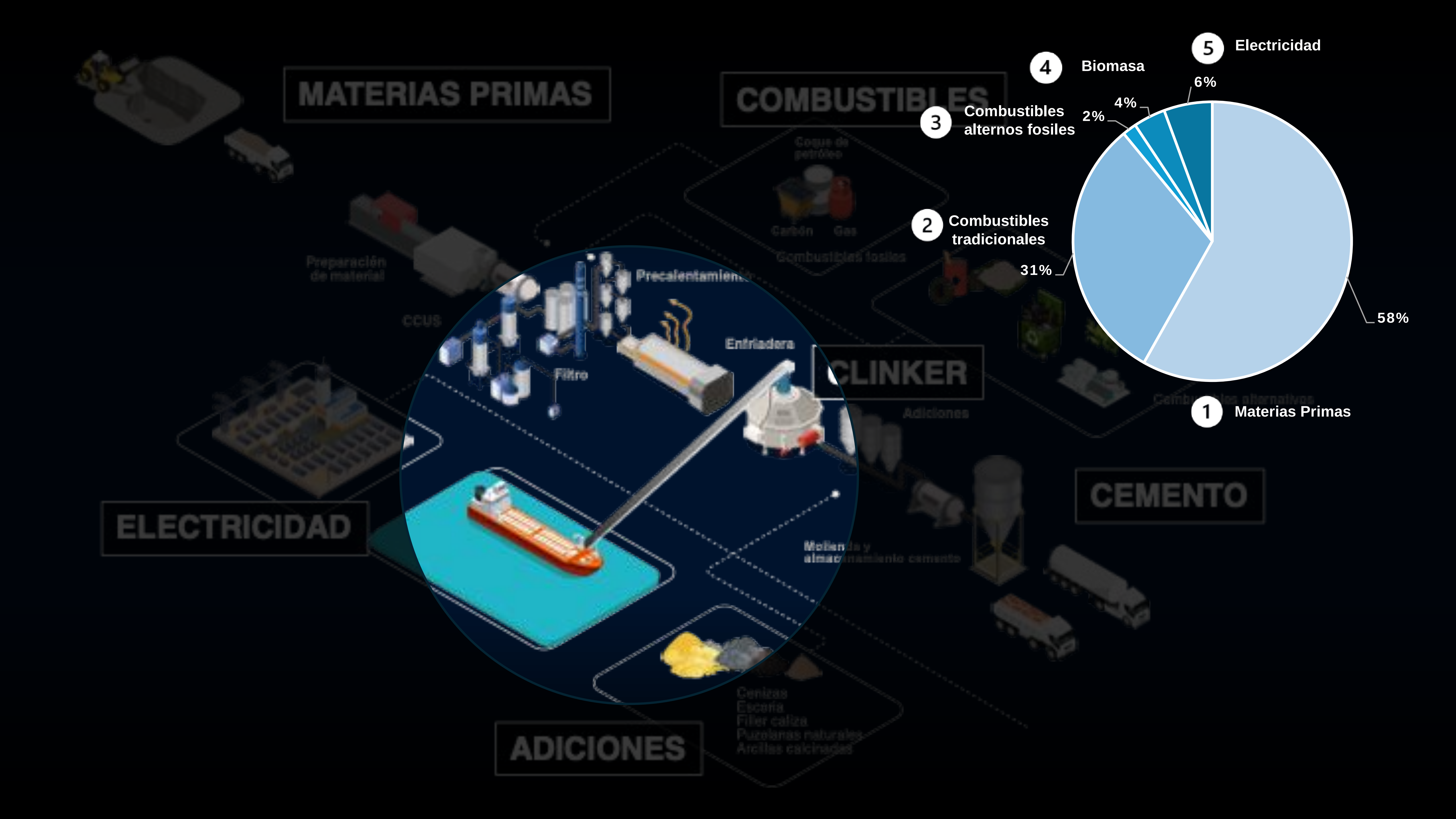

MATERIAS PRIMAS
COMBUSTIBLES
CLINKER
CEMENTO
ELECTRICIDAD
ADICIONES
Enfriadera
Filtro
Cenizas
Escoria
Filler caliza
Puzolanas naturales
Arcillas calcinadas
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58%


MATERIAS PRIMAS
COMBUSTIBLES
Coque de petróleo
Carbón
Gas
Combustibles fosiles
Preparación de material
Precalentamiento
CCUS
Enfriadora
Filtro
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ELECTRICIDAD
Molienda y almacenamiento cemento
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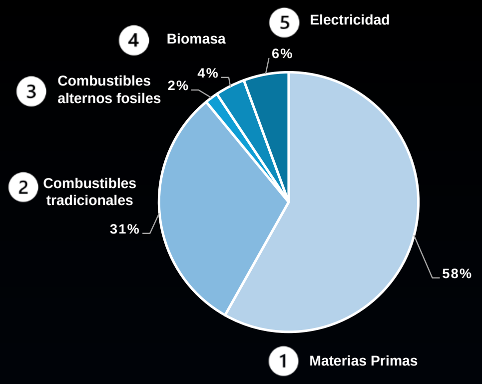
Escoria
Filler caliza
Puzolanas naturales
Arcillas calcinadas
ADICIONES


5 Electricidad
4 Biomasa
3 Combustibles alternos fosiles
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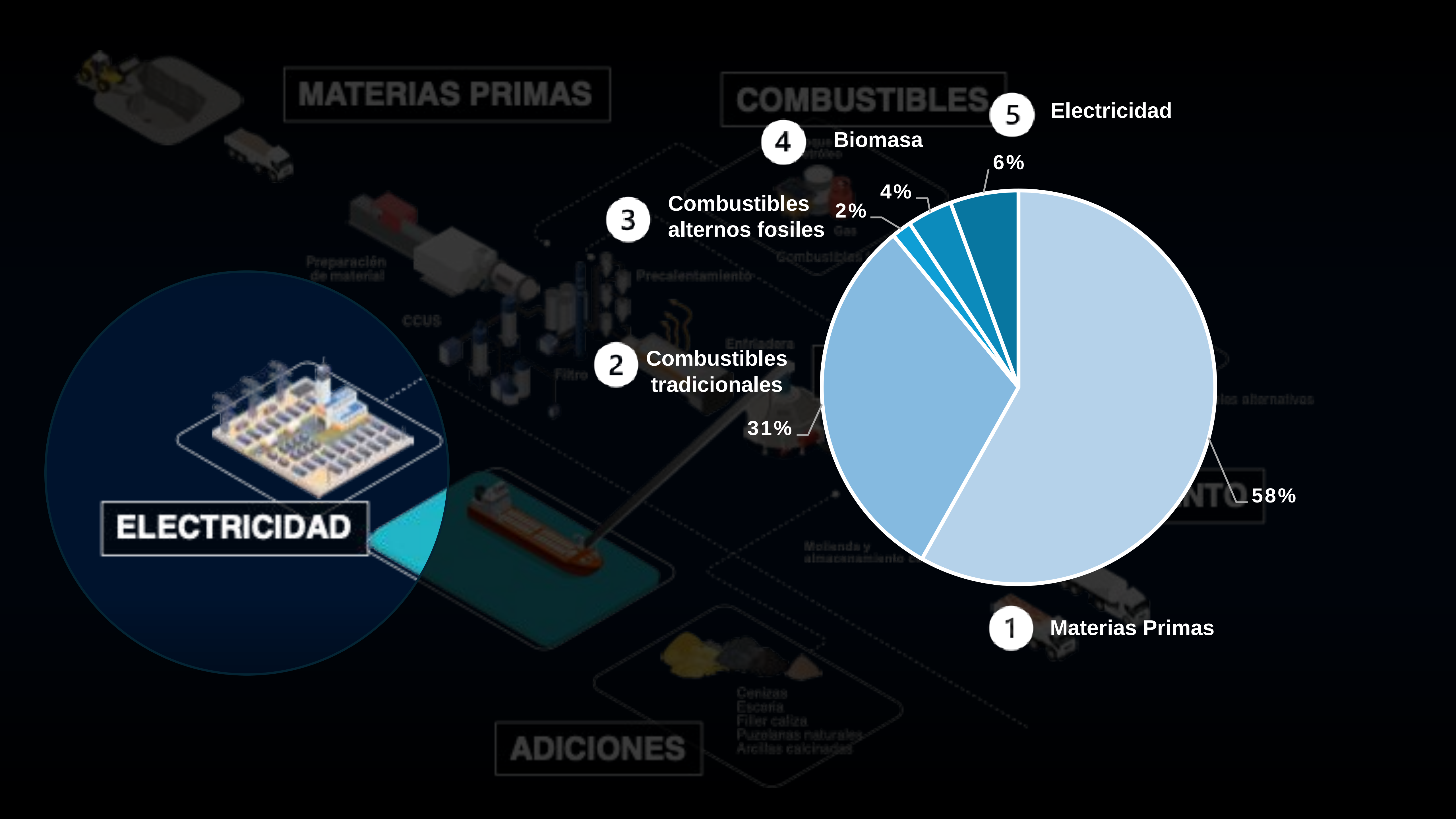
4%
2%
31%
58%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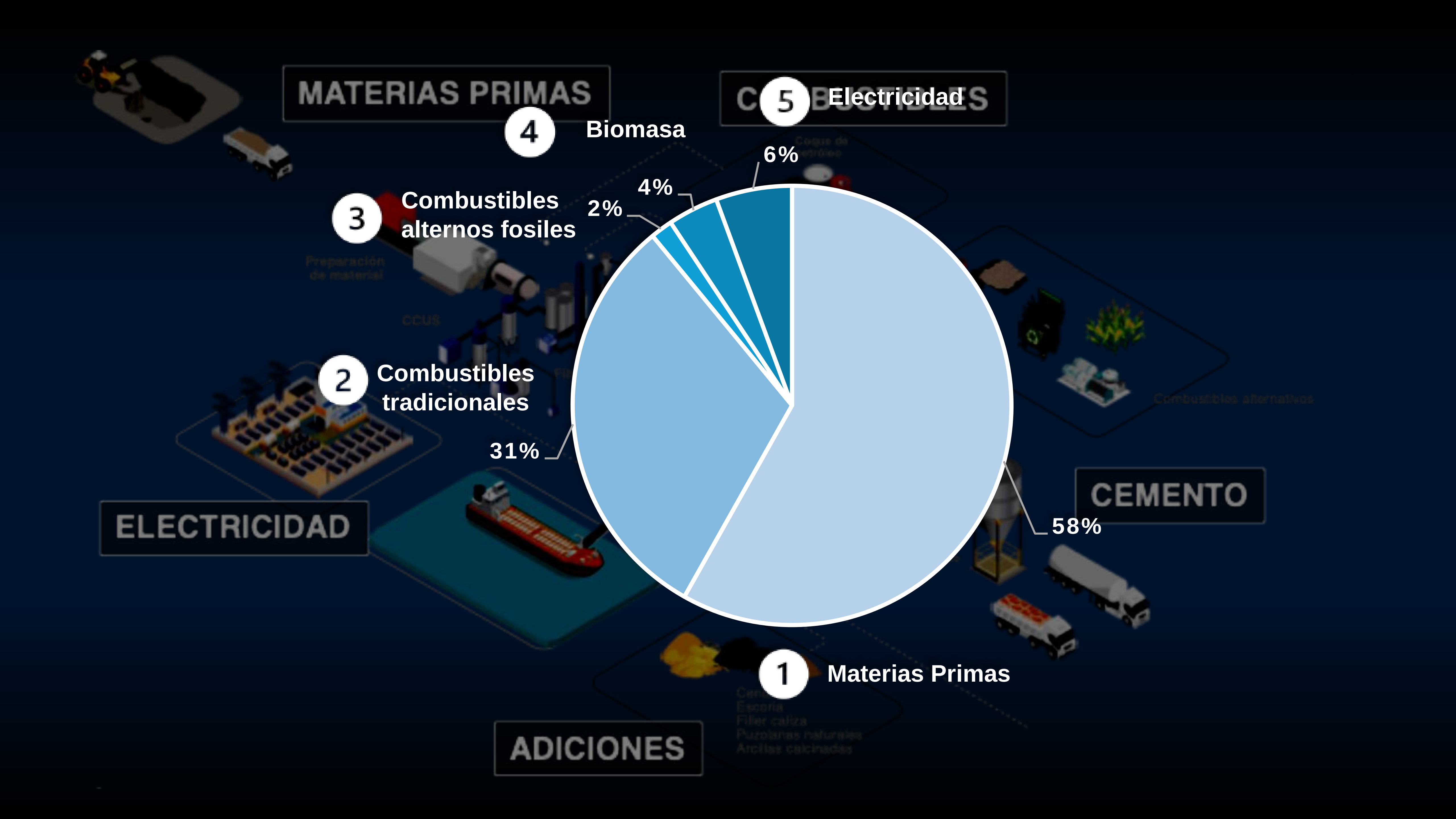

MATERIAS PRIMAS
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31%
58%
CEMENTO
ELECTRICIDAD
1 Materias Primas
ADICIONES

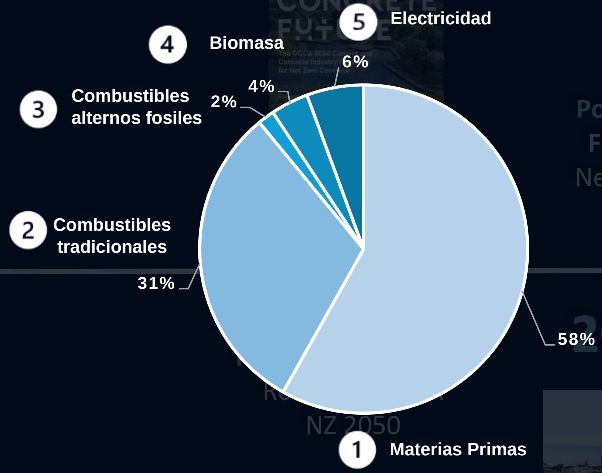
Net Zero FICEM

2010

Impulsamos
GNR
Números Correctos

Desarrollo
Hojas Rutas 2030
x País

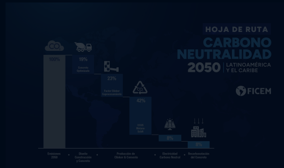
2015



NZ 2050

Posición
FICEM
Net Zero

2022



2024

Lanzamiento
Roadmap
FICEM 2050
Net Zero

FICEM en Acción
- Certeza Jurídica
- Financiamiento
- Calculadora 4C
- Hojas de Ruta 2050 x País
- Acelerar el Conocimiento
- Difusión

2025

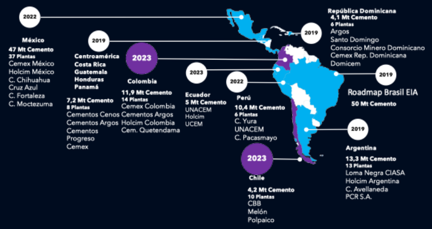
Net Zero FICEM

2010

Impulsamos
GNR
Números
Correctos

Desarrollo
Hojas Rutas 2030
x País

2015

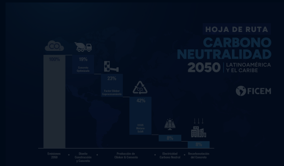


2021

Representamos LAC
Roadmap GCCA
NZ 2050

Posición
FICEM
Net Zero

2022



2024

Lanzamiento
Roadmap
FICEM 2050
Net Zero

FICEM en Acción
Certeza Jurídica
Financiamiento
Calculadora 4C
Hojas de Ruta 2050 x País
Acelerar el Conocimiento
Difusión

2025

2022

México

47 Mt Cemento
37 Plantas
Cemex México
Holcim México
C. Chihuahua
Cruz Azul
C. Fortaleza
C. Moctezuma

2019

Centroamérica
Costa Rica
Guatemala
Honduras
Panamá

7,2 Mt Cemento
8 Plantas
Cementos Cenos
Cementos Argos
Cementos Progreso
Cemex

2023

Colombia

11,9 Mt Cemento
14 Plantas
Cemex Colombia
Cementos Argos
Holcim Colombia
Cem. Quetendama

2023

Ecuador
5 Mt Cemento
UNACEM
Holcim
UCEM

2022

Perú
10,4 Mt Cemento
6 Plantas
C. Yura
UNACEM
C. Pacasmayo

2023

Chile

4,2 Mt Cemento
10 Plantas
CBB
Melón
Polpaico

2019

República Dominicana
4,1 Mt Cemento
6 Plantas
Argos
Santo Domingo
Consorcio Minero Dominicano
Cemex Rep. Dominicana
Domicem

2019

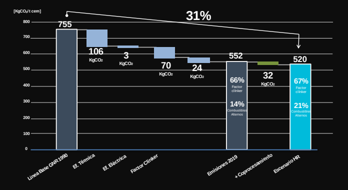
Roadmap Brasil EIA

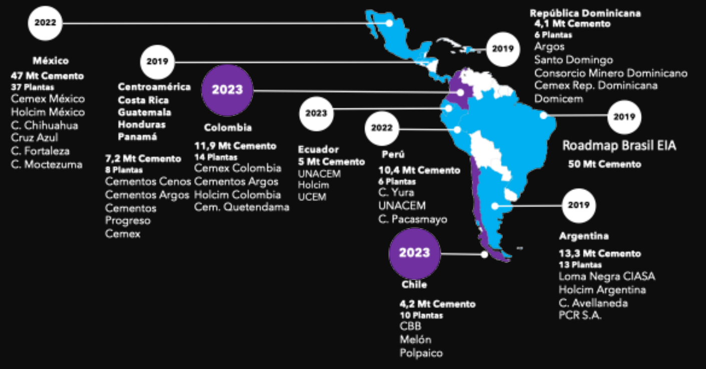
50 Mt Cemento

2019

Argentina

13,3 Mt Cemento
13 Plantas
Loma Negra CIASA
Holcim Argentina
C. Avellaneda
PCR S.A.




2022
México
47 Mt Cemento
37 Plantas
Cemex México
Holcim México
C. Chihuahua
Cruz Azul
C. Fortaleza
C. Moctezuma
2019
Centroamérica
Costa Rica
Guatemala
Honduras
Panamá
7,2 Mt Cemento
8 Plantas
Cementos Cenos
Cementos Argos
Cementos Progreso
Cemex
2023
Colombia
11,9 Mt Cemento
14 Plantas
Cemex Colombia
Cementos Argos
Holcim Colombia
Cem. Quetendama
2023
Ecuador
5 Mt Cemento
UNACEM
Holcim
UCEM
2022
Perú
10,4 Mt Cemento
6 Plantas
C. Yura
UNACEM
C. Pacasmayo
2023
Chile
4,2 Mt Cemento
10 Plantas
CBB
Melón
Polpaico
República Dominicana
4,1 Mt Cemento
6 Plantas
Argos
Santo Domingo
Consorcio Minero Dominicano
Cemex Rep. Dominicana
Domicem
2019
2019
Roadmap Brasil EIA
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Argentina
13,3 Mt Cemento
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Holcim Argentina
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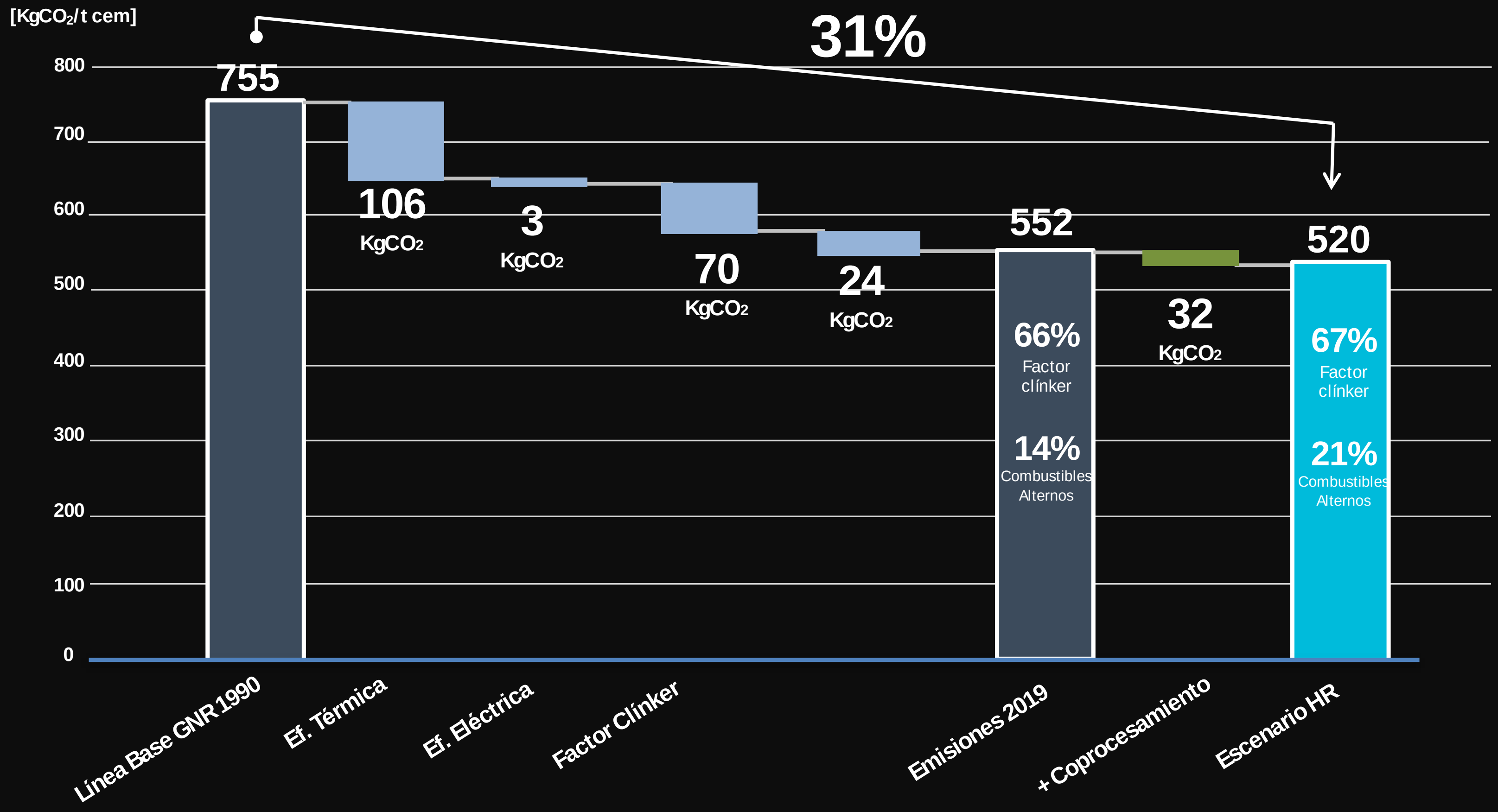

[KgCO2/t cem]
31%
800
700
600
500
400
300
200
100
0
755
106 KgCO2
3 KgCO2
70 KgCO2
24 KgCO2
552
66% Factor clínker
14% Combustibles Alternos
32 KgCO2
520
67% Factor clínker
21% Combustibles Alternos
Línea Base GNR 1990
Ef. Térmica
Ef. Eléctrica
Factor Clínker
Emisiones 2019
+ Coprocesamiento
Escenario HR

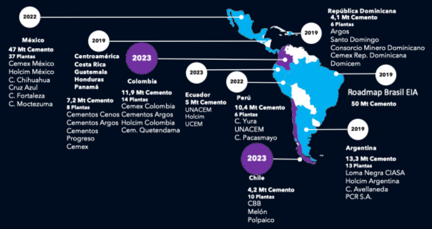
Net Zero FICEM

2010

Impulsamos
GNR
Números
Correctos

Desarrollo
Hojas Rutas 2030
x País

2015

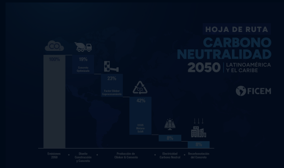


2021

Representamos LAC
Roadmap GCCA
NZ 2050

Posición
FICEM
Net Zero

2022



2024

Lanzamiento
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FICEM 2050
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- Certeza Jurídica
- Financiamiento
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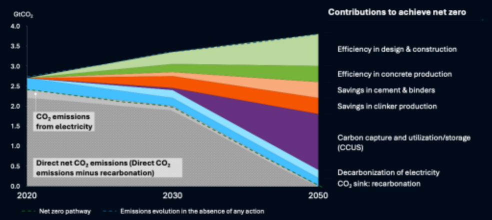
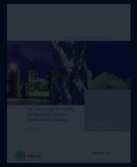
- Difusión

2025

Net Zero FICEM





2010

Impulsamos
GNR
Números Correctos

Desarrollo
Hojas Rutas 2030
x País

2015

2021

Representamos LAC
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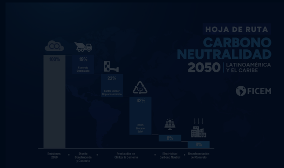
NZ 2050

Posición
FICEM
Net Zero

2022



2024

Lanzamiento
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FICEM 2050
Net Zero

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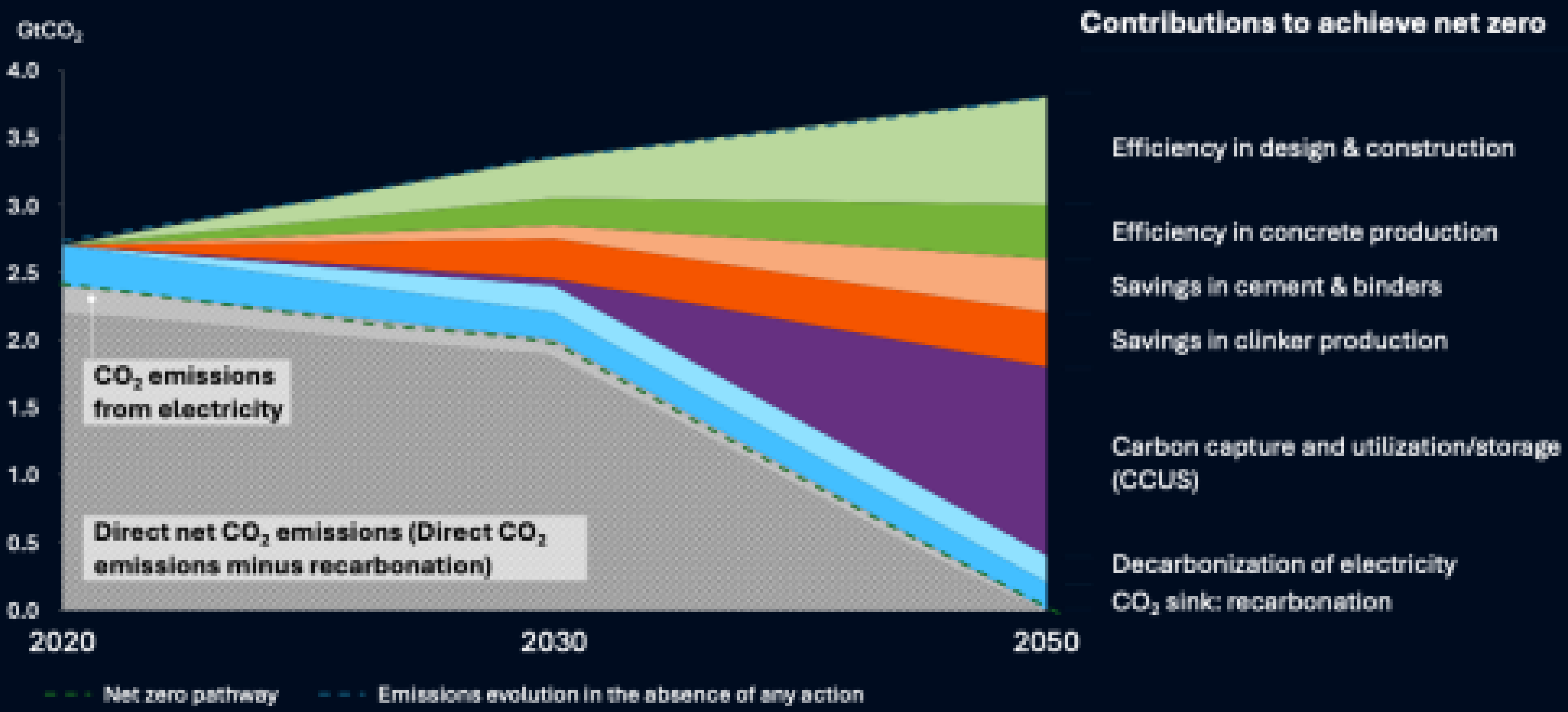
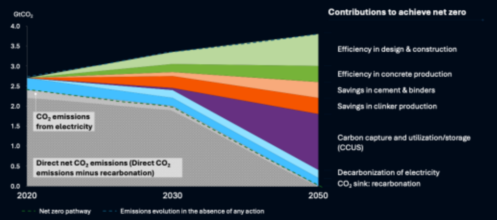
Certeza Jurídica
Financiamiento
Calculadora 4C
Hojas de Ruta 2050 x País
Acelerar el Conocimiento
Difusión

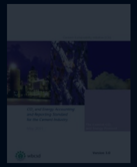
2025


CONCRETE
FUTURE
The GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete


GtCO$_2$
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2020
2030
2050
CO_2 emissions from electricity
Direct net CO_2 emissions (Direct CO_2 emissions minus recarbonation)
Contributions to achieve net zero
Efficiency in design & construction
Efficiency in concrete production
Savings in cement & binders
Savings in clinker production
Carbon capture and utilization/storage (CCUS)
Decarbonization of electricity
CO_2 sink: recarbonation
Net zero pathway
Emissions evolution in the absence of any action

Net Zero FICEM





2010

Impulsamos
GNR
Números Correctos

Desarrollo
Hojas Rutas 2030
x País

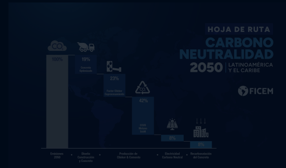
2015

2021

Representamos LAC
Roadmap GCCA
NZ 2050

Posición
FICEM
Net Zero

2022

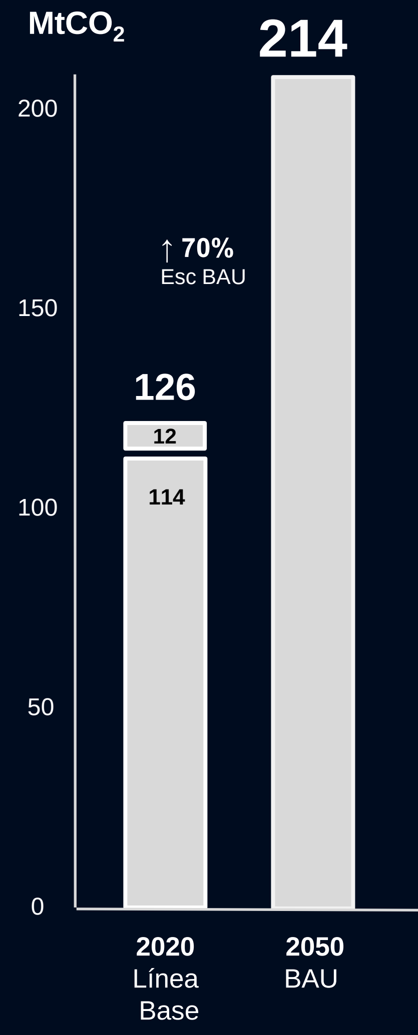


2024

Lanzamiento
Roadmap
FICEM 2050
Net Zero

FICEM en Acción
- Certeza Jurídica
- Financiamiento
- Calculadora 4C
- Hojas de Ruta 2050 x País
- Acelerar el Conocimiento
- Difusión

2025

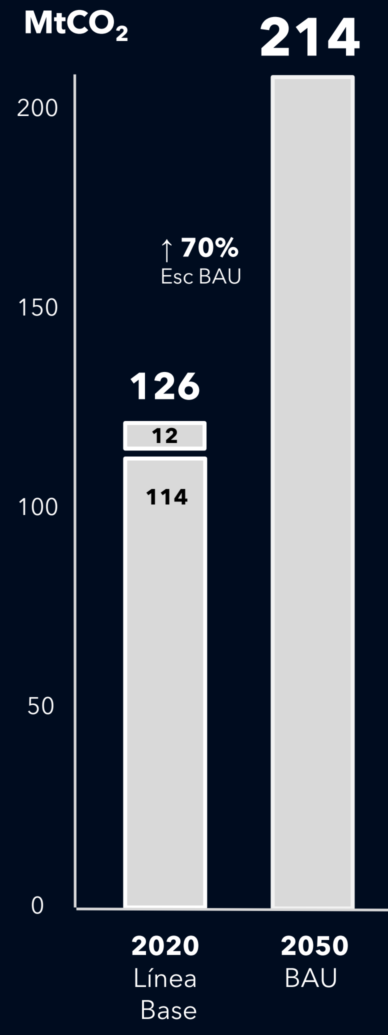


MtCO2
200
150
100
50
0
126
12
114
↑ 70%
Esc BAU
214
2020
Línea
Base
2050
BAU

¿Net Zero?

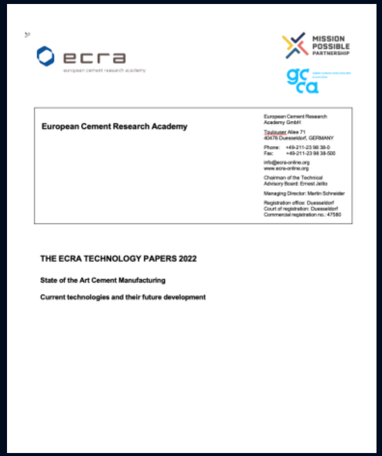
FICEM
AMBICIÓN
CLIMÁTICA


AMBICIÓN
CLIMÁTICA


$MtCO_2$
214
200
150
100
50
0
↑ 70%
Esc BAU
126
12
114
2020
Línea
Base
2050
BAU


IMPLEMENTACION
ESTRATEGIA DE
MERCADO DEL CARBONO
INDUSTRIA DEL CEMENTO
LATINOAMERICANA
Deloitte.

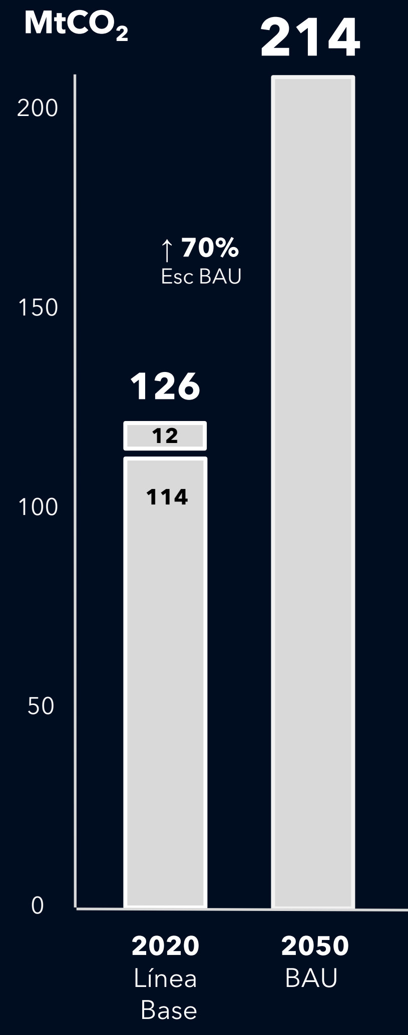

Precio del
Carbono al
Cemento
Precio del Carbono
Planta Cementera
Estándar
Impacto Financiero y
Oportunidades
Plantas FICEM
PRECIO AL CARBONO EN LA
INDUSTRIA DEL CEMENTO
APLICACIÓN DE DISTINTOS INSTRUMENTOS A UNA PLANTA
CEMENTERA ESTÁNDAR


ecra
European Cement Research Academy
THE ECRA TECHNOLOGY PAPERS 2022
State of the Art Cement Manufacturing
Current technologies and their future development

¿Net Zero?


IMPLEMENTACION
ESTRATEGIA DE
MERCADO DEL CARBONO
INDUSTRIA DEL CEMENTO
LATINOAMERICANA
Deloitte.


IMPLEMENTACION ESTRATEGIA DE MERCADO DEL CARBONO
INDUSTRIA DEL CEMENTO LATINOAMERICANA
Deloitte.


MtCO$_2$
214
200
150
100
50
0
↑ 70%
Esc BAU
126
12
114
2020
Línea
Base
2050
BAU


FICEM
AMBICIÓN
CLIMÁTICA


IMPLEMENTACION
ESTRATEGIA DE
MERCADO DEL CARBONO
INDUSTRIA DEL CEMENTO
LATINOAMERICANA
Deloitte.


FICEM
Precio del
Carbono al
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Precio del Carbono
Planta Cementera
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Impacto Financiero y
Oportunidades
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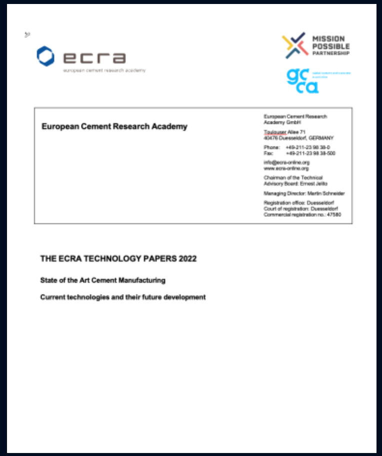
ecra
MISSION
POSSIBLE
PARTNERSHIP
gcca
European Cement Research Academy
THE ECRA TECHNOLOGY PAPERS 2022
State of the Art Cement Manufacturing
Current technologies and their future development

¿Net Zero?

ecra
european cement research academy

MISSION POSSIBLE PARTNERSHIP

gcca

European Cement Research Academy

European Cement Research Academy GmbH
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40476 Duesseldorf, GERMANY
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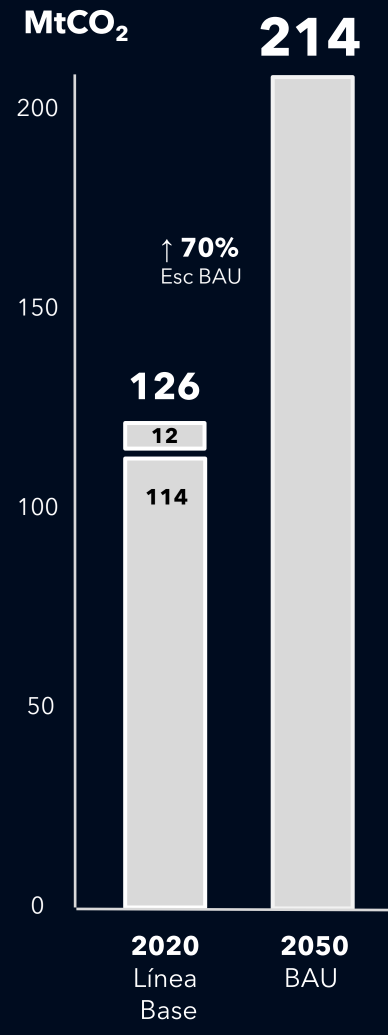
Fax: +49-211-23 98 38-500
info@ecra-online.org
www.ecra-online.org
Chairman of the Technical Advisory Board: Ernest Jelito
Managing Director: Martin Schneider
Registration office: Duesseldorf
Court of registration: Duesseldorf
Commercial registration no.: 47580

THE ECRA TECHNOLOGY PAPERS 2022

State of the Art Cement Manufacturing

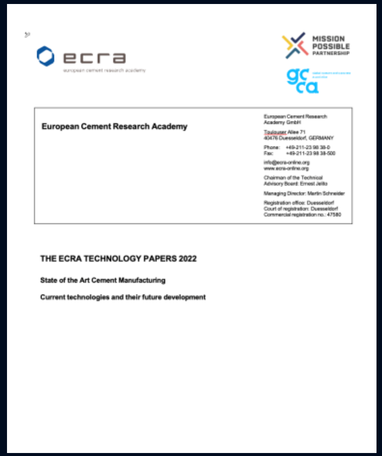
Current technologies and their future development


MtCO2
214
200
↑ 70%
Esc BAU
150
126
12
114
100
50
0
2020
Línea
Base
2050
BAU


FICEM
AMBICIÓN
CLIMÁTICA


IMPLEMENTACION
ESTRATEGIA DE
MERCADO DEL CARBONO
INDUSTRIA DEL CEMENTO
LATINOAMERICANA
Deloitte.


FICEM
Precio del
Carbono al
Cemento
Precio del Carbono
Planta Cementera
Estándar
Impacto Financiero y
Oportunidades
Plantas FICEM
PRECIO AL CARBONO EN LA
INDUSTRIA DEL CEMENTO
APLICACIÓN DE DISTINTOS INSTRUMENTOS A UNA PLANTA
CEMENTERA ESTÁNDAR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POSSIBLE
PARTNERSHIP
gcca
European Cement Research Academy
THE ECRA TECHNOLOGY PAPERS 2022
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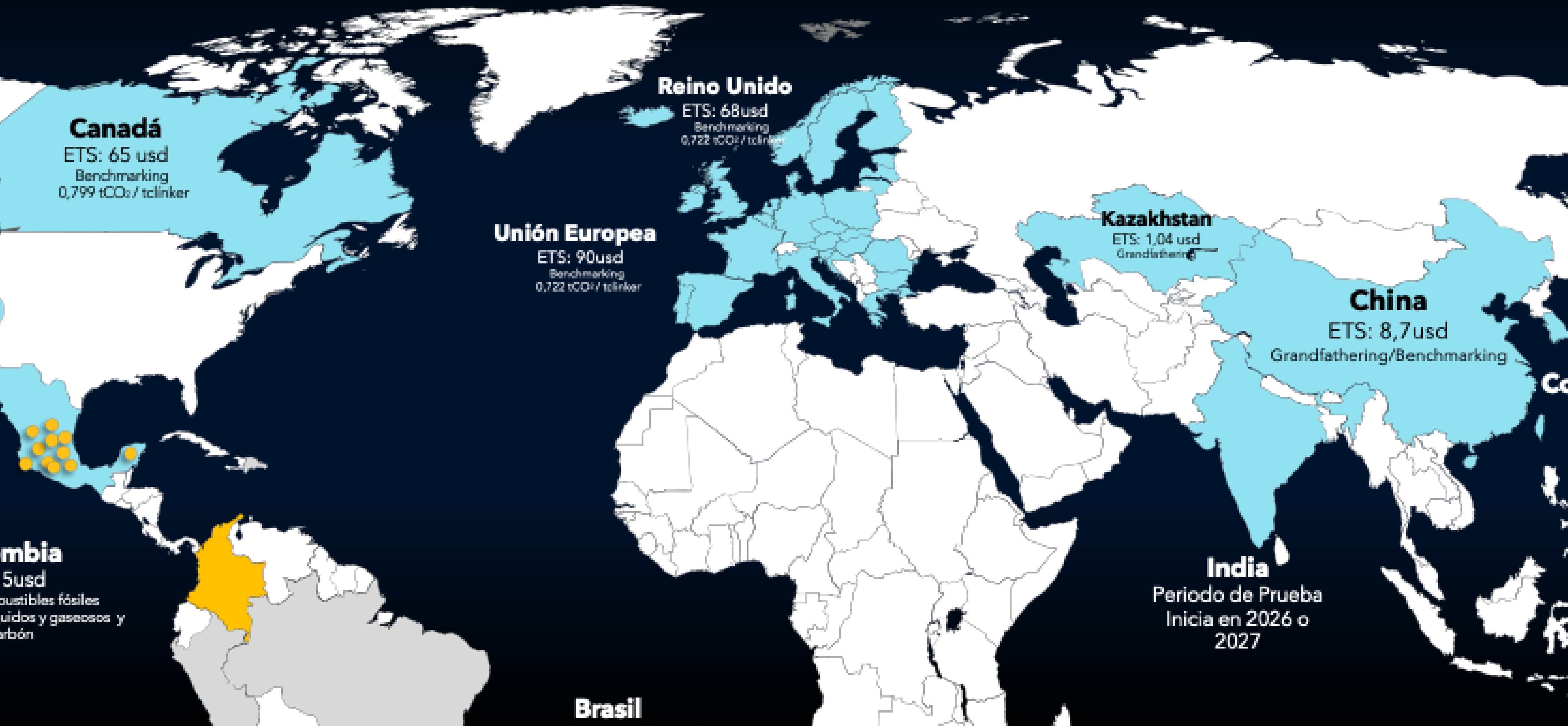
Current technologies and their future development

¿Net Zero?

Canadá
ETS: 65 usd
Benchmarking
0,799 tCO₂ / tclinker
California
ETS: 33 usd
Benchmarking
0,742 tCO₂ / tcement
México
12 Tax Estatales: Baja California, Durango, Zacatecas, Colima, San Luis de Potosí, Guanajuato, Tamaulipas, Estado de México, Ciudad de México, Morelos Querétaro, Yucatán.
México
ETS: Piloto
Grandfathering- 2018
Colombia
Tax: 5usd
Grava combustibles fósiles tradicionales líquidos y gaseosos y carbón
Brasil
ETS aprobado en el Senado. En trámite
Chile
Tax: 5usd
Grava combustibles fósiles tradicionales y alternos
Argentina
Tax: 5usd
Grava combustibles fósiles (excluye gas natural)
Reino Unido
ETS: 68usd
Benchmarking
Unión Europea
ETS: 90usd
Benchmarking
0,722 tCO₂ / tclinker
Kazakhstan
ETS: 1,04 usd
China
ETS: 8,7usd
Grandfathering/Benchmarking
Tokio/Japón
ETS: 5usd
Grandfathering
Corea del Sur
ETS: 8,5usd
Benchmarking
India
Periodo de Prueba Inicia en 2026 o 2027
Sudáfrica
ETS: 9usd
Benchmarking
0,52 tCO₂ / tcement proceso más CO2 combustible
Australia
ETS: 38usd
Grandfathering
Nueva Zelanda
ETS: 48usd
Benchmarking
0,785 tCO₂ / tclinker
ETS e Impuestos al Carbono Sector Cemento
Países con Impuesto al Carbono
Impuesto al Carbono Subnacionales
Países con ETS
ETS Subnacionales
Países sin precio al Carbono

FICEM
Precio del Carbono al Cemento
Precio del Carbono
Planta Cementera Estándar
Impacto Financiero y Oportunidades
Plantas FICEM
PRECIO AL CARBONO EN LA INDUSTRIA DEL CEMENTO
APLICACIÓN DE DISTINTOS INSTRUMENTOS A UNA PLANTA CEMENTERA ESTÁNDAR



Reino Unido
ETS: 68usd
Benchmarking
Canadá
ETS: 65 usd
Benchmarking
0,799 tCO₂ / tclinker
Unión Europea
ETS: 90usd
Benchmarking
0,722 tCO₂ / tclinker
Kazakhstan
ETS: 1,04 usd
China
ETS: 8,7usd
Grandfathering/Benchmarking
mbia
5usd
bustibles fósiles
uidos y gaseosos y
arbón
India
Periodo de Prueba
Inicia en 2026 o
2027
Brasil

México

12 Tax Estatales: Baja California, Durango, Zacatecas, Colima, San Luis de Potosí, Guanajuato, Tamaulipas, Estado de México, Ciudad de México, Morelos Querétaro, Yucatán.

ETS e Impuestos al Carbono Sector Cemento

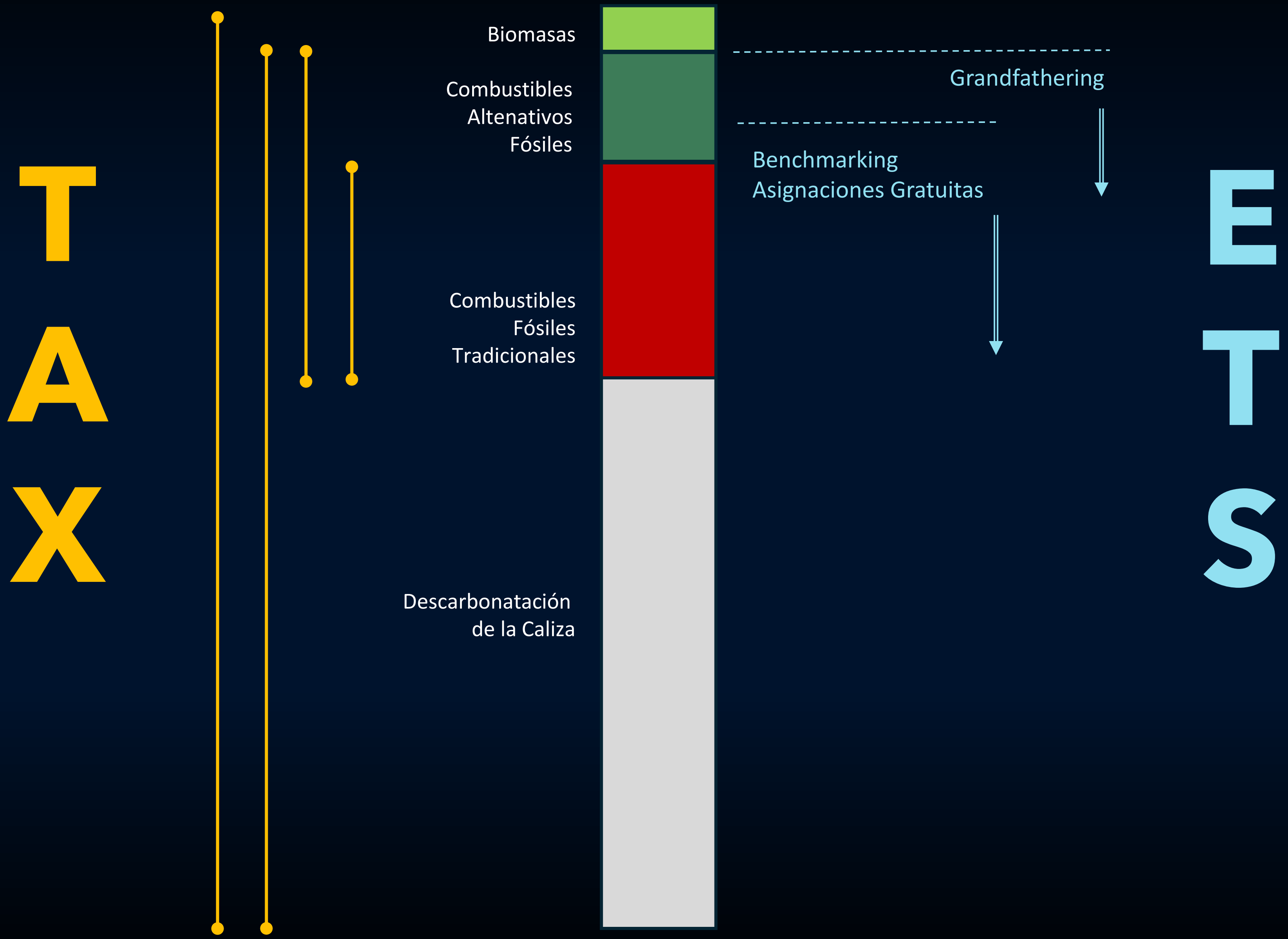
Países con Impuesto al Carbono

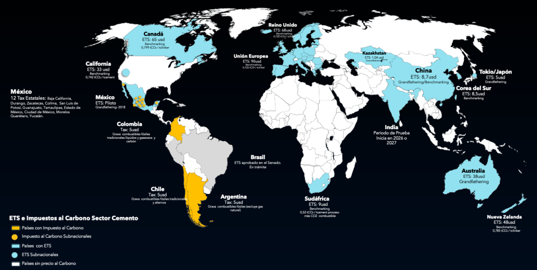
Precio al Carbono

1% TAX

99 %ETS

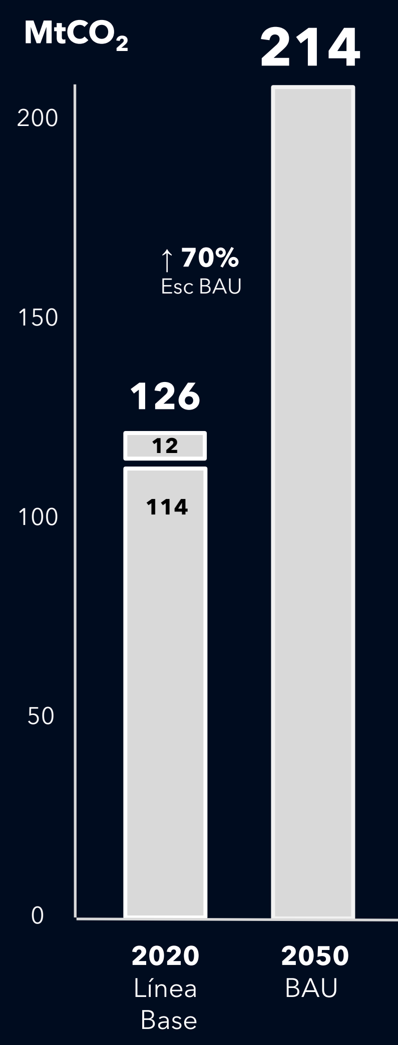
Totales 890 $KgCO_2$/tClinker

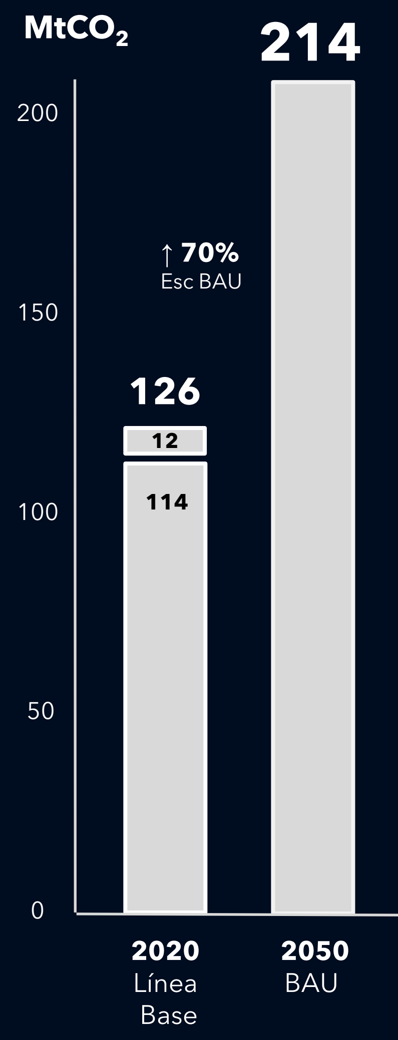




Jurisdicción (modelo)	AG	CAP		US$	$kgCO_2$ gravado	Costo a tonelada de Clinker
UK (nuevo) (Benchmarking)	96%	0,722	tCO_2/tCk	$ 75,0	82	$ 5,73
Unión Europea (Benchmarking)	96%	0,722	tCO_2/tCk	$ 62,6	82	$ 5,13
Chile Ley 2018 (TAX)	NA	N/A		$ 5,0	775	$ 3,88
Nueva Zelanda (Benchmarking)	90%	0,785	tCO_2/tCk	$ 32,0	69	$ 2,19
Nueva Scotia. (Grandfathering)	88%	N/A		$ 23,0	93	$ 2,14
Nueva Zelanda (Benchmarking)	90%	0,785	tCO_2/tCk	$ 20,0	69	$ 1,37
Chile Reglamento 2023 (TAX)	NA	N/A		$ 5,0	269	$ 1,35
Corea (Benchmarking sin data)	90%	0,799	tCO_2/tCk	$ 23,0	56	$ 1,29
Tokio 2024. (Grandfathering - 1,2% anual x 4 años)	100%	N/A		$ 4,9	219	$ 1,07
Fujian (Benchmarking sin data)	75%	0,799	tCO_2/tCk	$ 2,2	216	$ 0,49
Unión Europea (Benchmarking)	100%	0,768	tCO_2/tCk	$ 26,0	15	$ 0,39
Beijing (Grandfathering)	95%	N/A		$ 9,5	39	$ 0,37
Sudáfrica (Grandfathering)	95%	N/A		$ 9,0	39	$ 0,35
Chongqing (Grandfathering - 4,85% x 4 años)	100%	N/A		$ 4,5	75	$ 0,34
Argentina 2018 (TAX)	NA	N/A		$ 1,3	269	$ 0,34
Guangdong (Grandfathering)	97%	N/A		$ 4,3	23	$ 0,10
Colombia (TAX)	NA	N/A		$ 5,0	1	$ 0,01
Hubei (Benchmarking sin data)	100%	0,799	tCO_2/tCk	$ 4,7	-24	$ -0,11
Canadá (Benchmarking)	100%	0,799	tCO_2/tCk	$ 32,0	-24	$ -0,77
California (Benchmarking)	100%	0,742	$tCO_2e/tCem$	$ 22,0	-78	$ -1,72
Quebec (Benchmarking)	100%	0,717	$tCO_2e/tCem$	$ 22,4	-118	$ -2,66

Costo no acción 13 billones USD





Net Zero 2050.

Vulnerabilidad Climática.

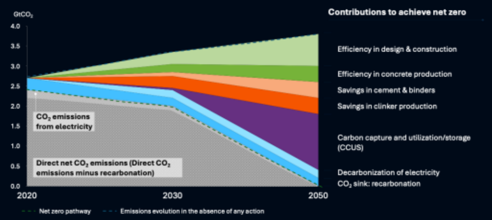
Certeza Jurídica.

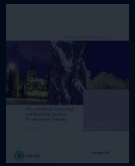
Aceptación de las SbN.

Reconocimiento Metano.

Acceso a financiamiento.

Net Zero FICEM





2010

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Desarrollo
Hojas Rutas 2030
x País

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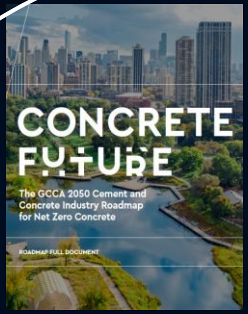

Representamos LAC
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Posición
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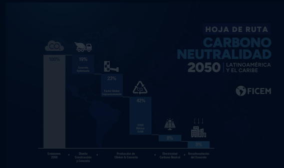

Lanzamiento
Roadmap
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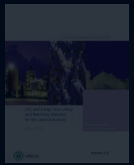
Net Zero

2025

FICEM en Acción
- Certeza Jurídica
- Financiamiento
- Calculadora 4C
- Hojas de Ruta 2050 x País
- Acelerar el Conocimiento
- Difusión

Net Zero FICEM



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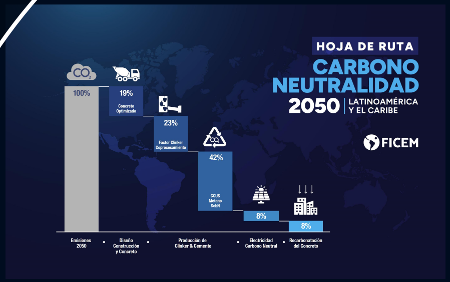

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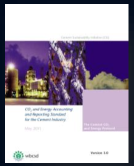

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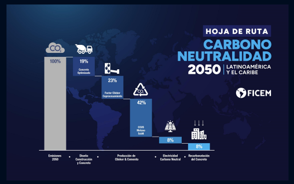

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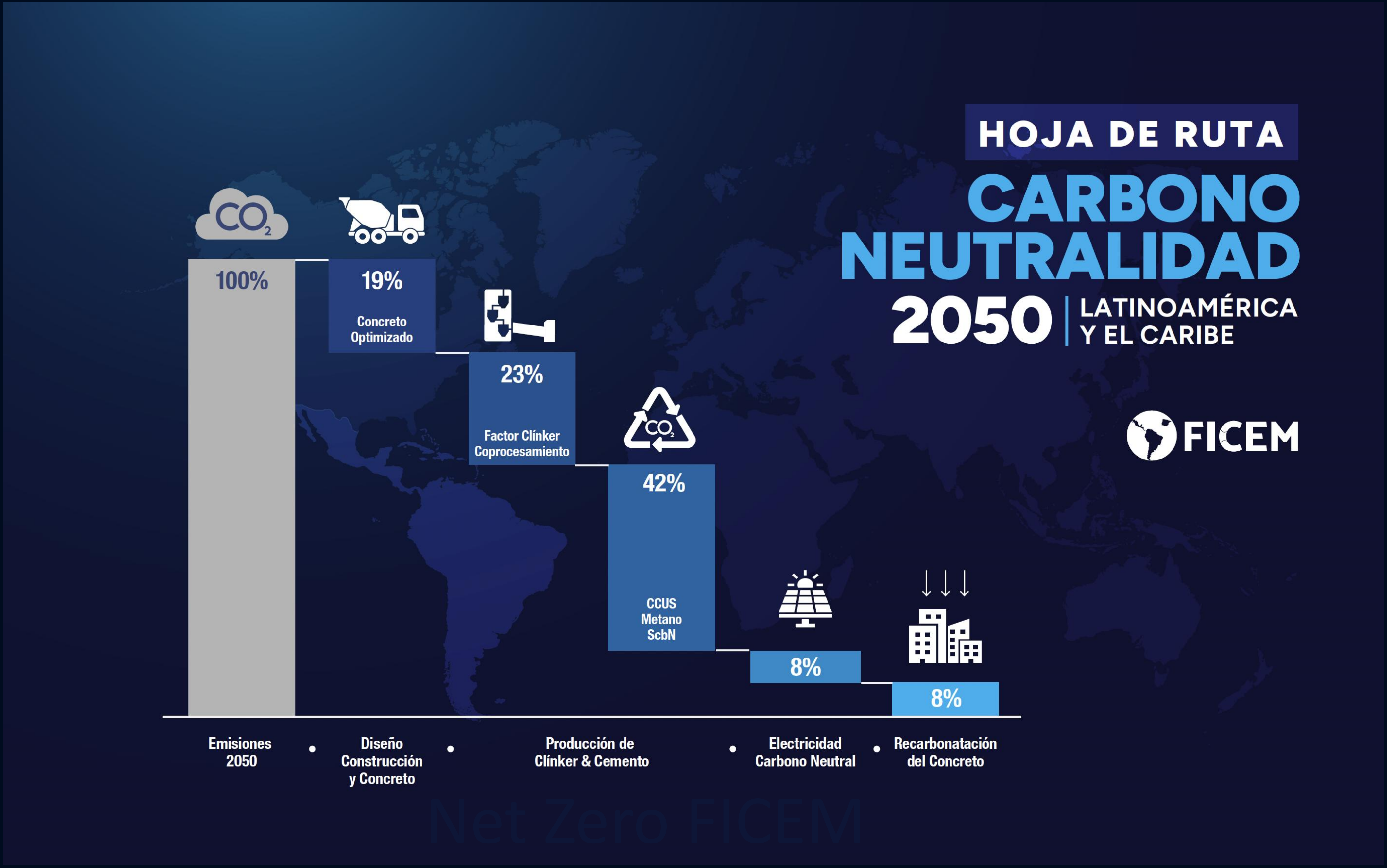
HOJA DE RUTA
CARBONO NEUTRALIDAD
2050
LATINOAMÉRICA Y EL CARIBE
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Concreto Optimizado
23%
Factor Clínker Coprocesamiento
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CCUS Metano ScbN
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Emisiones 2050
Diseño Construcción y Concreto
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Electricidad Carbono Neutral
Recarbonatación del Concreto
Net Zero FICEM

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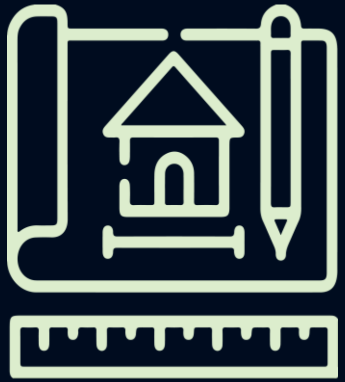

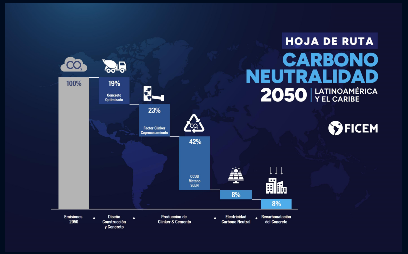
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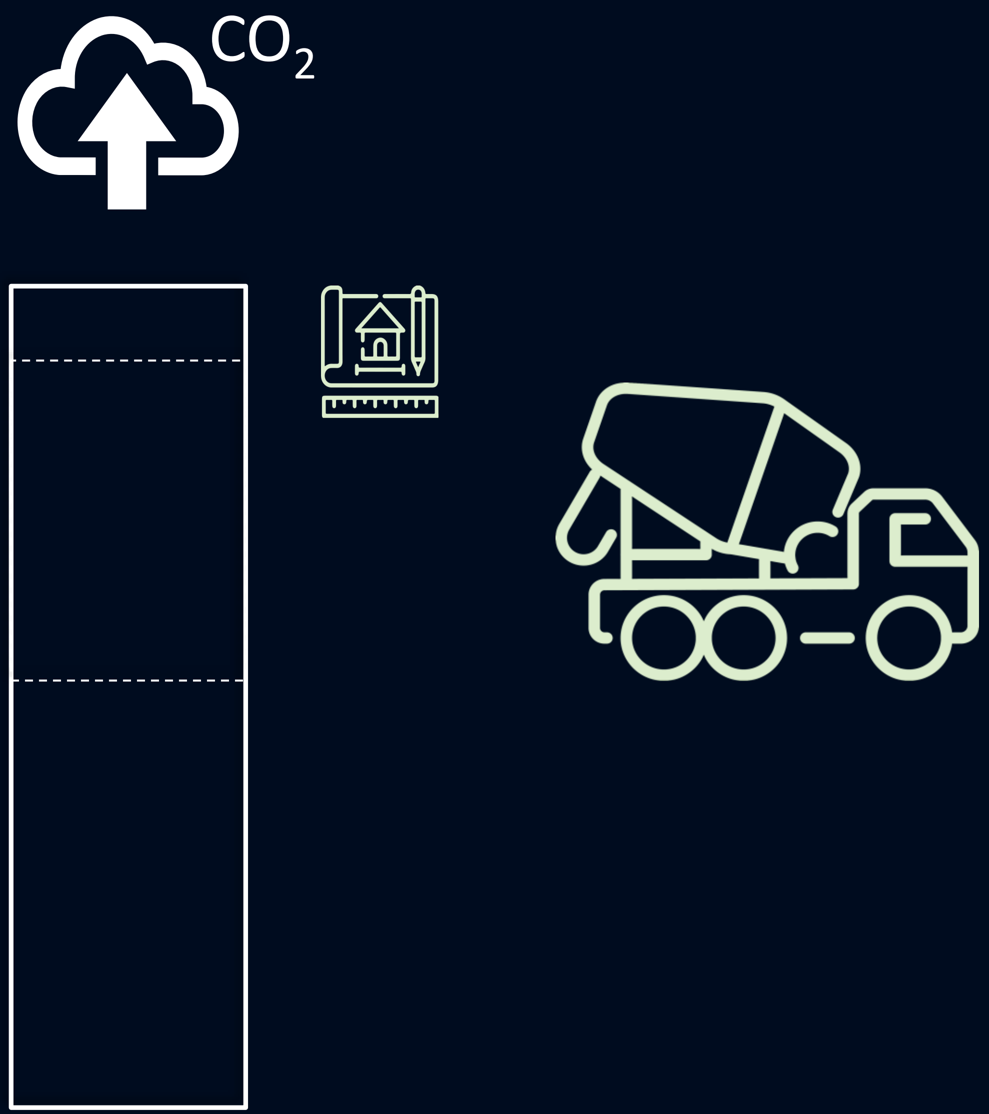
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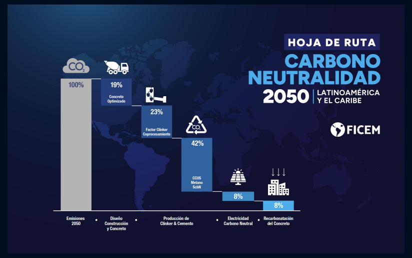
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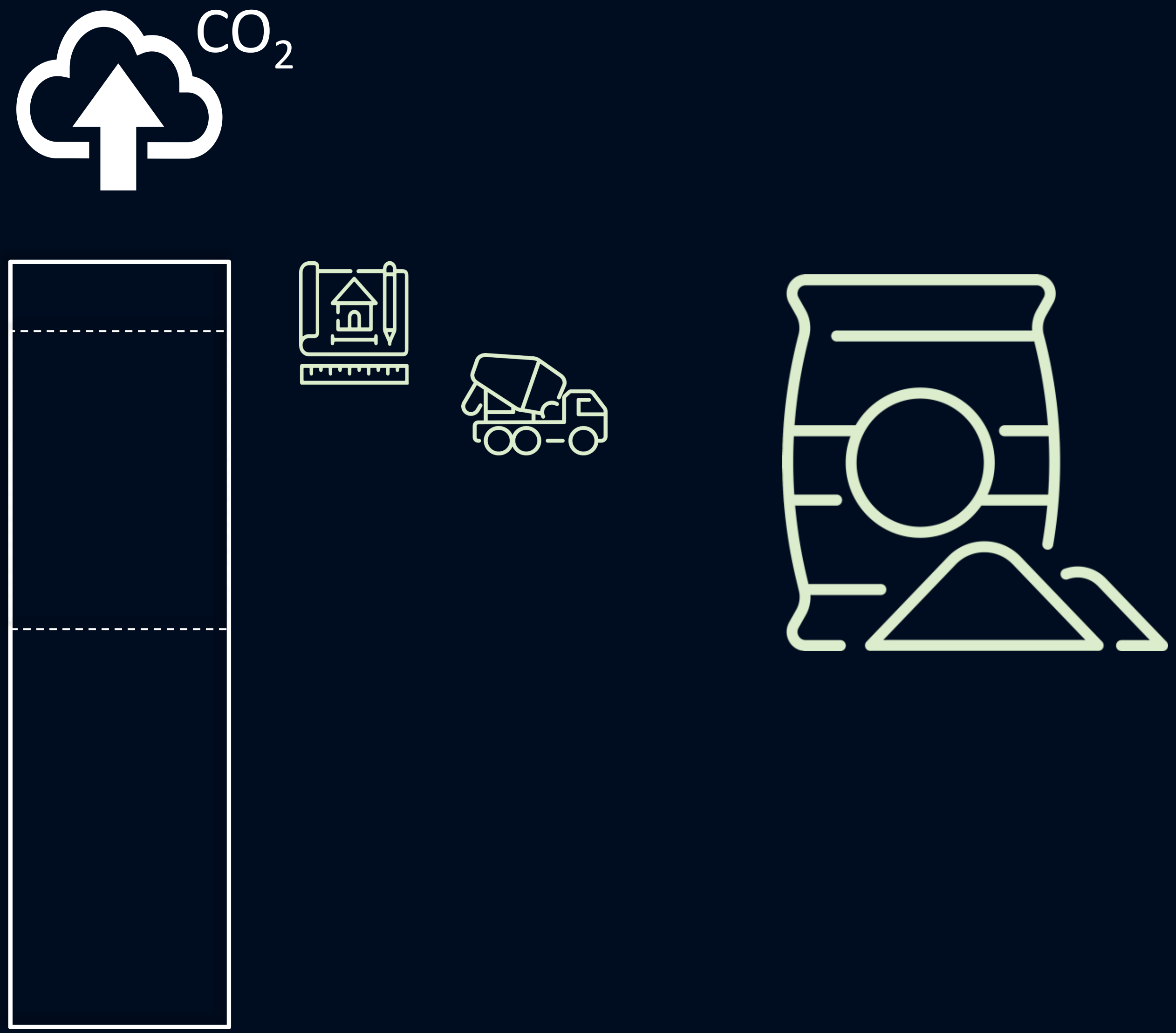
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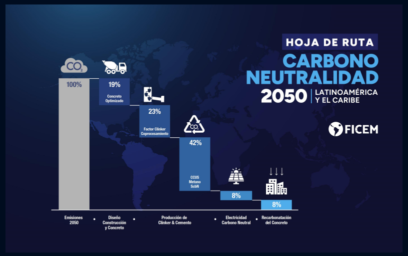
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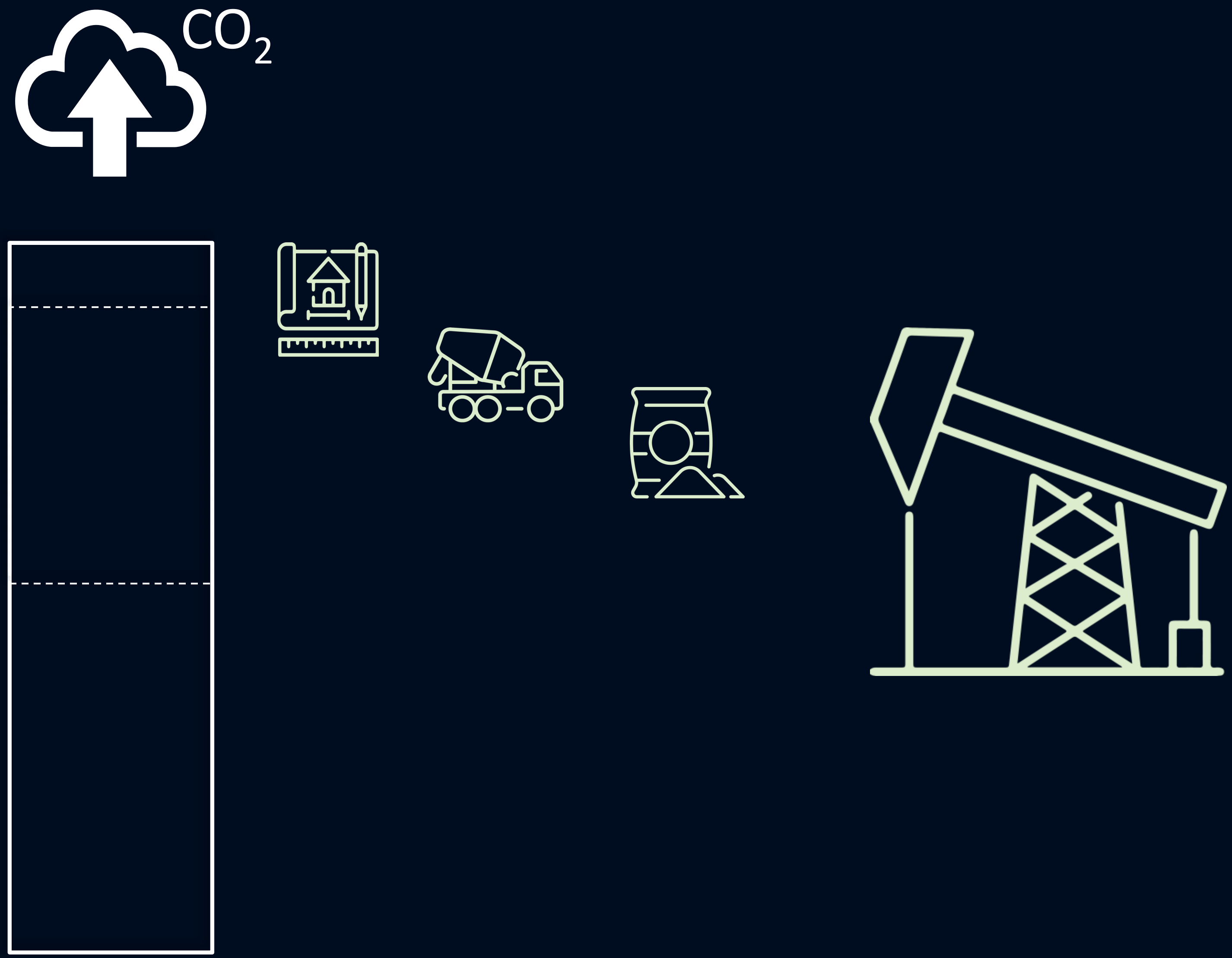
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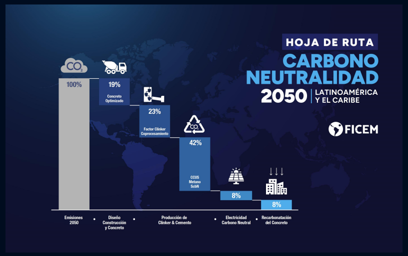
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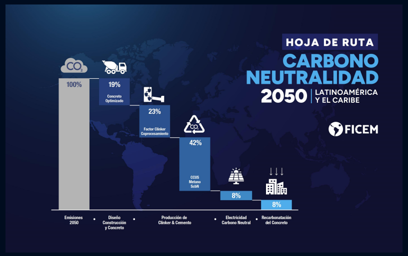
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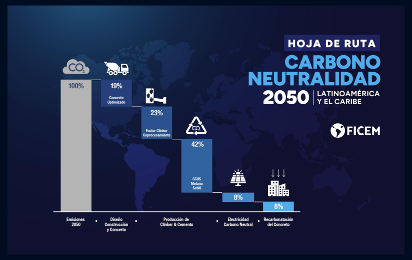
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Diseño Construcción y Concreto
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Recarbonatación del Concreto


CO2
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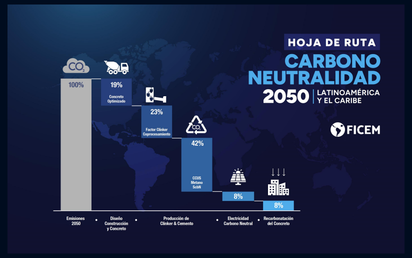
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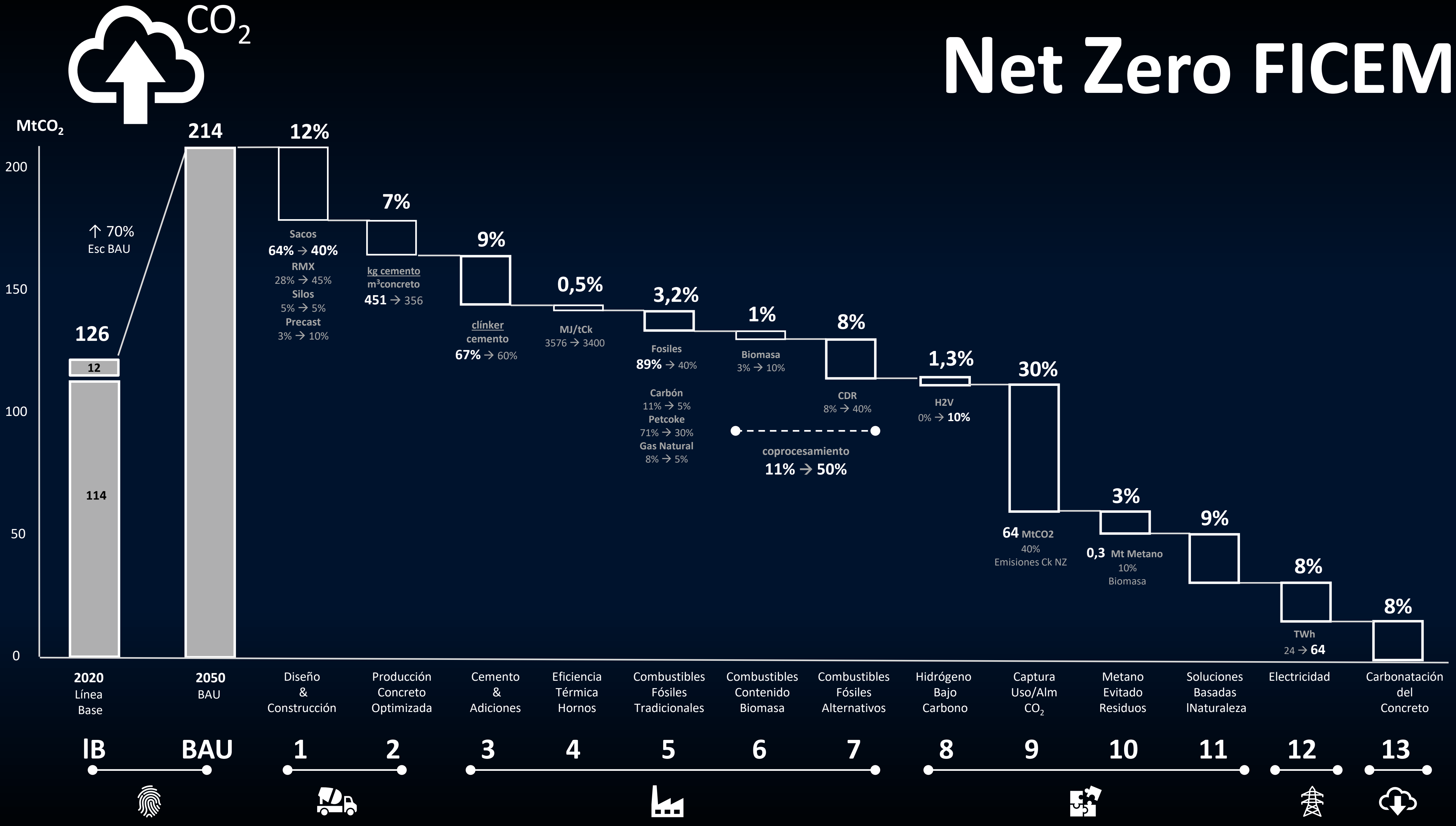
Net Zero FICEM



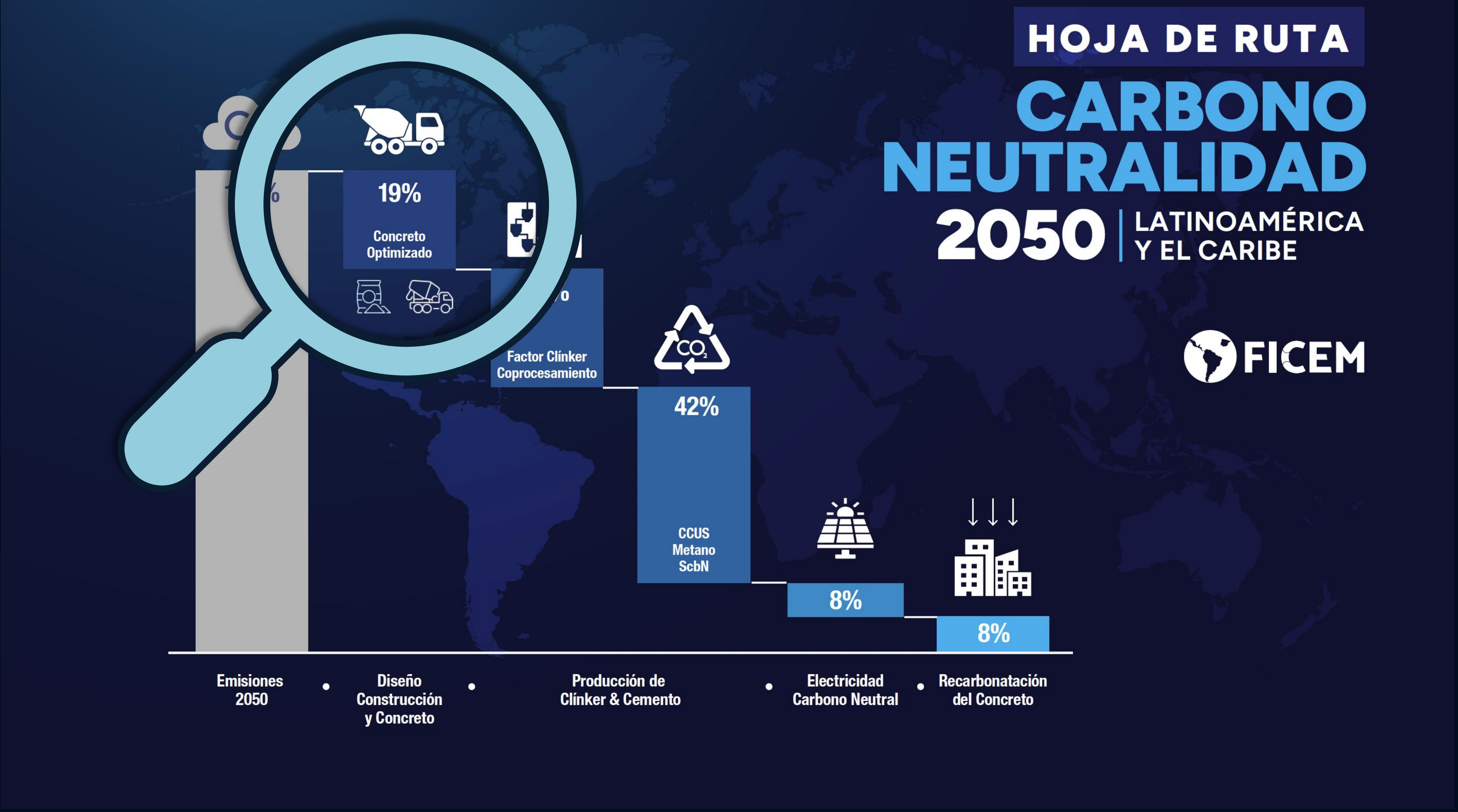
Contexto

Net **Z**ero **FICEM**

Desafíos **NZ**

Herramientas **FICEM**

Desafíos NZ



HOJA DE RUTA
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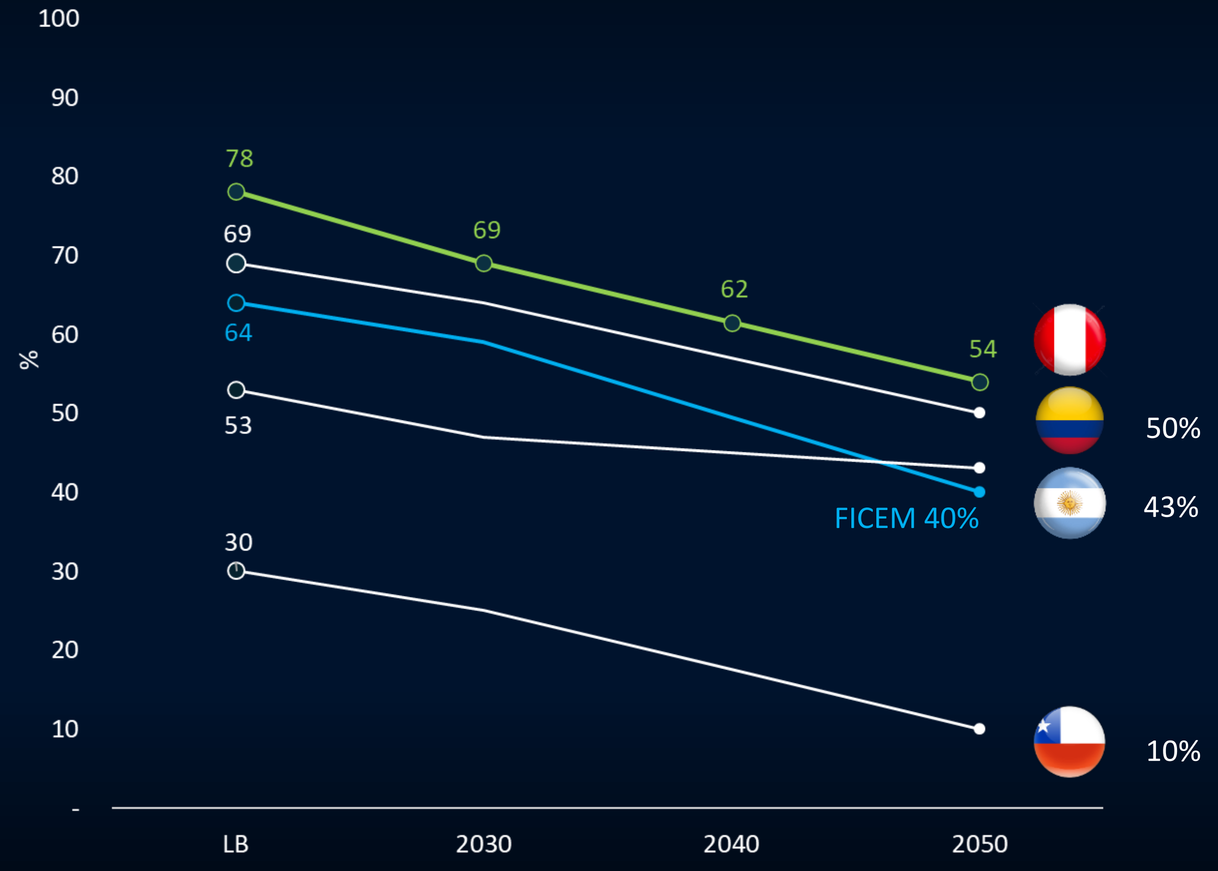
CEMENTO EN SACOS



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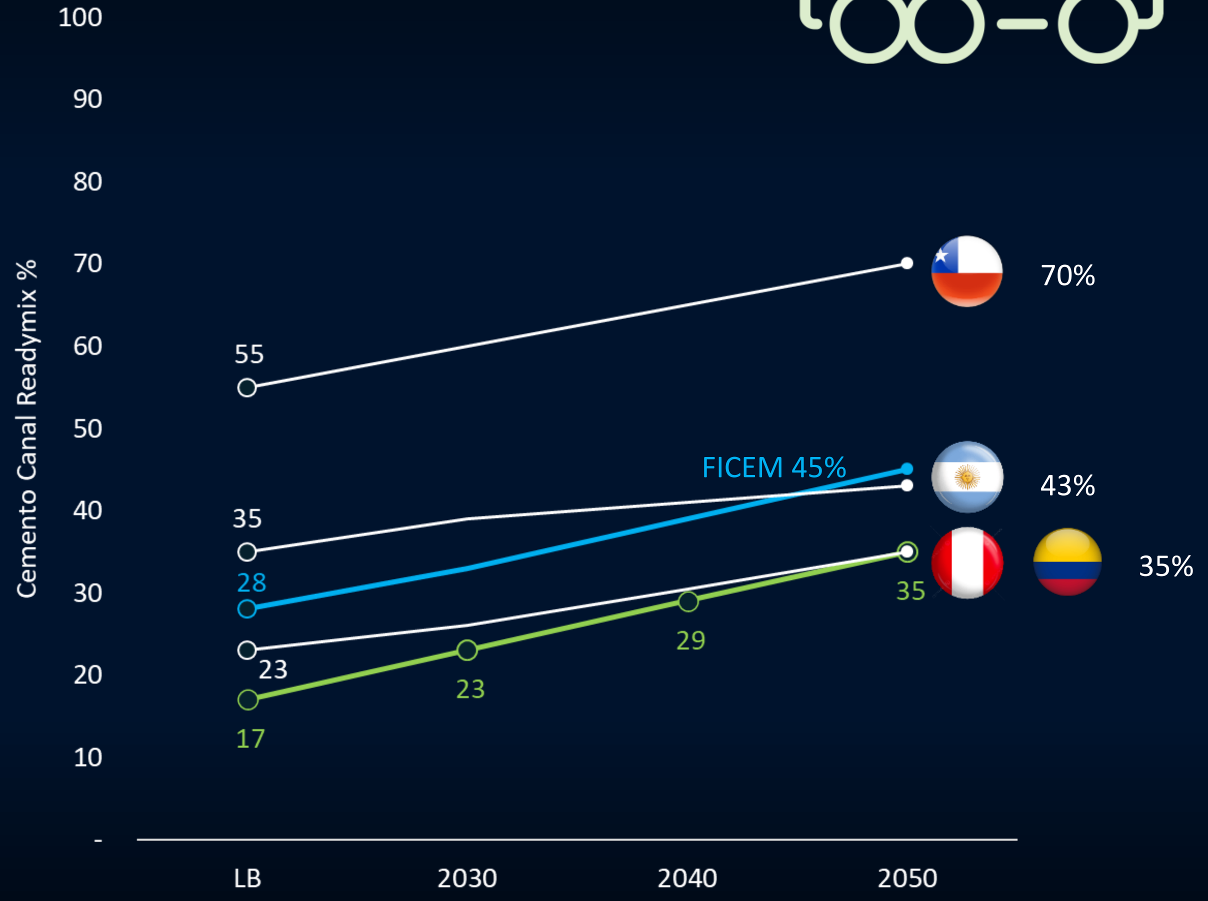

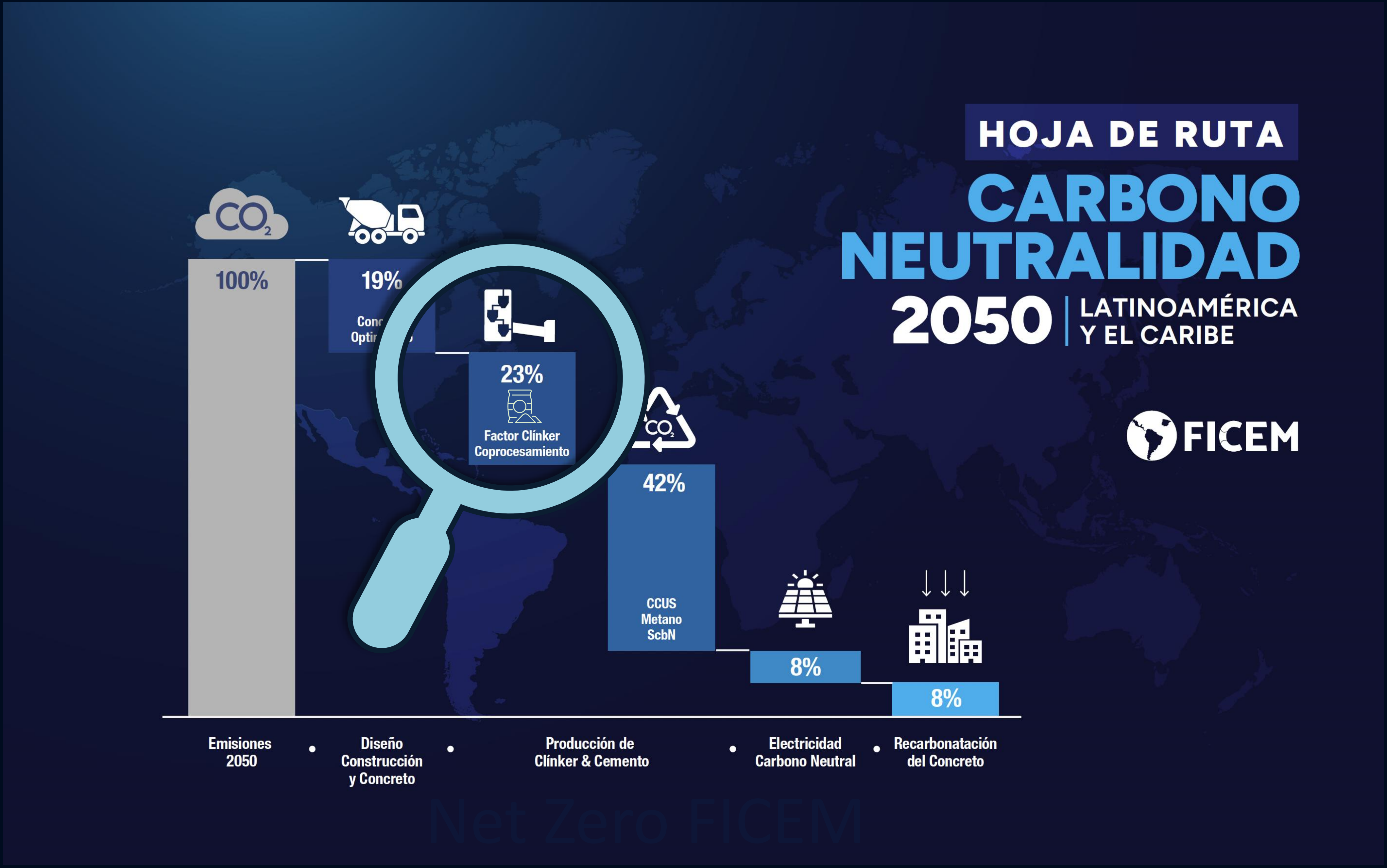
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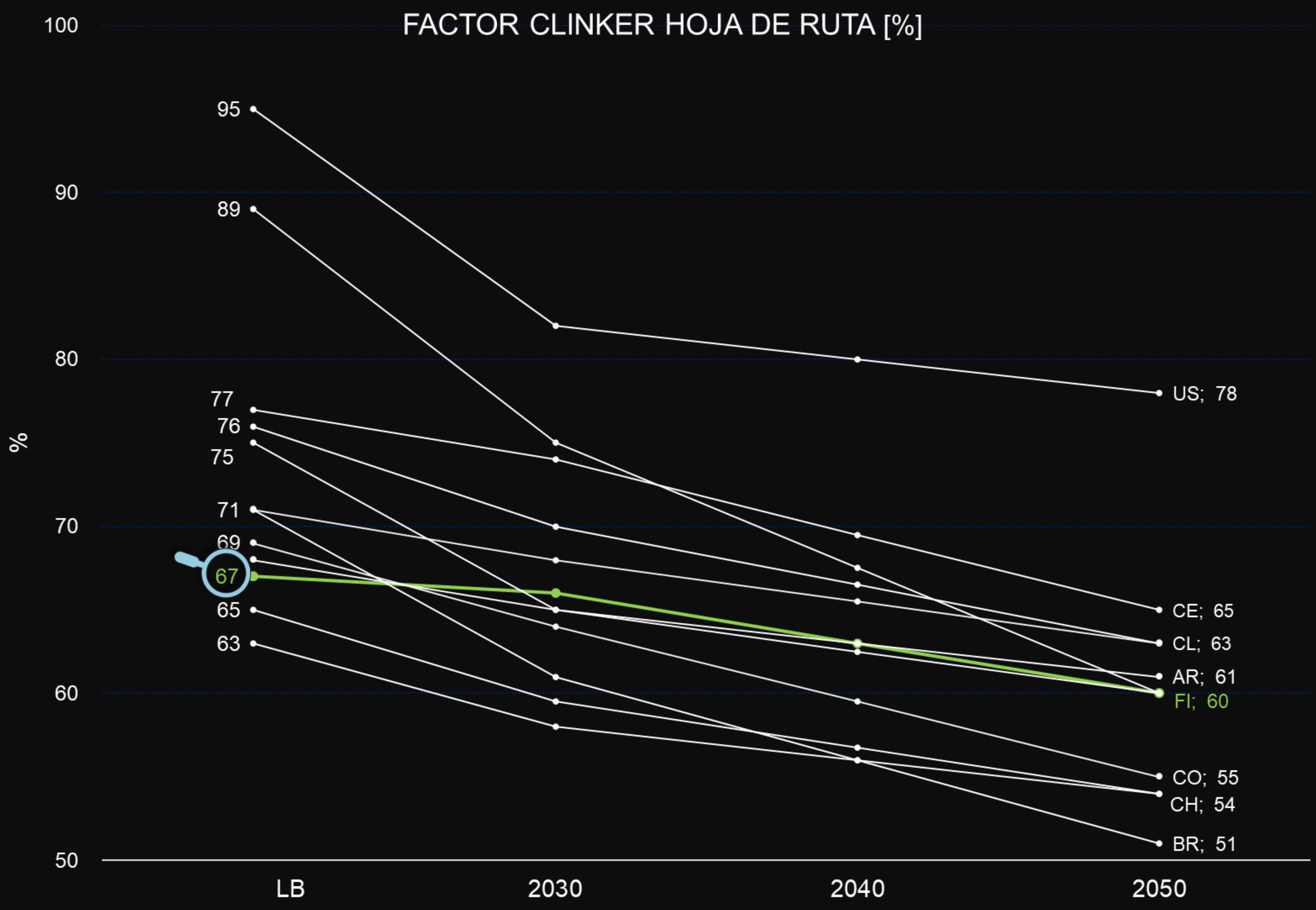
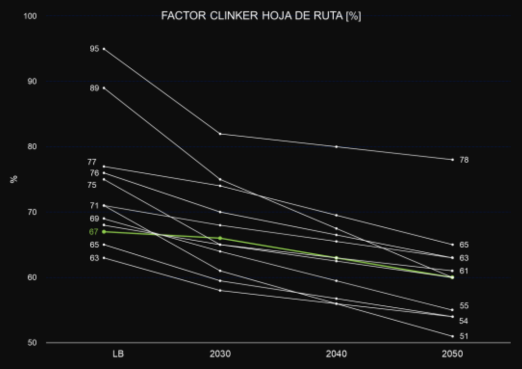
Recarbonatación del Concreto
Net Zero FICEM

HRs Net Zero



Entidad	LB	2030	2040	2050
FICEM	**67**	**66**	**63**	**60**
PERU	76	70	67	63
COLOMBIA	69	64	60	55
CHILE	71	68	66	63
ARGENTINA	68	65	63	61
BRASIL	71	61	56	51
GCCA	63	58	56	54
USA	95	82	80	78
CANADA	89	75	68	60
INDIA	75	65	63	60
CEMBUREAU	77	74	70	65
CHINA	65	60	57	54

HRs Net Zero



Entidad	2040	2050
FICEM	63	60
PERU	67	63
COLOM	60	55
CHILE	66	63
ARGENT	63	61
BRASIL	56	51
GCCA	56	54
USA	80	78
CANADA	68	60
INDIA	63	60
CEMBU	70	65
CHINA	57	54

RILEM Technical Letters (2022) 7: 30-46
https://doi.org/10.21809/rilemtechlett.2022.155

RILEM technical letters

Overview of cement and concrete production in Latin America and the Caribbean with a focus on the goals of reaching carbon neutrality

Yury Villagrán-Zaccardi[1,2]*, Ricardo Pareja[3], Lina Rojas[3], Edgardo Irassar[4], Andrés Torres-Acosta[5], Jorge Tobón[6], Vanderley M. John[7]

1 Magnel-Vandepitte Laboratory for Structural Engineering and Construction Materials, Ghent University, 9000 Gent, Belgium
2 CCT-La Plata, CONICET, 1900 La Plata, Argentina
3 Inter American Federation of Cement (FICEM), 110111 Bogotá, Colombia
4 Facultad de Ingeniería, Centro de Investigaciones en Física e Ingeniería del Centro de la Provincia de Buenos Aires (UNCPBA–CICPBA-CONICET), B7400JWI Olavarría, Argentina
5 Tecnológico de Monterrey, School of Engineering and Science, 76130 Querétaro, Queretaro, Mexico
6 Cement and Building Materials Research Group, Departamento de Materiales y Minerales, Facultad de Minas, Universidad Nacional de Colombia, 050034 Medellín, Colombia
7 Escola Politécnica da Universidade de São Paulo, 05508-010 São Paulo, Brazil

Received: 25 January 2022 / Accepted: 20 July 2022 / Published online: 15 August 2022

Abstract

Carbon neutrality to limit global warming is an increasing challenge for all industries, particularly for the cement industry, due to the chemical emission of the process. For decades, reducing the clinker factor has been one of the main strategies to reduce the carbon footprint. Additional cuttings in the clinker content of cements seem possible with the upsurge of novel supplementary cementitious materials. This potential contribution represents only a fraction of the required carbon reductions for achieving the goal of carbon neutrality in the coming decades. This paper describes the current situation of the cement industry in Latin America and the Caribbean and the global opportunities and strategies to reduce the carbon footprint of cement and concrete and their adaptation to the regional conditions. Besides describing emerging supplementary cementitious materials, the potential contributions of industrialization and quality control are discussed. Moreover, limitations related to geography and standardization are analyzed. Regional considerations are made given the specific prospects of human development.

Keywords: Low carbon cement; Supplementary cementitious materials; Cement production; Global warming potential; Industrialization

1 Introduction

As a developing region with an increasing demand for large-scale infrastructure expansion, Latin America and the Caribbean (LAC) are likely to experience an increasing demand for cement and concrete. Moreover, suburban and rural housing construction development increases through programs and housing refurnished through informal sectors.

Global warming is an urgent worldwide problem requiring full attention from all sectors. Current scenarios preview impacts on wellbeing to different degrees depending on the actions taken in the present. Also, the effects of natural disasters will bring additional demand for cement and concrete. For a target scenario of a maximum of 1.5 °C (1.5 D) above pre-industrial levels, related global greenhouse emissions must be progressively reduced [1]. The global cement industry is thus on the path toward the challenge of achieving carbon-neutral concrete by 2050 [2]. Such a goal shifts the focus from cement (intermediate product) to concrete (final product). Therefore, policies and new strategies must cover both cement production and use. Strategies for reducing the carbon footprint of the industry should account for human development needs and avoid the intensification of inequalities.

This paper revises the current situation in the LAC cement and concrete industries concerning carbon neutrality. The cement market and standardization in LAC are described, and a discussion is presented on the potential contribution of industrialization and emerging supplementary cementitious materials (SCMs) for achieving goals concerning human development and the limitation of global warming.

2 Latin American market

Approximately 272 cement plants are currently operating in LAC, including 191 integrated plants, 78 grinding mills, and 3 clinker plants. The installed capacity of the integrated plants is 261 Mt of cement and that of the grinding mills is 43 Mt (Figure 1).

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Global warming is an urgent worldwide problem requiring full attention from all sectors. Current scenarios preview impacts on wellbeing to different degrees depending on the actions taken in the present. Also, the effects of natural disasters will bring additional demand for cement and concrete. For a target scenario of a maximum of 1.5 °C (1.5 D) above pre-industrial levels, related global greenhouse emissions must be progressively reduced [1]. The global cement industry is thus on the path toward the challenge of achieving carbon-neutral concrete by 2050 [2]. Such a goal shifts the focus from cement (intermediate product) to concrete (final product). Therefore, policies and new strategies must cover both cement production and use. Strategies for redu
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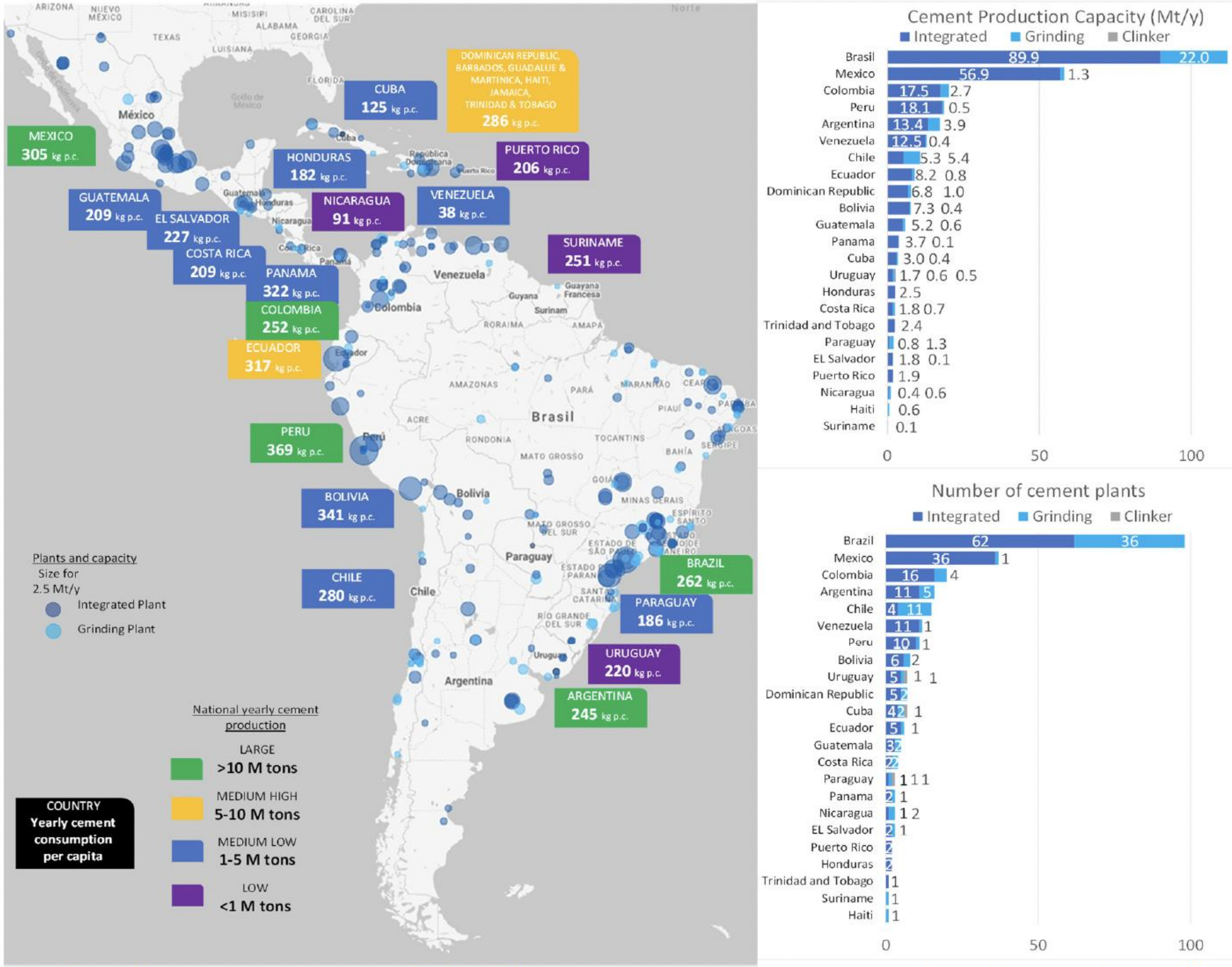

Figure 1. Latin American cement plants (source: FICEM, 2019), yearly cement consumption per capita and national cement production [3].

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Approximately 272 cement plants are curr LAC, including 191 integrated plants, 78 gri clinker plants. The installed capacity of the is 261 Mt of cement and that of the grind (Figure 1).

*Corresponding authors: Yury Villagrán-Zaccardi, yury.villagranzaccardi@ugent.be

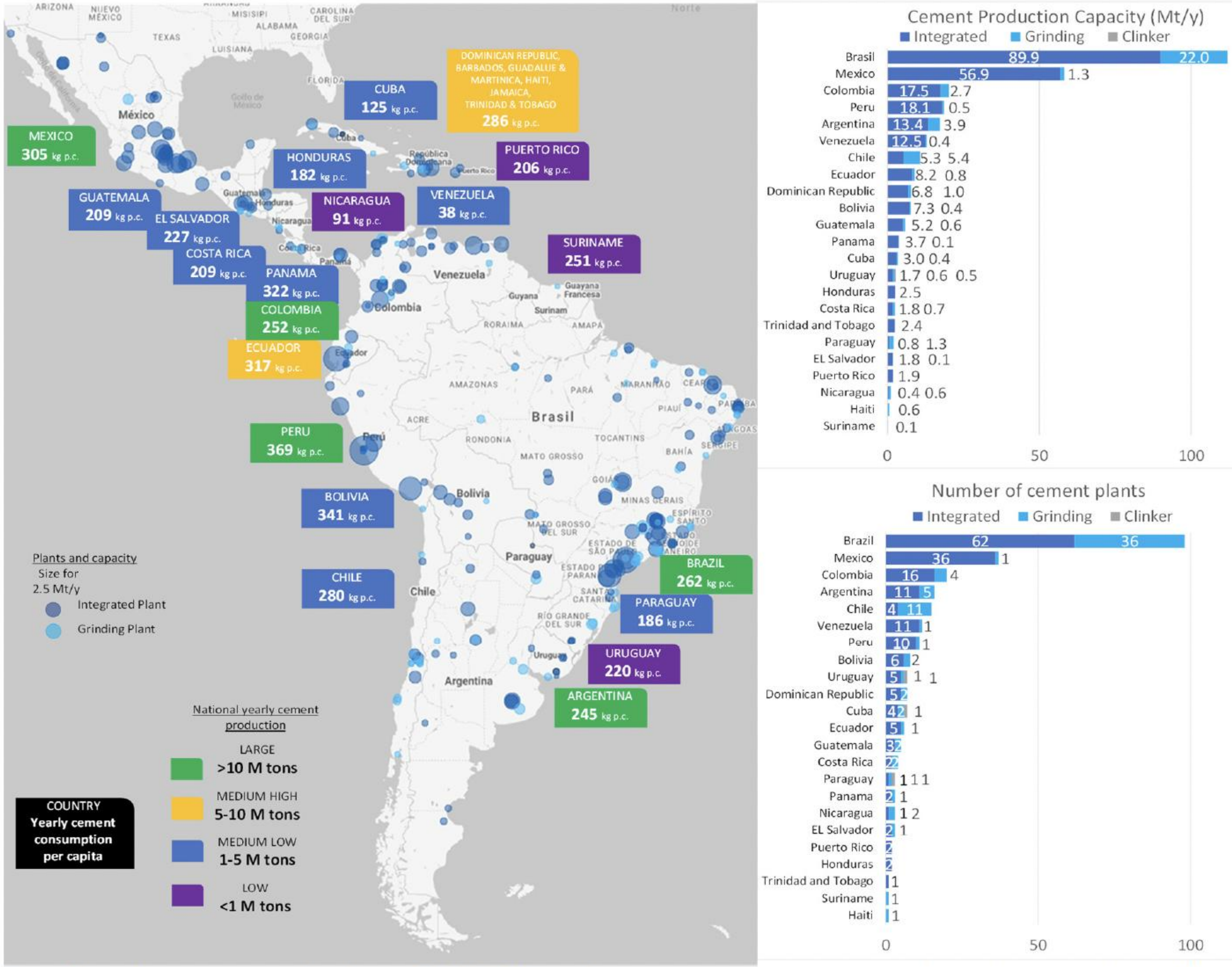

Figure 1. Latin American cement plants (source: FICEM, 2019), yearly cement consumption per capita and national cement production [3].

RILEM Technical Letters (2022) 7: 30-46
https://doi.org/10.21809/rilemtechlett.2022.155

Overview of cement and concrete producti… Caribbean with a focus on the goals of reac…

Yury Villagrán-Zaccardi[1,2]*, Ricardo Pareja[3], Lina Rojas[3], Edgardo…
Jorge Tobón[6], Vanderley M. John[7]

[1] Magnel-Vandepitte Laboratory for Structural Engineering and Construction Materials,…
[2] CCT-La Plata, CONICET, 1900 La Plata, Argentina
[3] Inter American Federation of Cement (FICEM), 110111 Bogotá, Colombia
[4] Facultad de Ingeniería, Centro de Investigaciones en Física e Ingeniería del Centro de… CONICET), B7400JWI Olavarría, Argentina
[5] Tecnológico de Monterrey, School of Engineering and Science, 76130 Querétaro, Que…
[6] Cement and Building Materials Research Group, Departamento de Materiales y Mine… Colombia, 050034 Medellín, Colombia
[7] Escola Politécnica da Universidade de São Paulo, 05508-010 São Paulo, Brazil

Received: 25 January 2022 / Accepted: 20 July 2022 / Published online: 15 August 2022

Abstract

Carbon neutrality to limit global warming is an increasing challenge for all industries, particula… the process. For decades, reducing the clinker factor has been one of the main strategies to r… content of cements seem possible with the upsurge of novel supplementary cementitious ma… of the required carbon reductions for achieving the goal of carbon neutrality in the coming… cement industry in Latin America and the Caribbean and the global opportunities and strate… and their adaptation to the regional conditions. Besides describing emerging supplement… industrialization and quality control are discussed. Moreover, limitations related to geograph… are made given the specific prospects of human development.

Keywords: Low carbon cement; Supplementary cementitious materials; Cement production;…

1 Introduction

As a developing region with an increasing demand for large-scale infrastructure expansion, Latin America and the Caribbean (LAC) are likely to experience an increasing demand for cement and concrete. Moreover, suburban and rural housing construction development increases through programs and housing refurnished through informal sectors.

Global warming is an urgent worldwide problem requiring full attention from all sectors. Current scenarios preview impacts on wellbeing to different degrees depending on the actions taken in the present. Also, the effects of natural disasters will bring additional demand for cement and concrete. For a target scenario of a maximum of 1.5 °C (1.5 D) above pre-industrial levels, related global greenhouse emissions must be progressively reduced [1]. The global cement industry is thus on the path toward the challenge of achieving carbon-neutral concrete by 2050 [2]. Such a goal shifts the focus from cement (intermediate product) to concrete (final product). Therefore, policies and new strategies must cover both cement

production… footprint… developme… inequalities…

This paper… concrete in… market an… discussion… industrializ… materials… developme…

2 Latin…

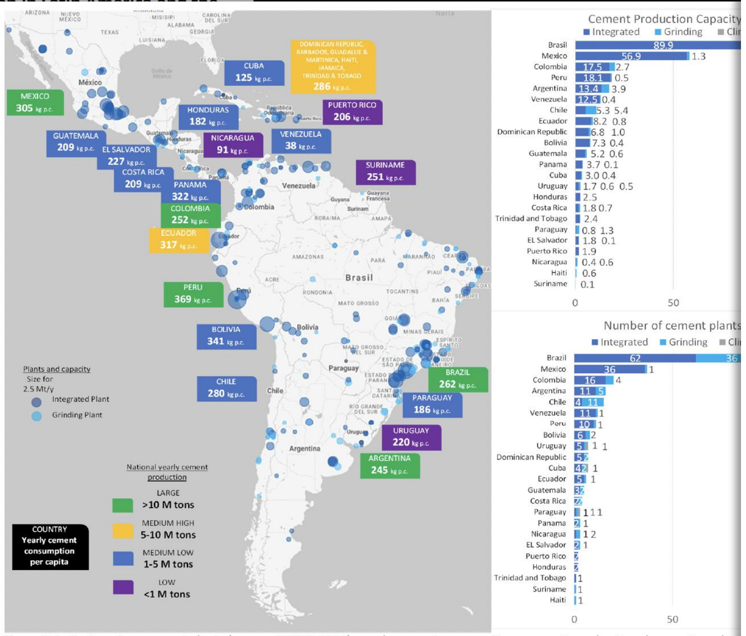

Figure 1. Latin American cement plants (source: FICEM, 2019), yearly cement consumption per capita and national cement product…

Approximately 272 cement plants are currently operating in LAC, including 191 integrated plants, 78 grinding mills, and 3 clinker plants. The installed capacity of the integrated plants is 261 Mt of cement and that of the grinding mills is 43 Mt (Figure 1).

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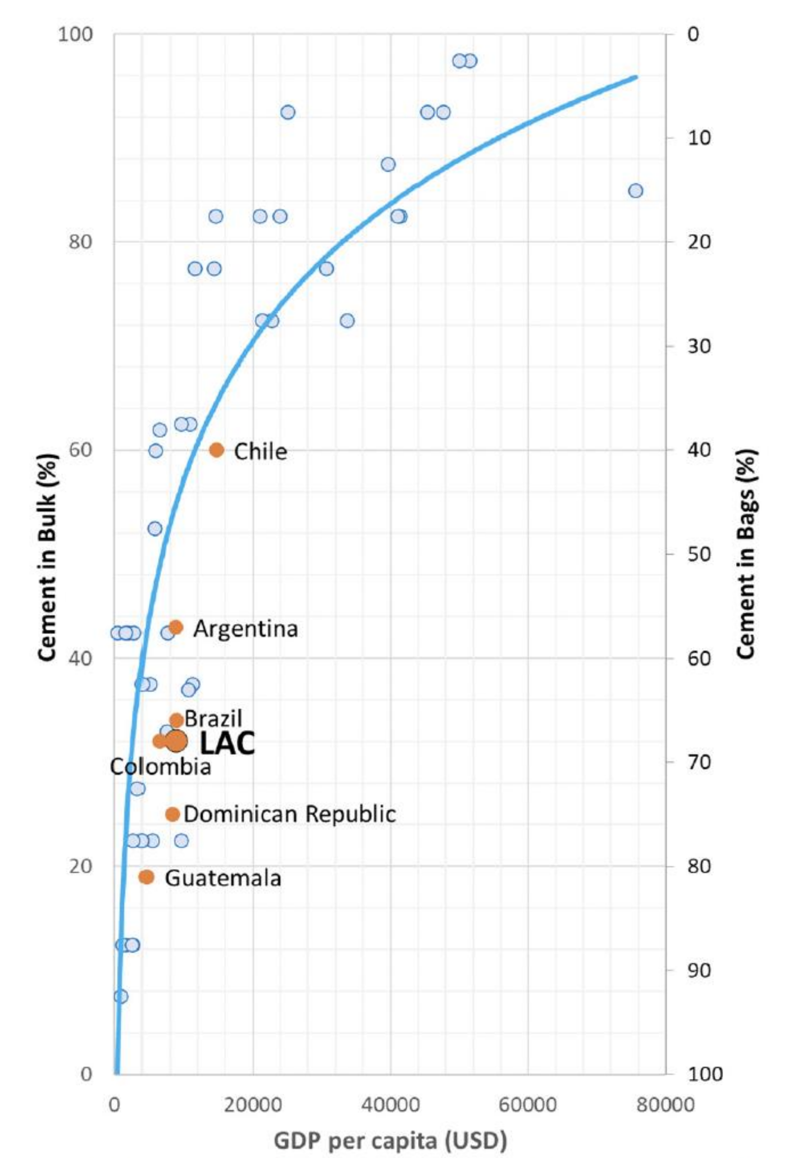

Figure 2. Market share of bagged cement in various regions and key countries with their GDP per capita (adapted from [12]).

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Overview of cement and concrete production in Latin America and the Caribbean with a focus on the goals of reaching carbon n

Yury Villagrán-Zaccardi[1,2]*, Ricardo Pareja[3], Lina Rojas[3], Edgardo Irassar[4], Andrés Torr
Jorge Tobón[6], Vanderley M. John[7]

[1] Magnel-Vandepitte Laboratory for Structural Engineering and Construction Materials, Ghent University, 9000 Gent
[2] CCT-La Plata, CONICET, 1900 La Plata, Argentina
[3] Inter American Federation of Cement (FICEM), 110111 Bogotá, Colombia
[4] Facultad de Ingeniería, Centro de Investigaciones en Física e Ingeniería del Centro de la Provincia de Buenos Aires (
CONICET), B7400JWI Olavarría, Argentina
[5] Tecnológico de Monterrey, School of Engineering and Science, 76130 Querétaro, Queretaro, Mexico
[6] Cement and Building Materials Research Group, Departamento de Materiales y Minerales, Facultad de Minas, Uni
Colombia, 050034 Medellín, Colombia
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Abstract

Carbon neutrality to limit global warming is an increasing challenge for all industries, particularly for the cement industry, du
the process. For decades, reducing the clinker factor has been one of the main strategies to reduce the carbon footprint. Ad
content of cements seem possible with the upsurge of novel supplementary cementitious materials. This potential contribut
of the required carbon reductions for achieving the goal of carbon neutrality in the coming decades. This paper describe
cement industry in Latin America and the Caribbean and the global opportunities and strategies to reduce the carbon foot
and their adaptation to the regional conditions. Besides describing emerging supplementary cementitious materials, th
industrialization and quality control are discussed. Moreover, limitations related to geography and standardization are anal
are made given the specific prospects of human development.

Keywords: Low carbon cement; Supplementary cementitious materials; Cement production; Global warming potential; Indu

1 Introduction

As a developing region with an increasing demand for large-scale infrastructure expansion, Latin America and the Caribbean (LAC) are likely to experience an increasing demand for cement and concrete. Moreover, suburban and rural housing construction development increases through programs and housing refurnished through informal sectors.

Global warming is an urgent worldwide problem requiring full attention from all sectors. Current scenarios preview impacts on wellbeing to different degrees depending on the actions taken in the present. Also, the effects of natural disasters will bring additional demand for cement and concrete. For a target scenario of a maximum of 1.5 °C (1.5 D) above pre-industrial levels, related global greenhouse emissions must be progressively reduced [1]. The global cement industry is thus on the path toward the challenge of achieving carbon-neutral concrete by 2050 [2]. Such a goal shifts the focus from cement (intermediate product) to concrete (final product). Therefore, policies and new strategies must cover both cement production and use. Strategies fo footprint of the industry should development needs and avoid inequalities.

This paper revises the current situatio concrete industries concerning carbo market and standardization in LAC are described, and a discussion is presented on the potential contribution of industrialization and emerging supplementary cementitious materials (SCMs) for achieving goals concerning human development and the limitation of global warming.

2 Latin American market

Approximately 272 cement plants are currently operating in LAC, including 191 integrated plants, 78 grinding mills, and 3 clinker plants. The installed capacity of the integrated plants is 261 Mt of cement and that of the grinding mills is 43 Mt (Figure 1).

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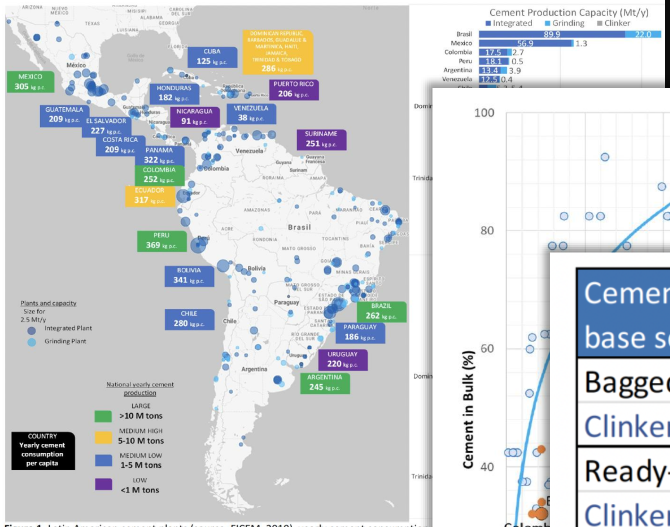


Figure 1. Latin American cement plants (source: FICEM, 2019), yearly cement consumption

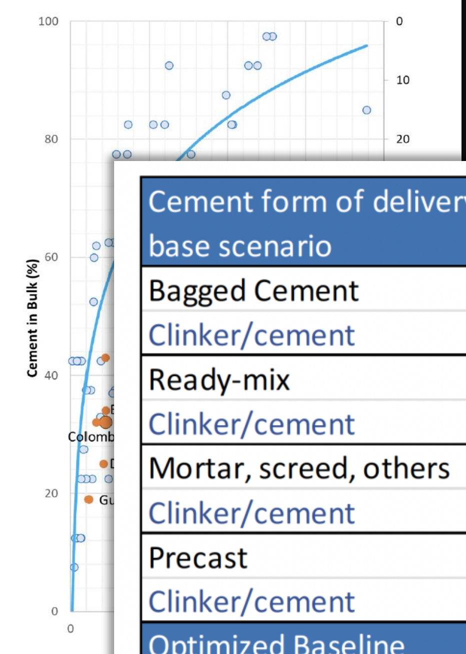
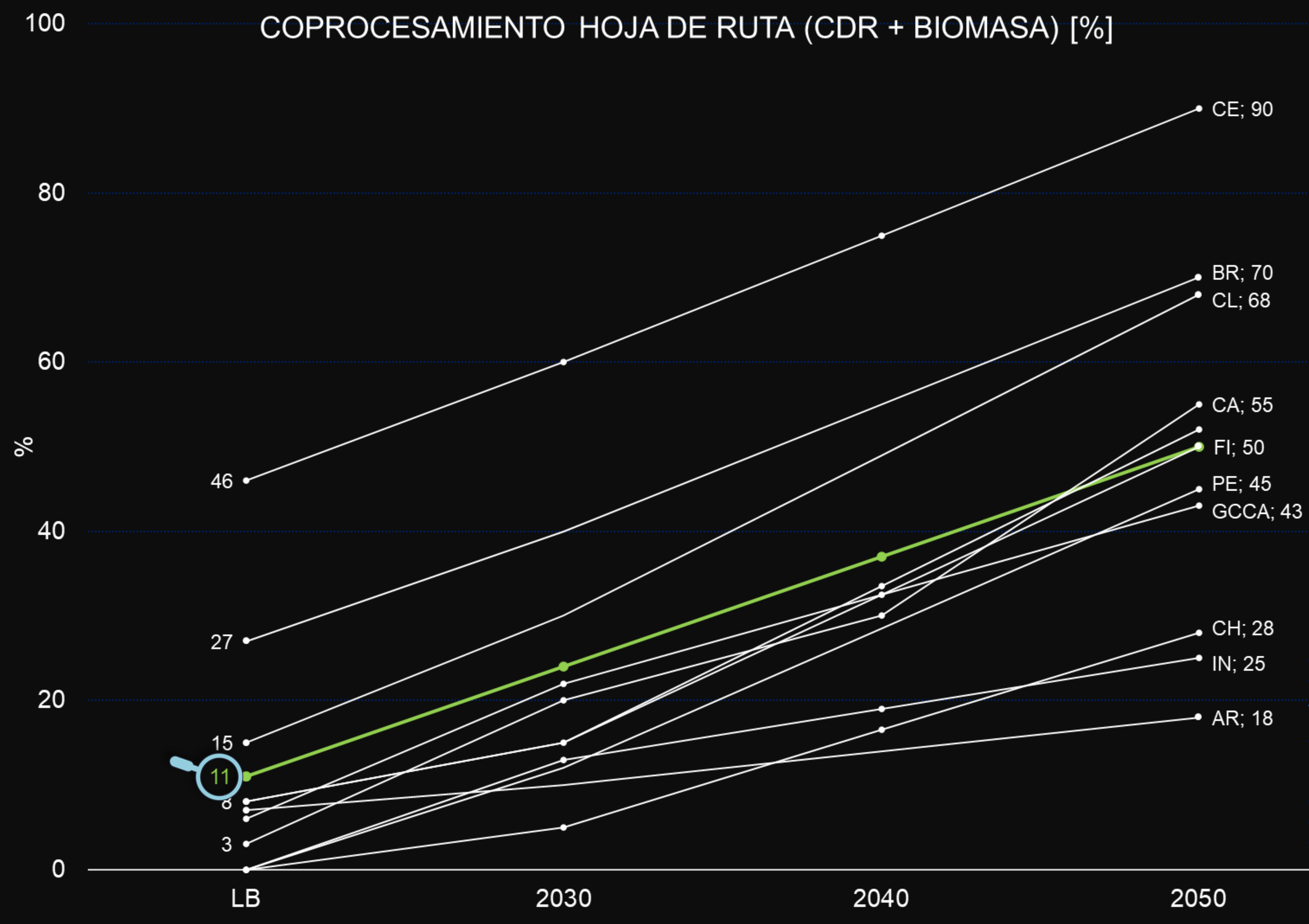


Figure 2. Market
countries with th

Cement form of delivery - base scenario	2020	2030	2050
Bagged Cement	68%	59%	42%
Clinker/cement	60%	45%	40%
Ready-mix	25%	33%	48%
Clinker/cement	83%	72%	65%
Mortar, screed, others	5%	5%	5%
Clinker/cement	60%	45%	40%
Precast	2%	3%	5%
Clinker/cement	90%	85%	85%
Optimized Baseline scenario	**2020**	**2030**	**2050**
Cement (Mt)	196	198	227
Clinker/cement	0.66	0.53	0.51*
Clinker (Mt)	128	105	115
SCMs (Mt)	67	93	111

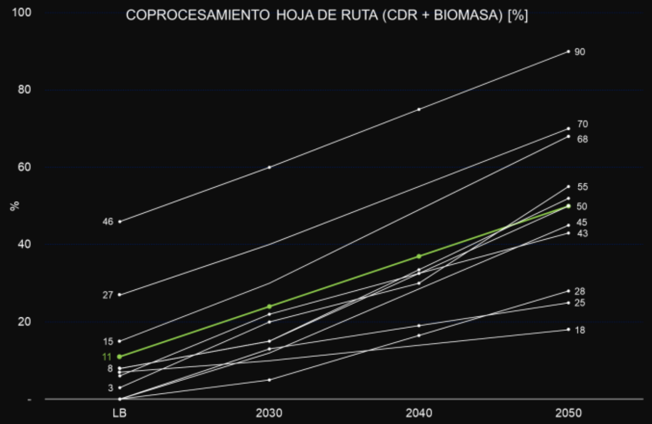
(*) This weighed clinker factor considers the clinker factors for all forms of distribution as well as supplementary cementitious materials used directly in concrete and cementitious mixes as a separate constituent of cement

HRs Net Zero

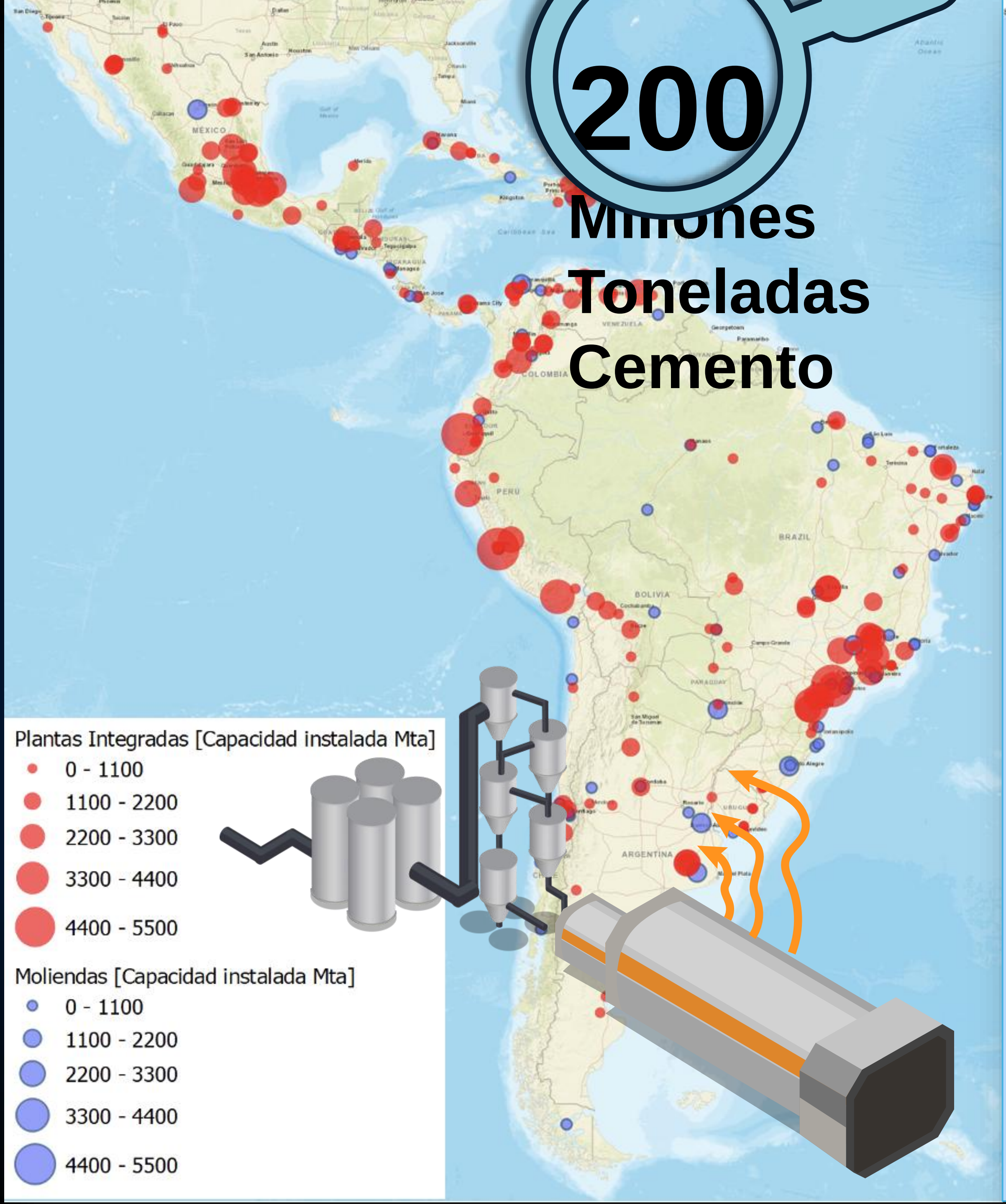


Entidad	LB	2030	2040	2050
FICEM	**11**	**24**	**37**	**50**
PERU	0	12	29	45
COLOMBIA	8	15	33	50
CHILE	15	30	49	68
ARGENTIN	7	10	14	18
BRASIL	27	40	55	70
GCCA	6	22	33	43
USA	8	15	34	52
INDIA	0	13	19	25
CEMBURE	46	60	75	90
CHINA	0	5	17	28
CANADA	3	20	30	55

HRs Net Zero

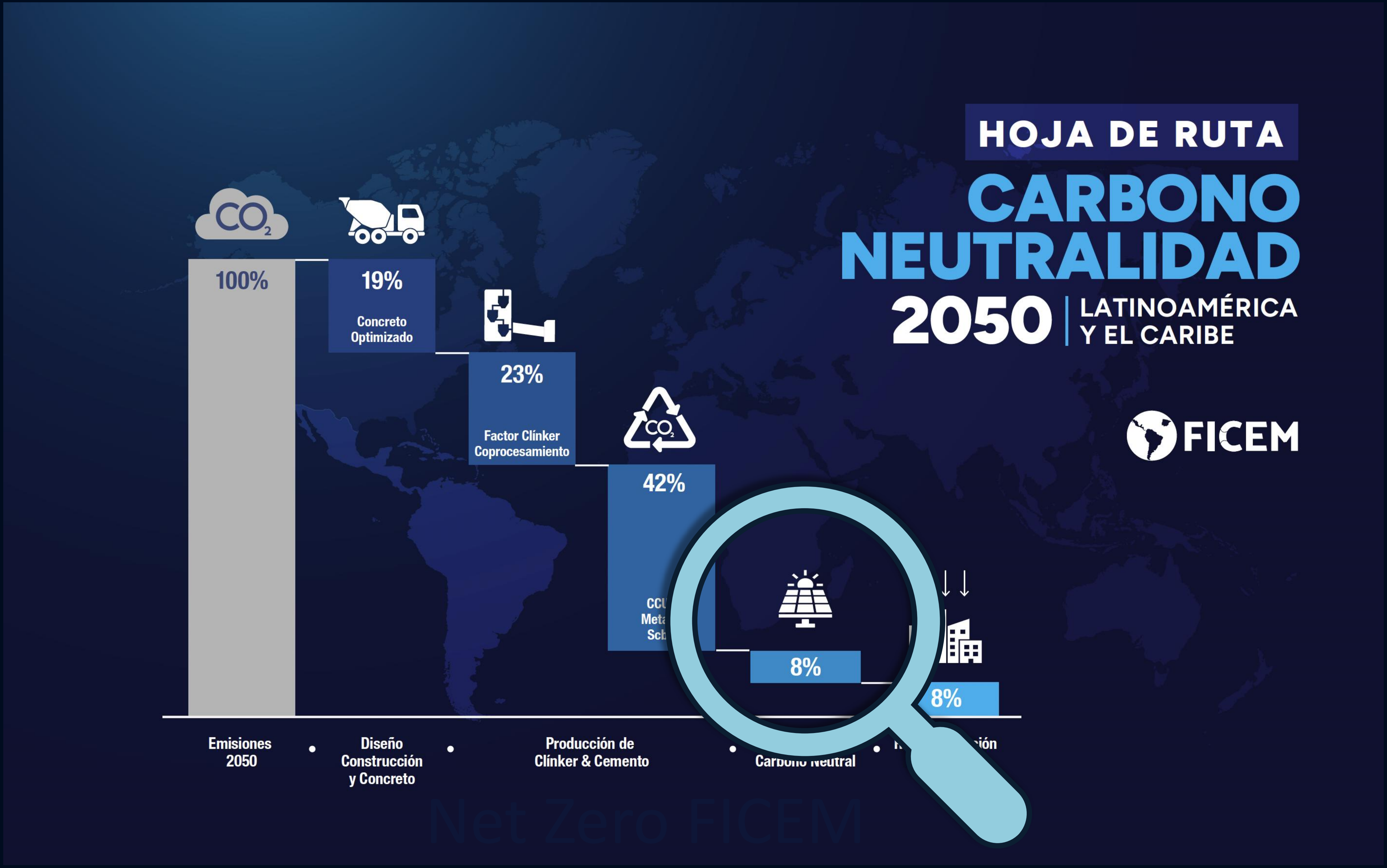


Entidad	2040	2050
FICEM	37	50
PERU	29	45
COLOMBIA	33	50
CHILE	49	68
ARGENTIN.	14	18
BRASIL	55	70
GCCA	33	43
USA	34	52
INDIA	19	25
CEMBUREA	75	90
CHINA	17	28
CANADA	30	55

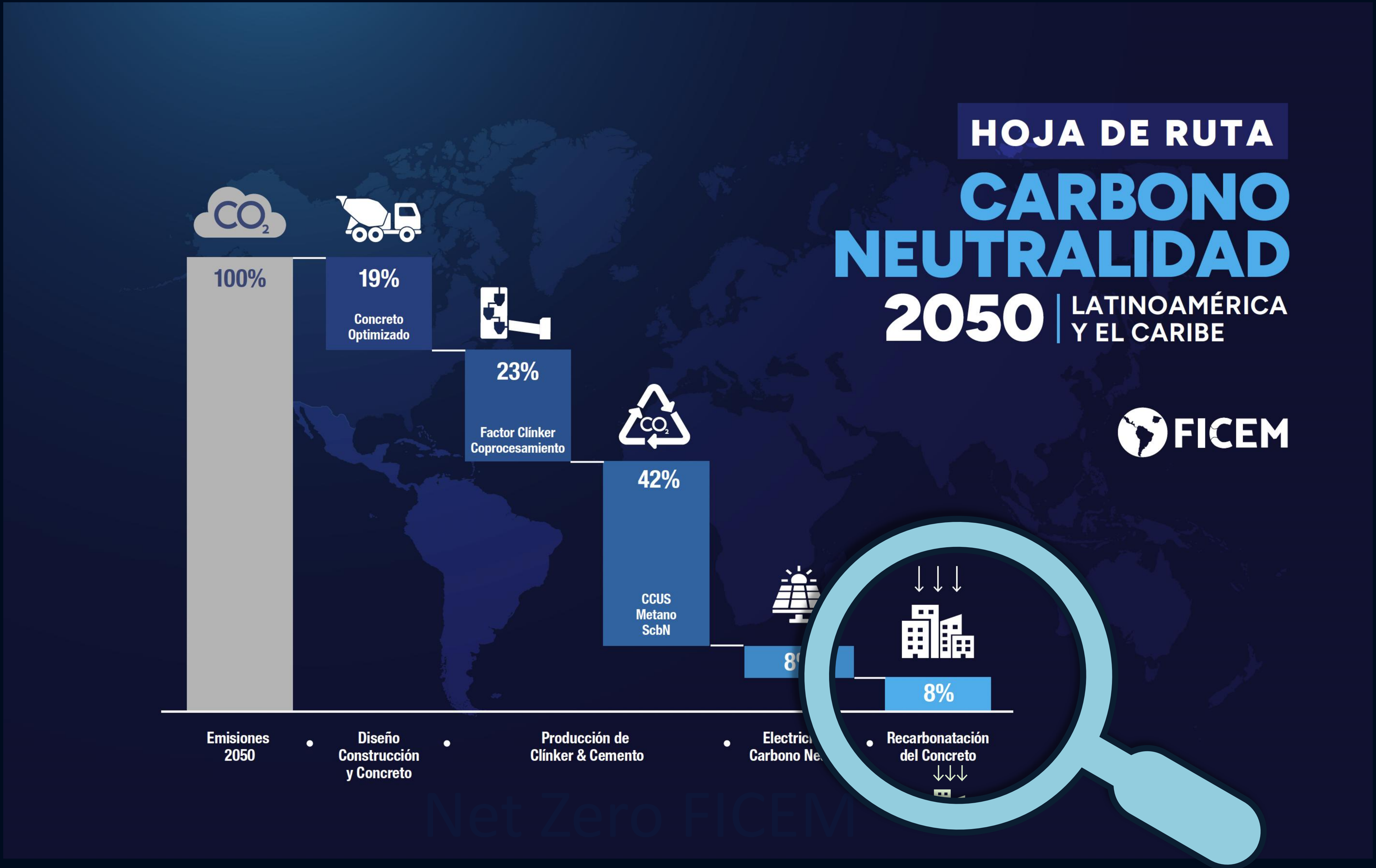


200
Millones Toneladas Cemento

250
Millones Toneladas RSU



HOJA DE RUTA
CARBONO NEUTRALIDAD
2050
LATINOAMÉRICA
Y EL CARIBE
FICEM
CO_2
100%
19%
Concreto
Optimizado
23%
Factor Clínker
Coprocesamiento
CO_2
42%
8%
8%
Emisiones
2050
Diseño
Construcción
y Concreto
Producción de
Clínker & Cemento
Net Zero FICEM


HOJA DE RUTA
CARBONO NEUTRALIDAD
2050
LATINOAMÉRICA Y EL CARIBE
FICEM
100%
Emisiones 2050
19%
Concreto Optimizado
Diseño Construcción y Concreto
23%
Factor Clínker Coprocesamiento
42%
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Producción de Clínker & Cemento
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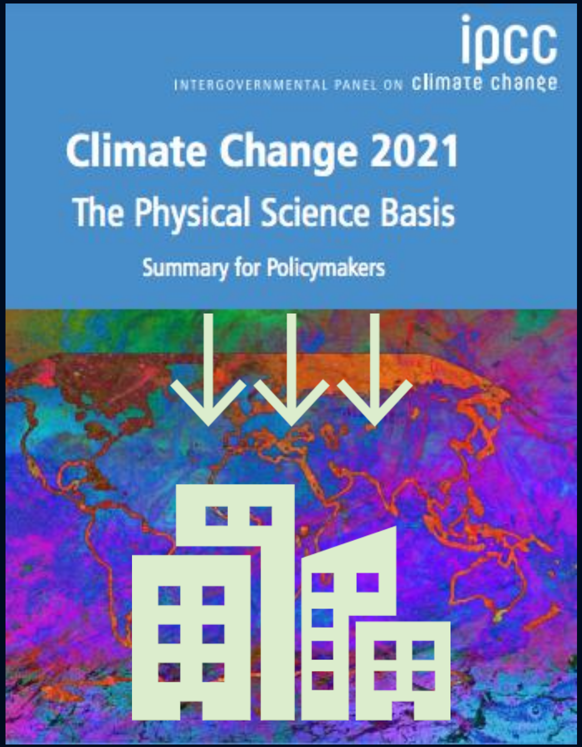
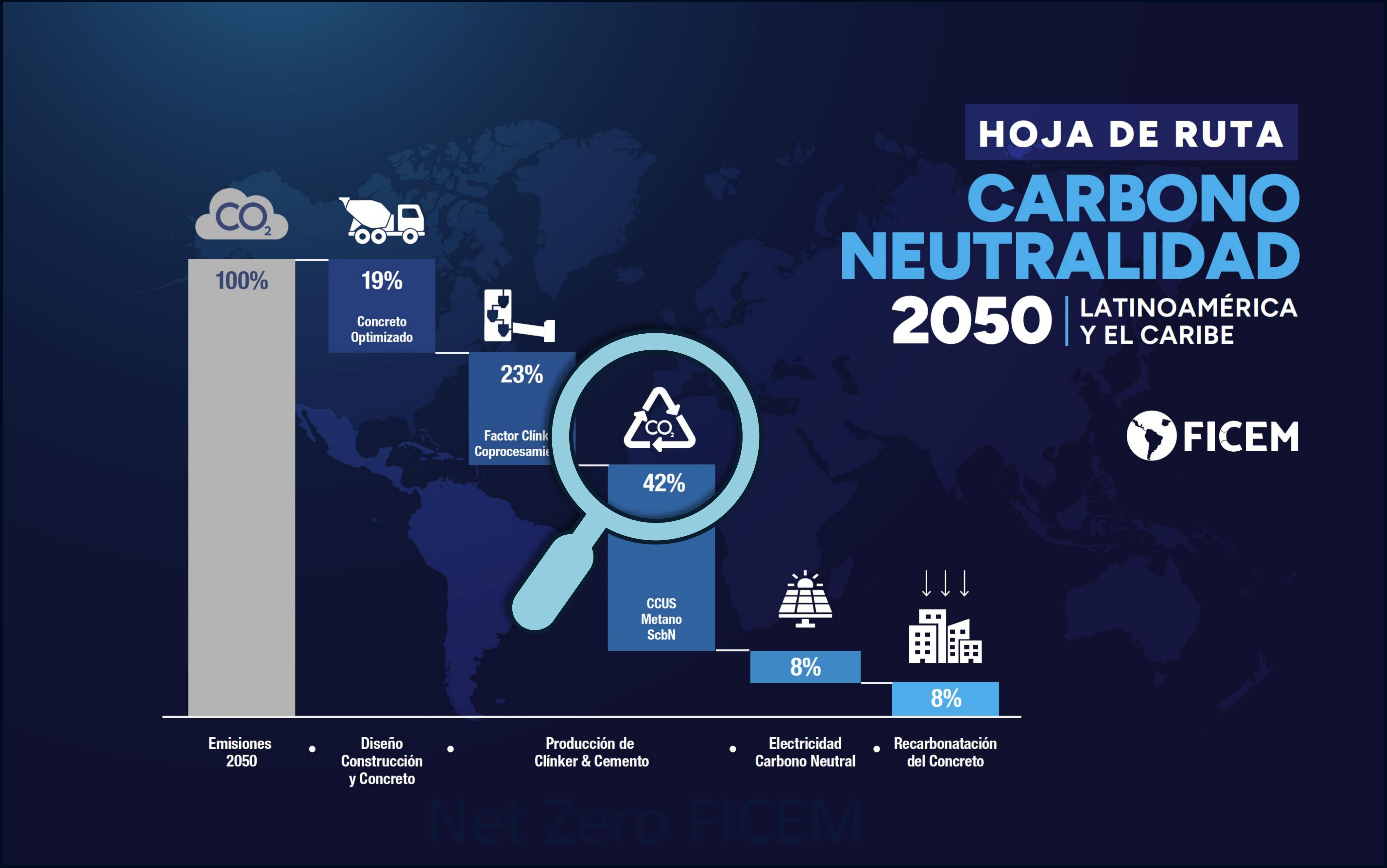
8%
Recarbonatación del Concreto
Net Zero FICEM



PAÍS	CARBONATACIÓN	FUENTE
Corea del Sur	10 %	Yang et al (2014)
España	11 %	Andrade et al (2018)
Japón	14 %	Sawa et al (2024)
EEUU	14 %	AzariJafari et al (2023)
Suiza	15 %	Nygaard et al (2012)
Portugal	15 %	Sanjuán et al (2020)
Irlanda	16 %	Fitzpatrick et al (2015)
Noruega	16 %	Pade et al (2003)
Suecia	18 %	Pade et al (2003)
Estudio IVL	**20 %**	**Cementa AB & IVL (2018)**
Dinamarca	24 %	Pade et al (2003)
Islandia	28 %	Pade et al (2003)
Argentina	29 %	Irassar et al (2022)
Países Bajos	30 %	Vermeulen et al (2017)
Reino Unido	31 %	Capon et al (2023)
China	55%	Huang et al (2020)


HOJA DE RUTA
CARBONO NEUTRALIDAD
2050
LATINOAMÉRICA Y EL CARIBE
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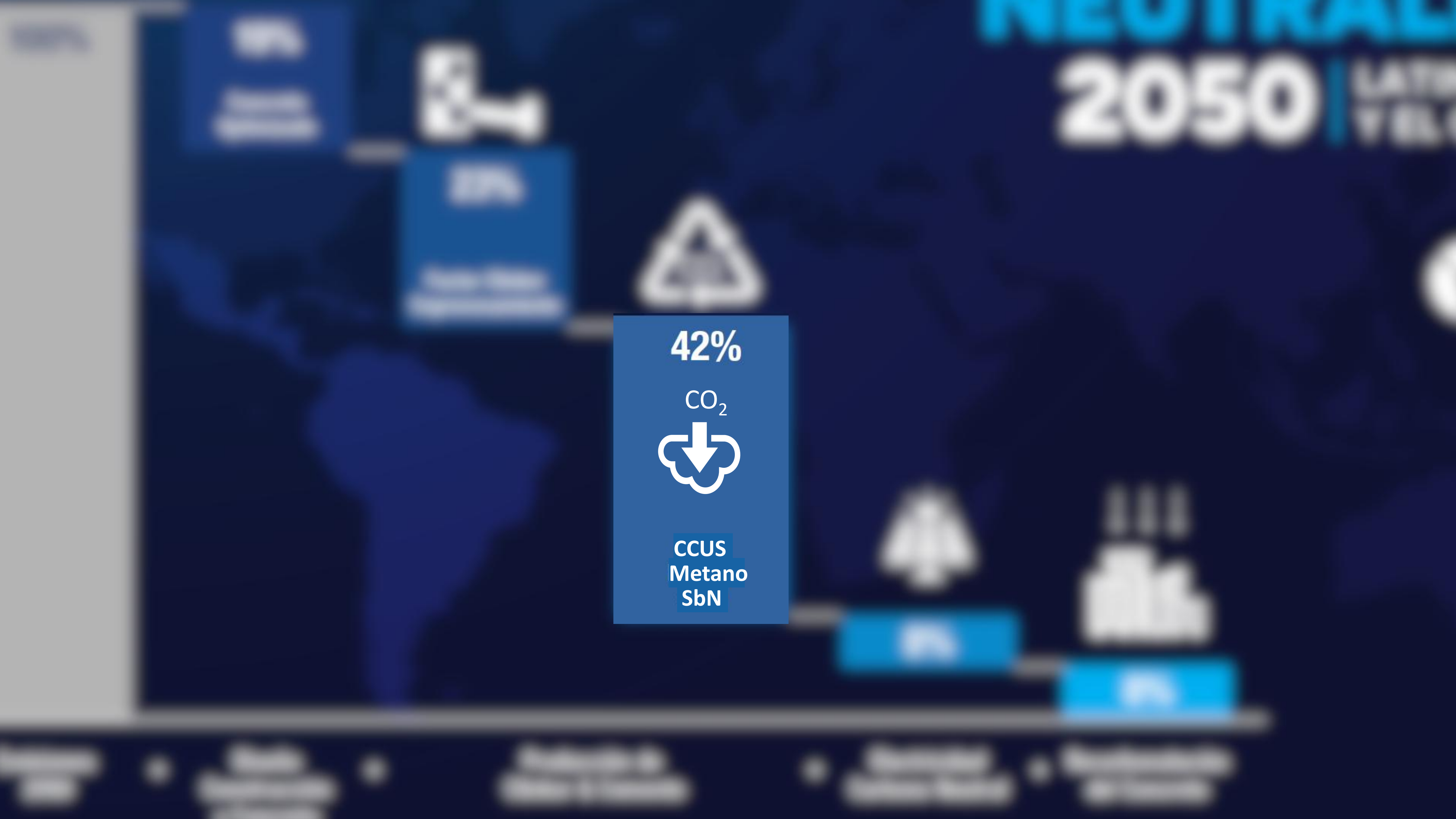
Concreto Optimizado
23%
Factor Clínk
Coprocesamie
CO_2
42%
CCUS
Metano
ScbN
8%
8%
Emisiones 2050
Diseño Construcción y Concreto
Producción de Clínker & Cemento
Electricidad Carbono Neutral
Recarbonatación del Concreto
Net Zero FICEM


2050
42%
CO_2
CCUS
Metano
SbN

CCUS

Remociones CO_2 Tecnológicas

SbN

Remociones CO_2 Biológicas

CCUS Captura Uso & Almacenamiento de CO_2

Mongstad

Northern Lights

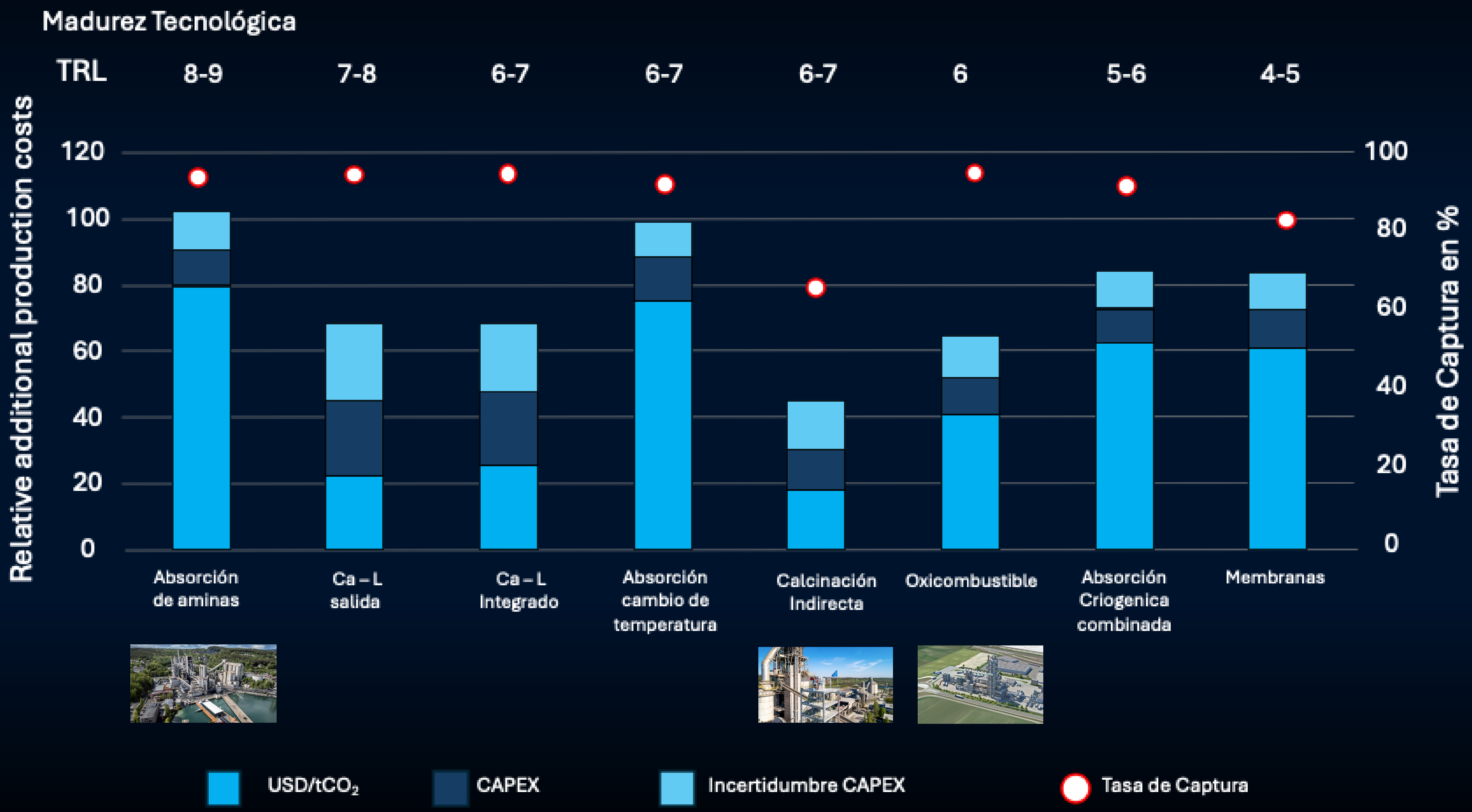
Brevik

Mergelstetten

Leilac

Cartagena

CCUS Captura Uso & Almacenamiento de CO_2



CCUS

Remociones CO_2 Tecnológicas

SbN

Remociones CO_2 Biológicas

SbN Soluciones Basadas en la Naturaleza

Reforestación Nativa

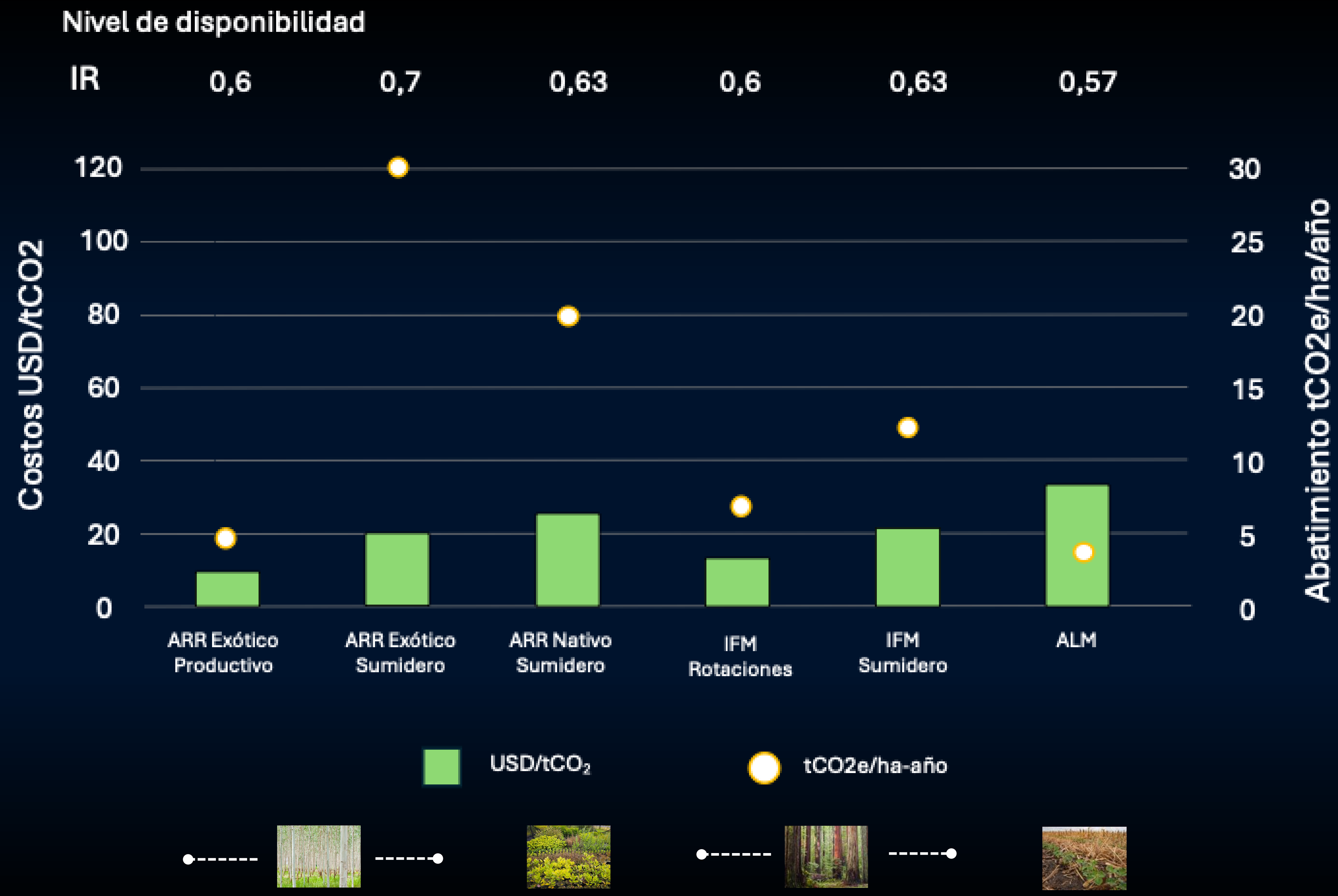
Conservación Bosques & Humedales

Reforestación Exótica

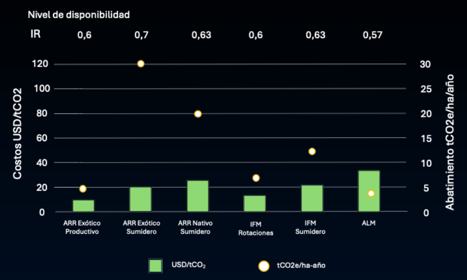
Conservación Manglares

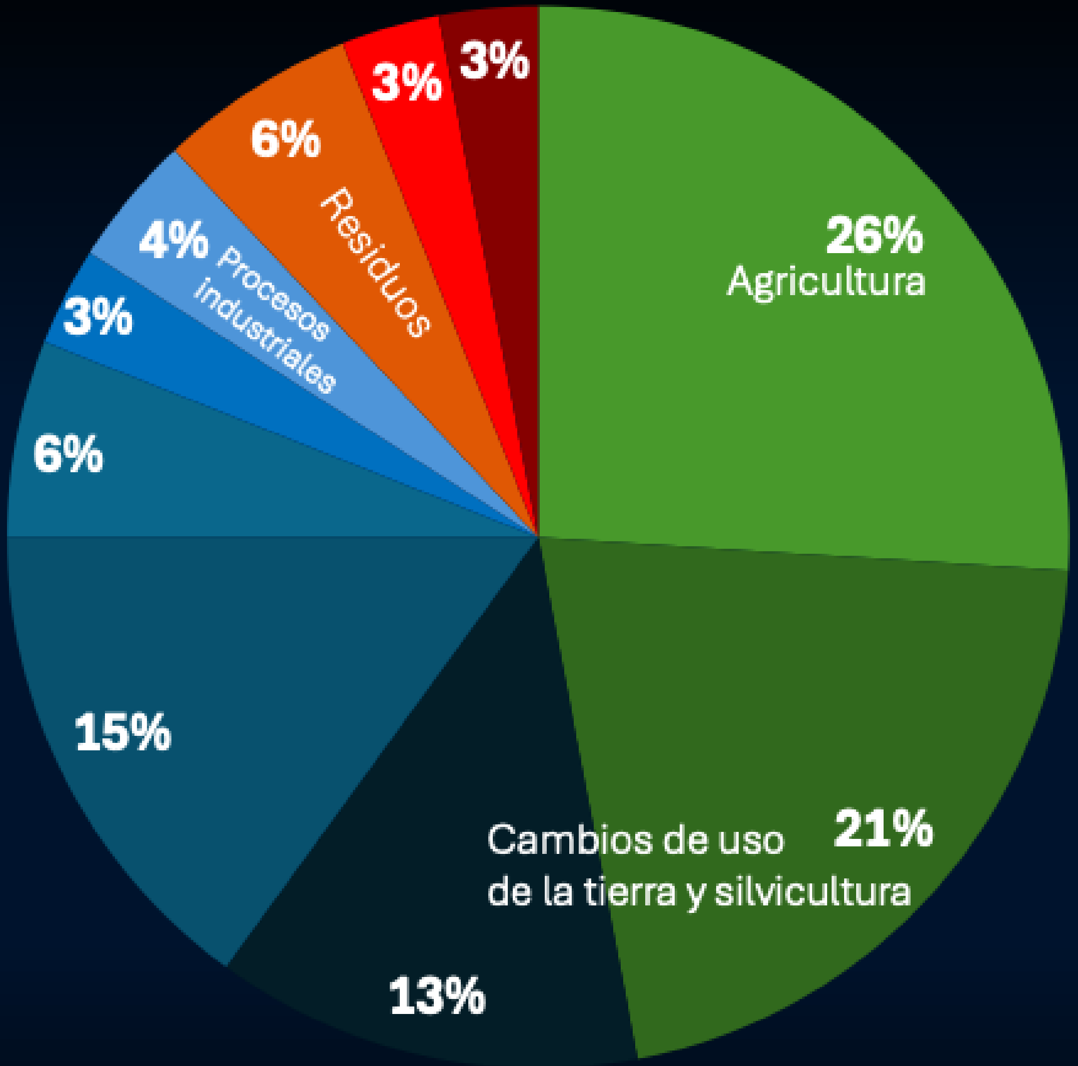
Agricultura Regenerativa

IFM: Manejo Forestal Mejorado

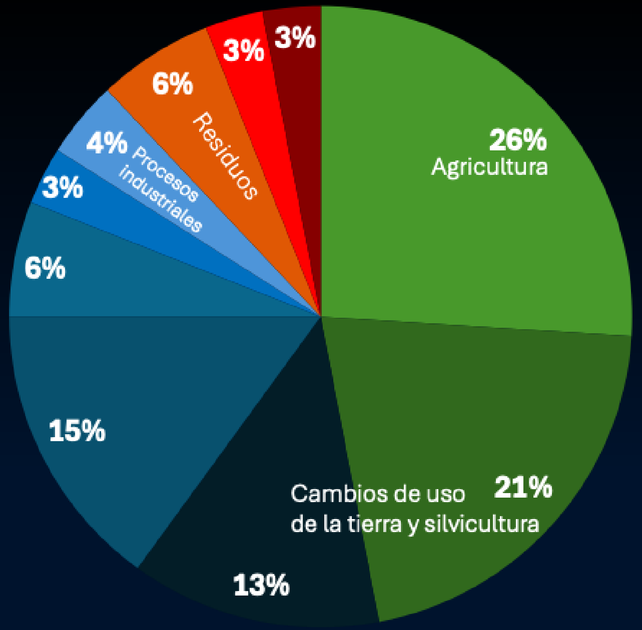


Nivel de disponibilidad
IR
0,6
0,7
0,63
0,6
0,63
0,57
Costos USD/tCO2
120
100
80
60
40
20
0
Abatimiento tCO2e/ha/año
30
25
20
15
10
5
0
ARR Exótico Productivo
ARR Exótico Sumidero
ARR Nativo Sumidero
IFM Rotaciones
IFM Sumidero
ALM
USD/tCO2
tCO2e/ha-año





Emisiones GEI Latinoamérica & el Caribe
Fuente: CAIT/Climate Watch (2020), Washington, DC, Instituto de Recursos Mundiales



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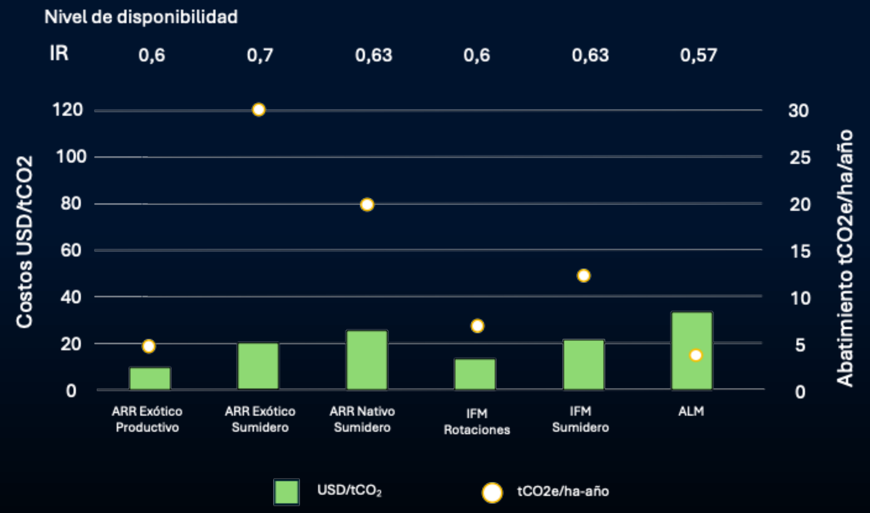
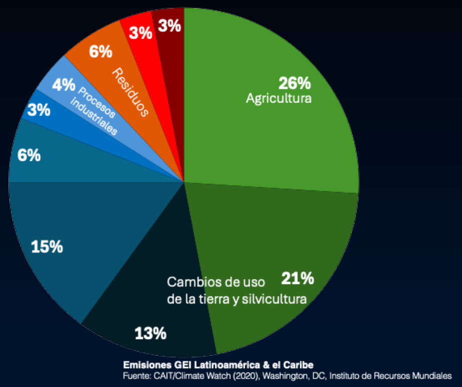


¿Qué implica un 9% de SbN en HR FICEM?

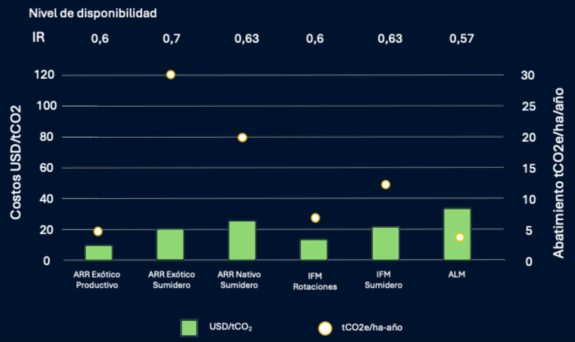


19 Millones tCO_2 equivale el **9%** roadmap FICEM (BAU/2050)

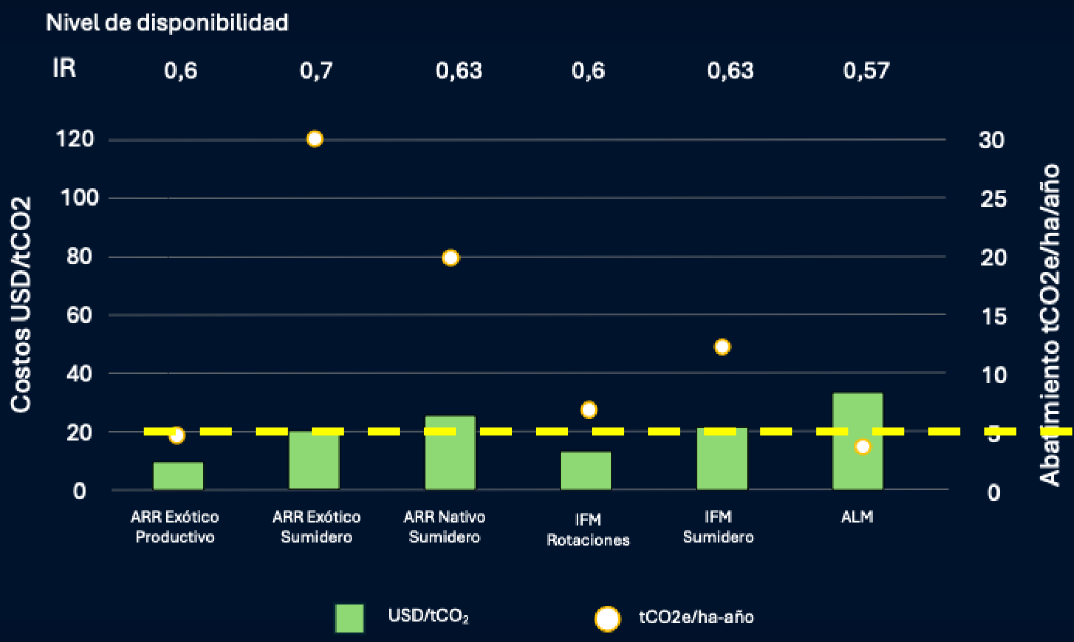
700K hectáreas aprox reforestación para este **9%**

2,7 Millones ha/año desforestadas

3 meses de deforestación LAC



SbN



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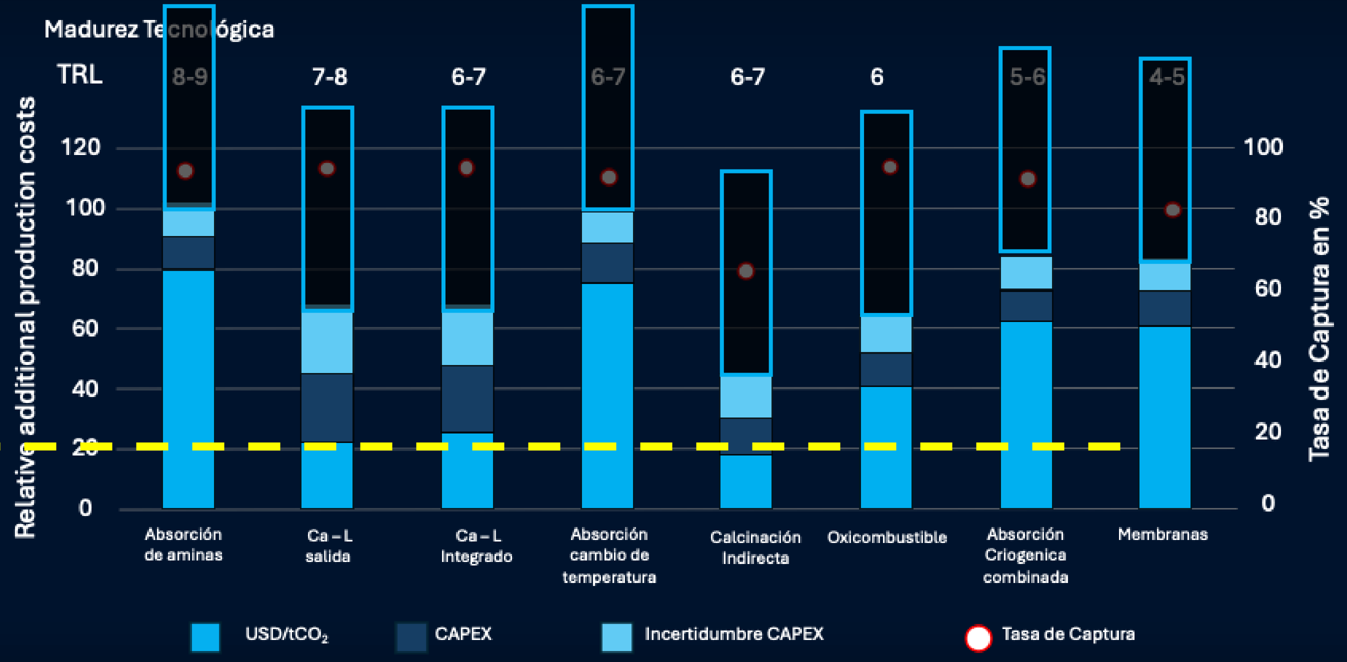

\+ costos de transporte y almacenamiento


LIBRO DE REGLAS
IMPLEMENTACION DE PROYECTOS ELEGIBLES DE REDUCCION DE EMISIONES DE GEI A PARTIR DE
SOLUCIONES BASADAS EN LA NATURALEZA
FICEM | FEDERACION INTERAMERICANA DEL CEMENTO Y EL CONCRETO
Coordinación: Aldo Cerda y Ricardo Pareja
Revisión Club Climático SbN
Primera Versión: Diciembre 2025


Nivel de disponibilidad
IR
0,6
0,7
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120
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Abatimiento tCO2e/ha/año
30
25
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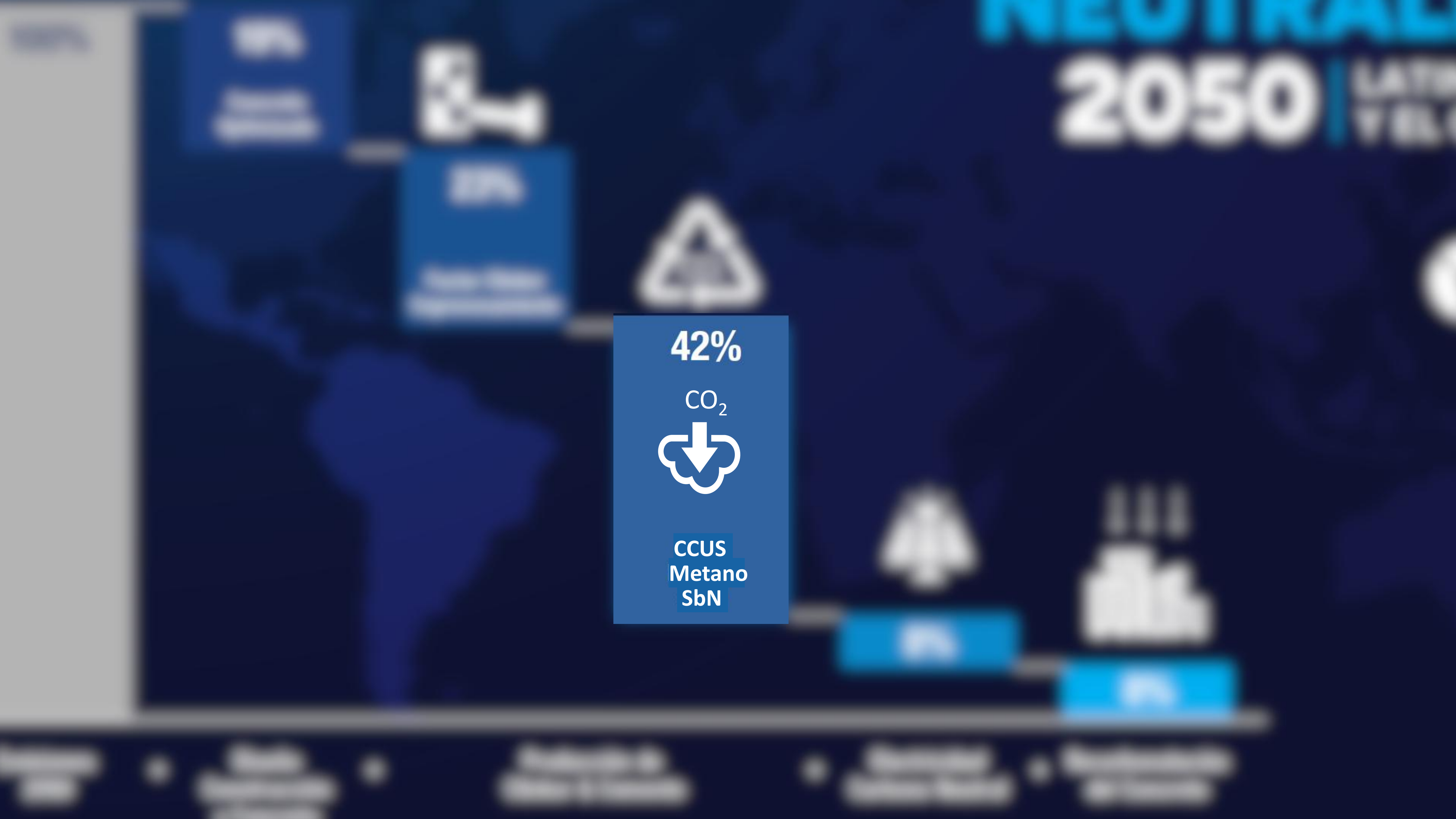
15
10
5
0
ARR Exótico Productivo
ARR Exótico Sumidero
ARR Nativo Sumidero
IFM Rotaciones
IFM Sumidero
ALM
USD/tCO2
tCO2e/ha-año


2050
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CO_2
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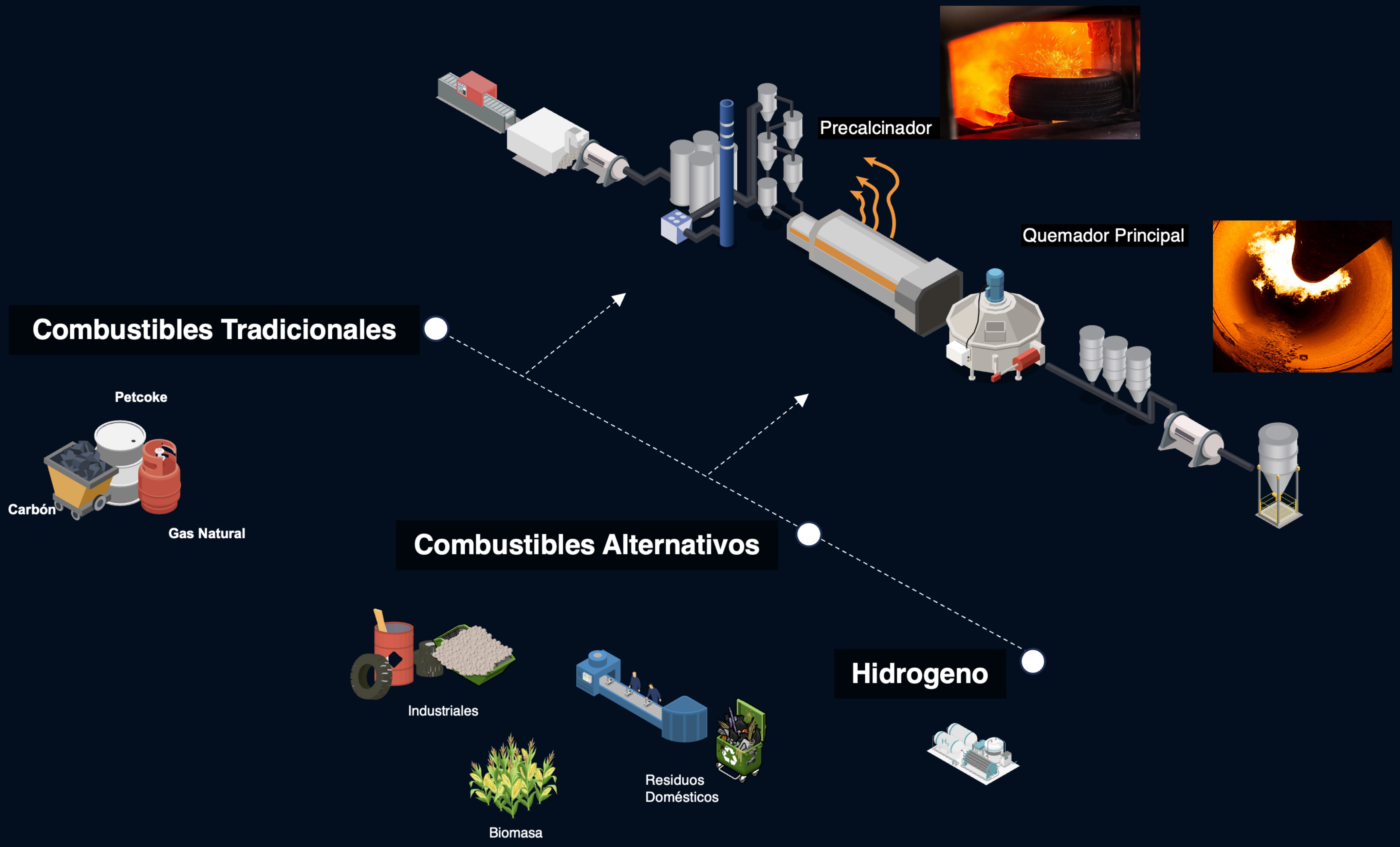
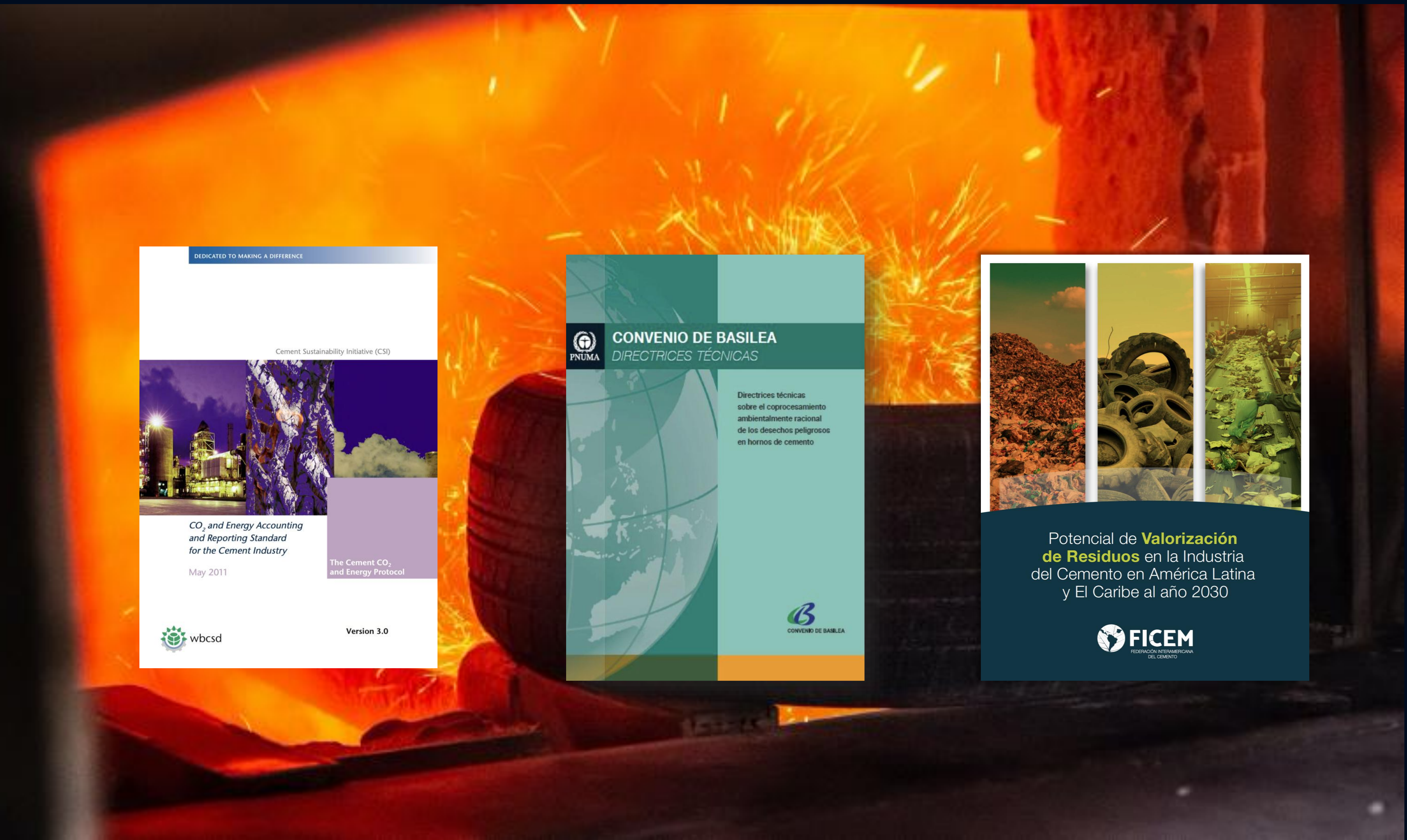
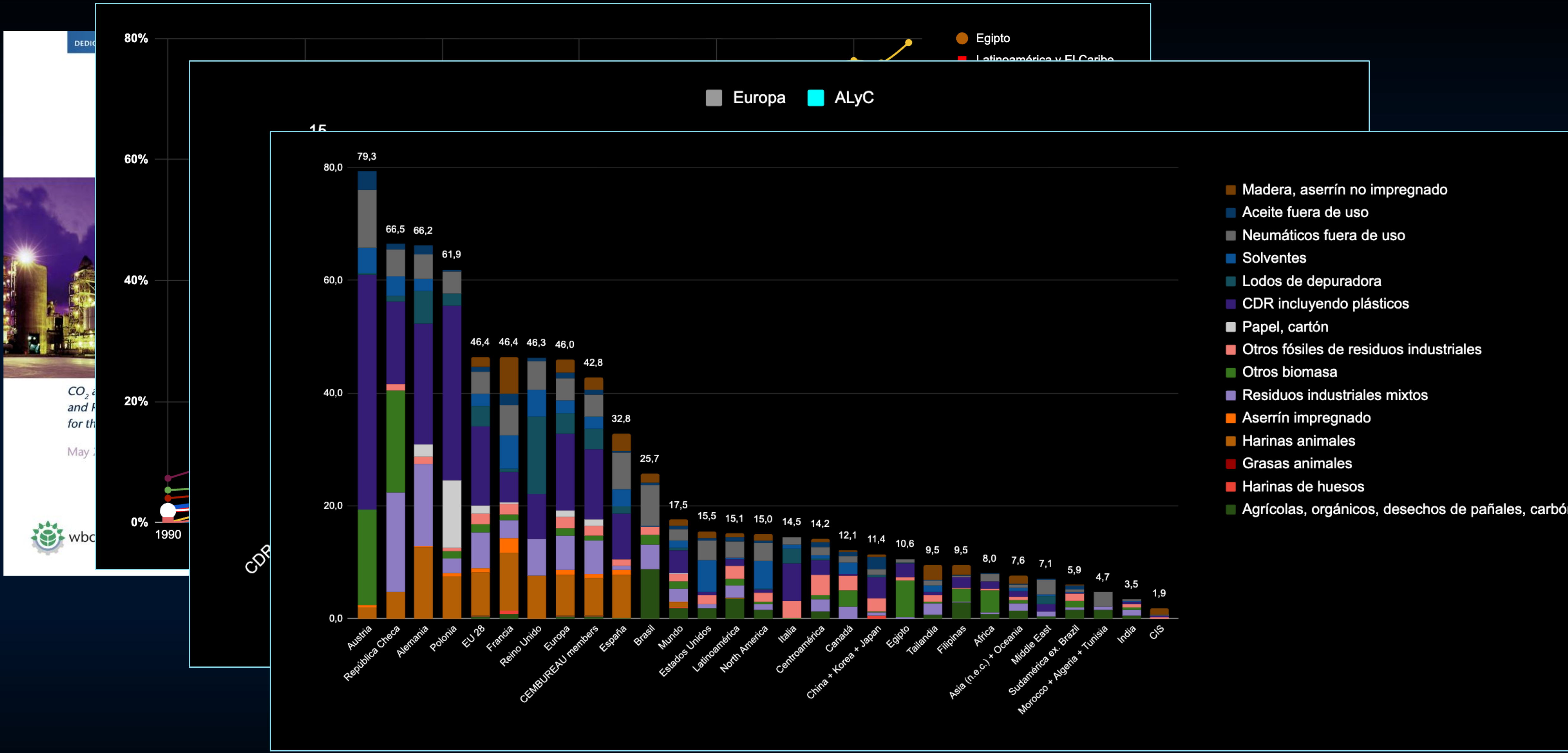
Metano
SbN

Metano Evitado

por el Coprocesamiento


Precalcinador
Quemador Principal
Combustibles Tradicionales
Petcoke
Carbón
Gas Natural
Combustibles Alternativos
Industriales
Residuos
Domésticos
Biomasa
Hidrogeno


DEDICATED TO MAKING A DIFFERENCE
Cement Sustainability Initiative (CSI)
CO2 and Energy Accounting and Reporting Standard for the Cement Industry
May 2011
The Cement CO2 and Energy Protocol
wbcsd
Version 3.0
PNUMA
CONVENIO DE BASILEA
DIRECTRICES TÉCNICAS
Directrices técnicas sobre el coprocesamiento ambientalmente racional de los desechos peligrosos en hornos de cemento
CONVENIO DE BASILEA
Potencial de Valorización de Residuos en la Industria del Cemento en América Latina y El Caribe al año 2030
FICEM
FEDERACIÓN INTERAMERICANA DEL CEMENTO


80%
60%
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0%
1990
Egipto
Europa
ALyC
80,0
60,0
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0,0
79,3
66,5
66,2
61,9
46,4
46,4
46,3
46,0
42,8
32,8
25,7
17,5
15,5
15,1
15,0
14,5
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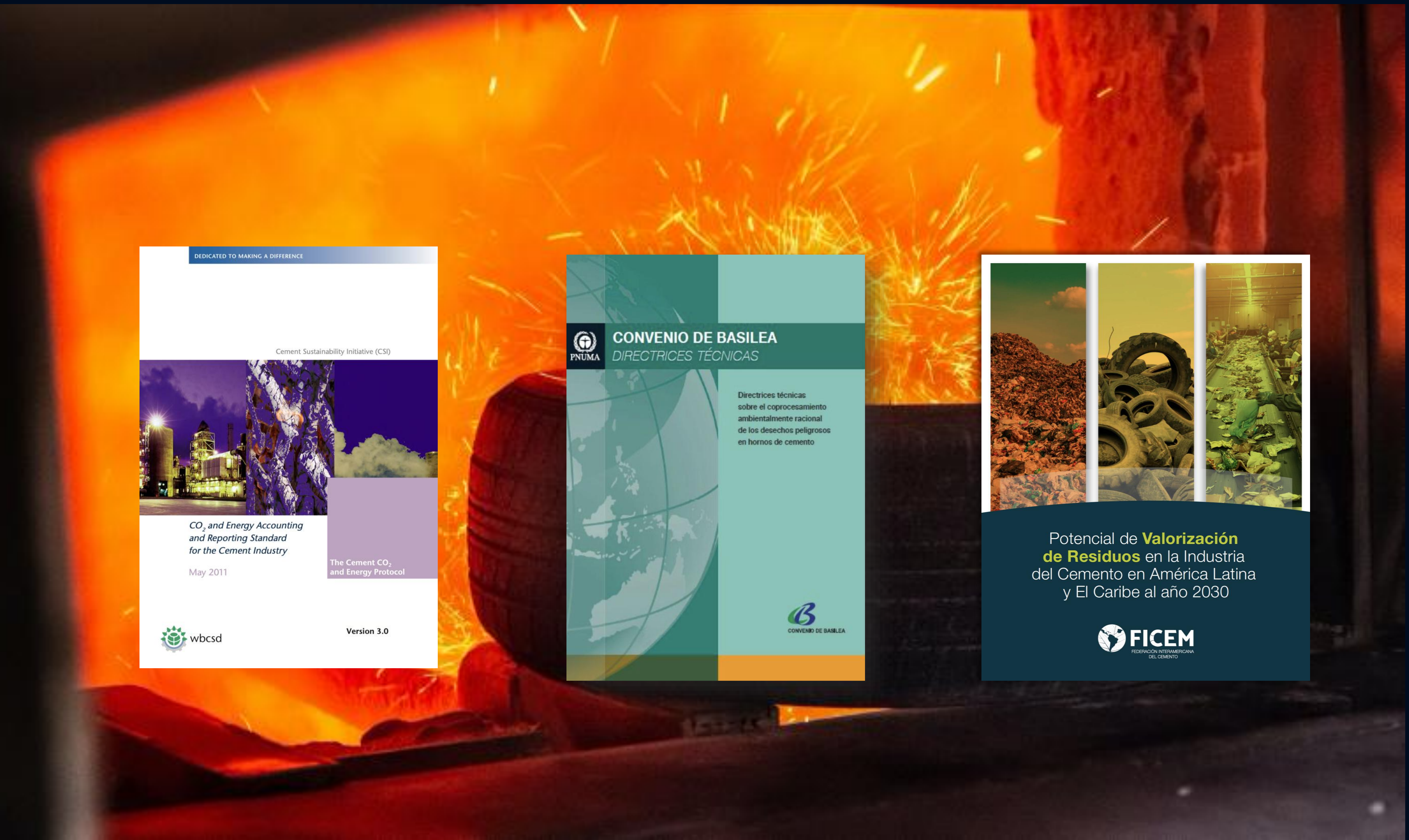
12,1
11,4
10,6
9,5
9,5
8,0
7,6
7,1
5,9
4,7
3,5
1,9
Austria
República Checa
Alemania
Polonia
EU 28
Francia
Reino Unido
Europa
CEMBUREAU members
España
Brasil
Mundo
Estados Unidos
Latinoamérica
North America
Italia
Centroamérica
Canadá
China + Korea + Japan
Egipto
Tailandia
Filipinas
Africa
Asia (n.e.c.) + Oceania
Middle East
Sudamérica ex. Brazil
Morocco + Algeria + Tunisia
India
CIS
Madera, aserrín no impregnado
Aceite fuera de uso
Neumáticos fuera de uso
Solventes
Lodos de depuradora
CDR incluyendo plásticos
Papel, cartón
Otros fósiles de residuos industriales
Otros biomasa
Residuos industriales mixtos
Aserrín impregnado
Harinas animales
Grasas animales
Harinas de huesos
Agrícolas, orgánicos, desechos de pañales, carbó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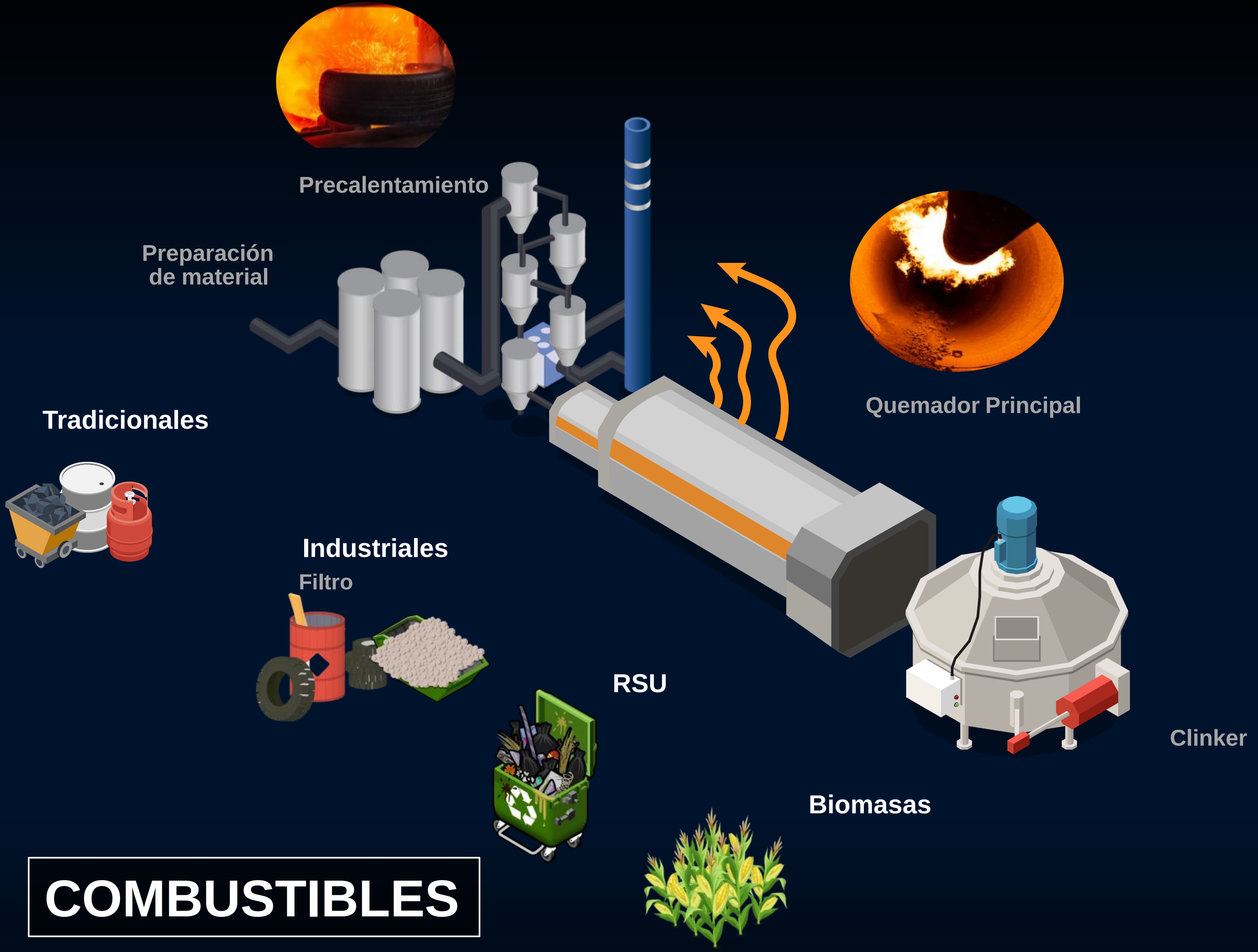
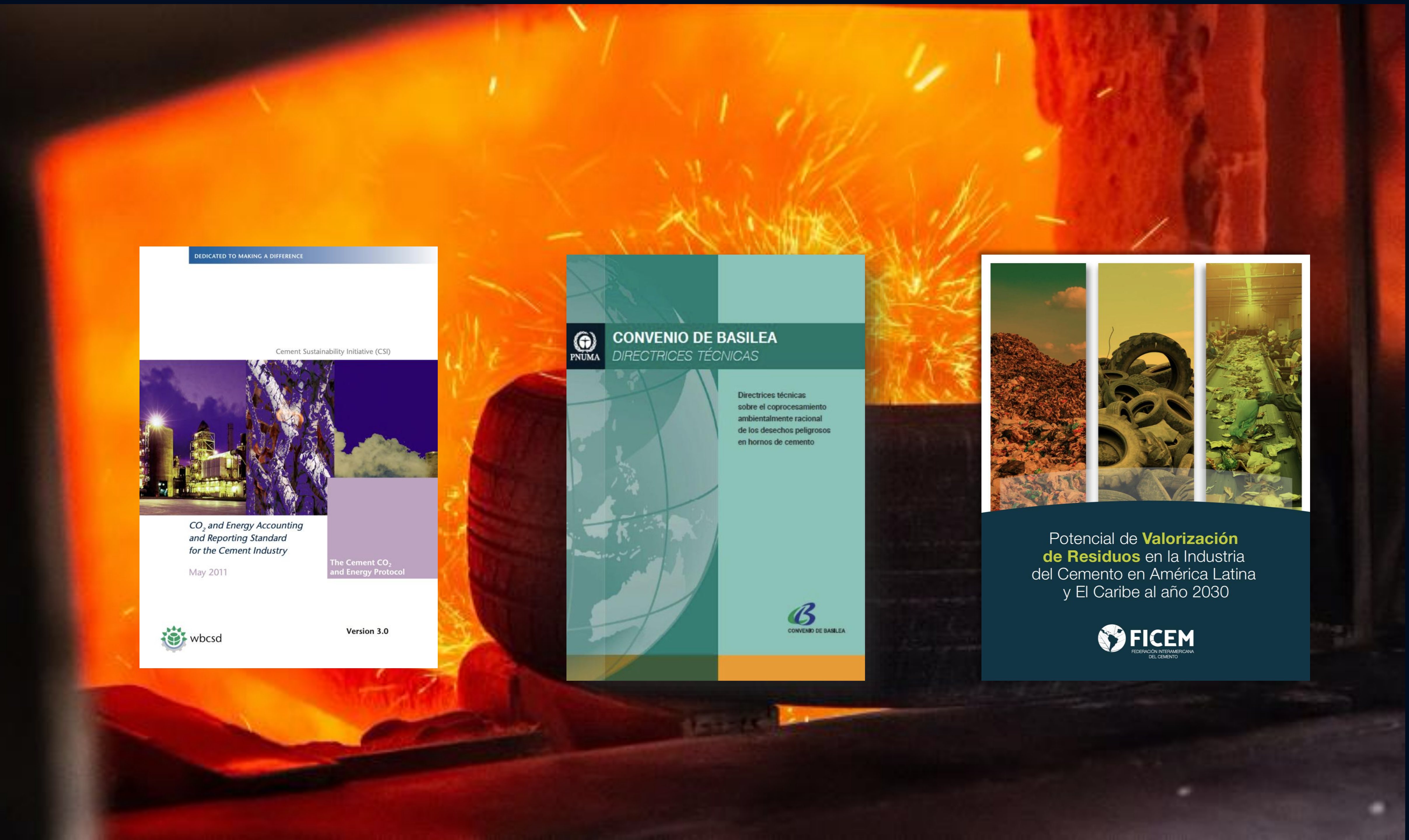
CONVENIO DE BASILEA
Potencial de Valorización de Residuos en la Industria del Cemento en América Latina y El Caribe al año 2030
FICEM
FEDERACIÓN INTERAMERICANA DEL CEMENTO


PNUMA
CONVENIO DE BASILEA
DIRECTRICES TÉCNICAS
Directrices técnicas sobre el coprocesamiento ambientalmente racional de los desechos peligrosos en hornos de cemento
CONVENIO DE BASILEA


Precalentamiento
Preparación de material
Quemador Principal
Tradicionales
Industriales
Filtro
RSU
Clinker
Biomasas
COMBUSTIBLES


DEDICATED TO MAKING A DIFFERENCE
Cement Sustainability Initiative (CSI)
CO2 and Energy Accounting and Reporting Standard for the Cement Industry
May 2011
The Cement CO2 and Energy Protocol
wbcsd
Version 3.0
PNUMA
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CONVENIO DE BASILEA
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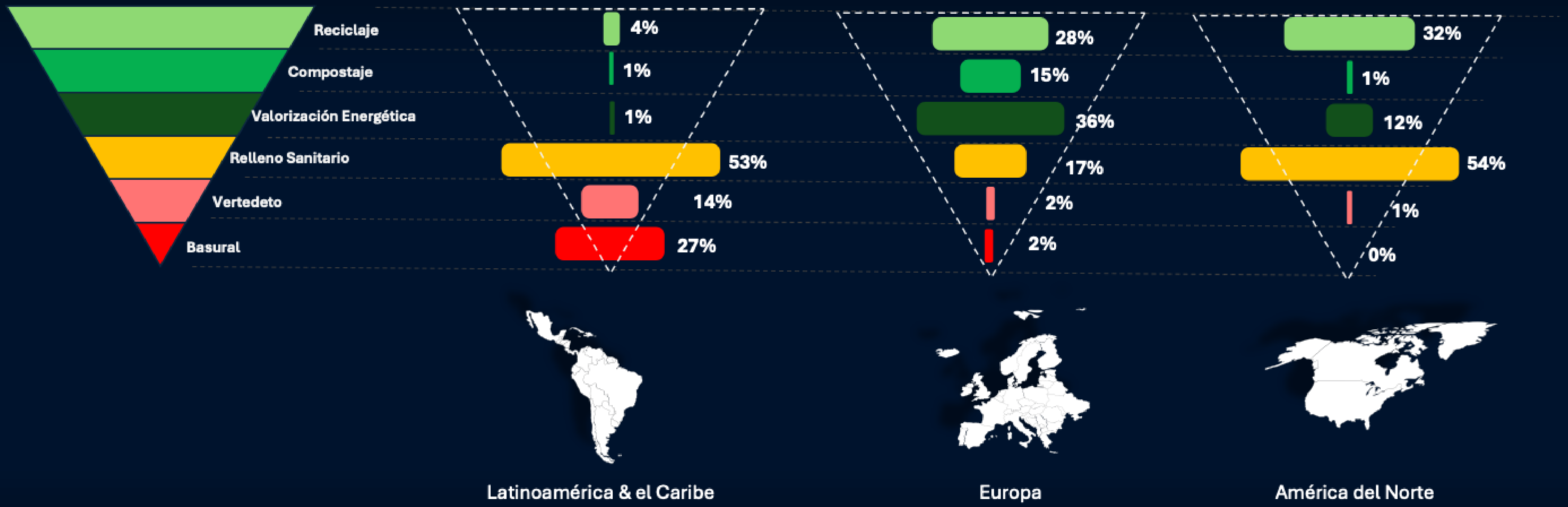
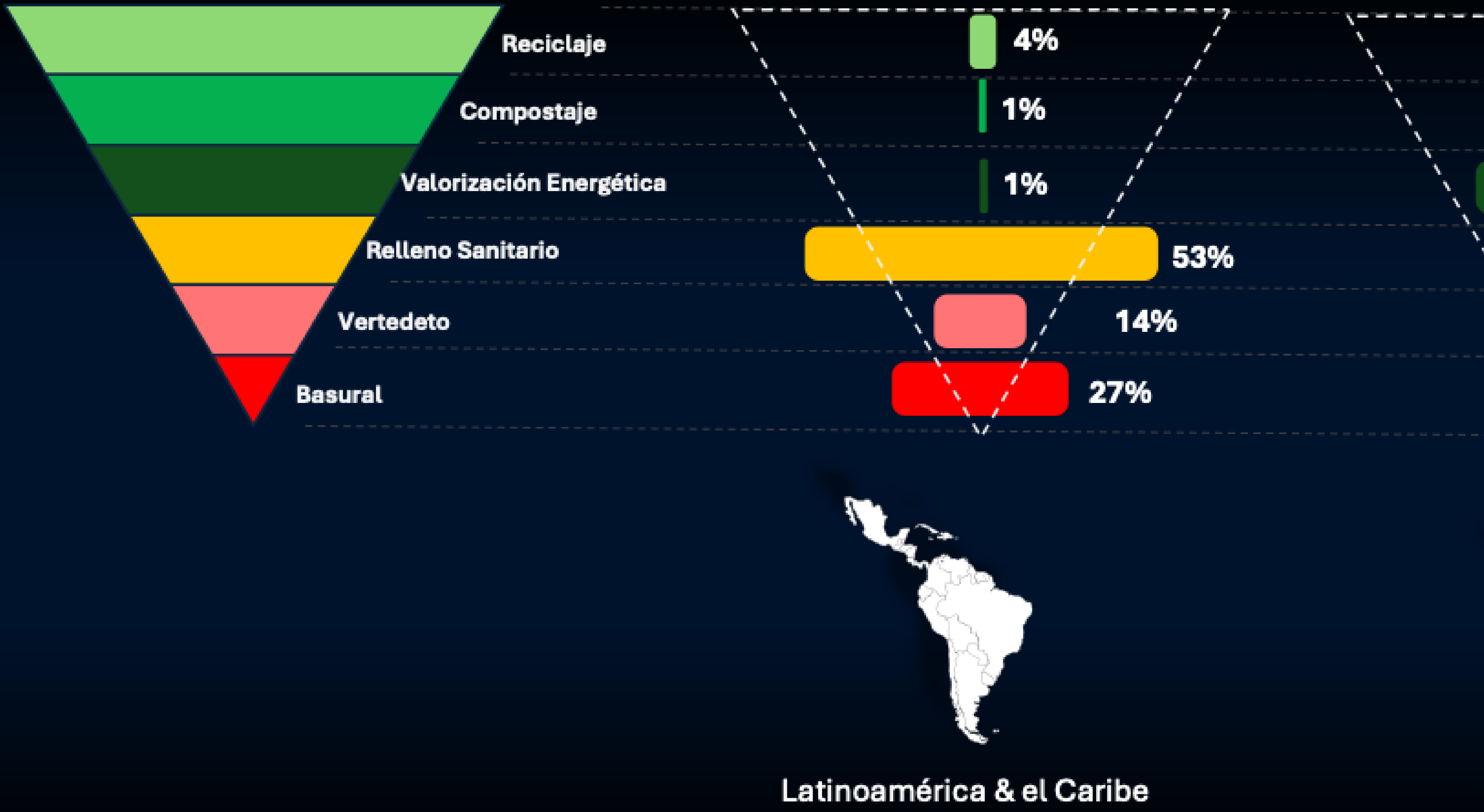
Potencial de Valorización de Residuos en la Industria del Cemento en América Latina y El Caribe al año 2030
FICEM


Reciclaje
Compostaje
Valorización Energética
Relleno Sanitario
Vertedeto
Basural
4%
1%
1%
53%
14%
27%
28%
15%
36%
17%
2%
2%
32%
1%
12%
54%
1%
0%
Latinoamérica & el Caribe
Europa
América del Norte



Reciclaje
Compostaje
Valorización Energética
Relleno Sanitario
Vertedeto
Basural
4%
1%
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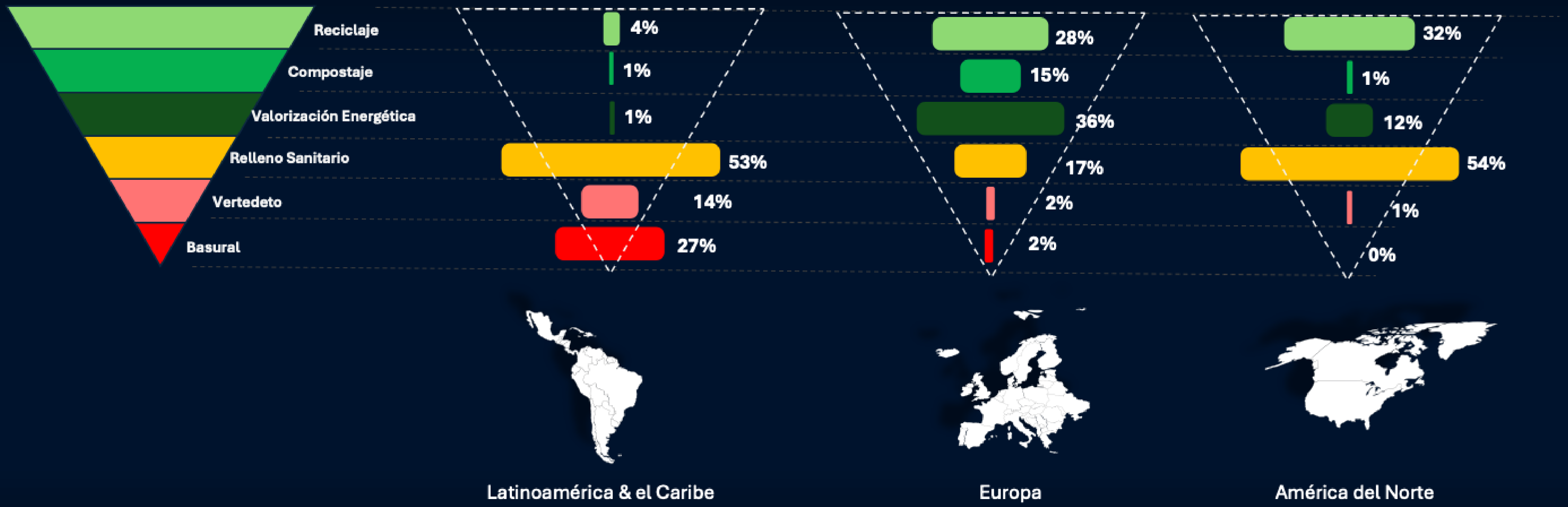
27%
Latinoamérica & el Caribe


Potencial de Valorización de Residuos en la Industria del Cemento en América Latina y El Caribe al año 2030
FICEM


Reciclaje
Compostaje
Valorización Energética
Relleno Sanitario
Vertedeto
Basural
4%
1%
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32%
1%
12%
54%
1%
0%
Latinoamérica & el Caribe
Europa
América del Norte


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Potencial de Valorización de Residuos en la Industria del Cemento en América Latina y El Caribe al año 2030
FICEM
FEDERACIÓN INTERAMERICANA DEL CEMENTO
Resumen para tomadores de decisiones
PROGRAMA REGIONAL DE COOPERACIÓN
Reducción de emisiones de metano provenientes de residuos orgánicos y cierre de basurales en América Latina y el Caribe
FORO DE MINISTRAS Y MINISTROS DE MEDIO AMBIENTE DE AMÉRICA LATINA Y EL CARIBE
ONU programa para el medio ambiente
A6.4-FORM-METH-002
PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL FORM FOR EMISSION REDUCTIONS ACTIVITIES
(Version 02.0)
INFORMATION TO BE COMPLETED BY THE SECRETARIAT AND METHODOLOGIES EXPERT PANEL
Type of standard
New baseline and monitoring methodology
Unique reference number and title of the proposed new methodology or new methodological tool
A6.4-PNM00xxxxx
Date when this form was received at UNFCCC secretariat:
22/09/2025
Date of posting in the UNFCCC A6.4 web site for global stakeholder consultation
30/09/2025
Version 02.0
Page 1 of 67

CLEAN DEVELOPMENT MECHANISM

ACM0003

Large-scale Consolidated Methodology

Partial substitution of fossil fuels in cement or quicklime manufacture

Version 09.0

Sectoral scope(s): 01 and 04

No aplica

United Nations
Framework Convention on
Climate Change

Ricardo Pareja
Proposal of New Methodology A6.4 - Sector Cement Manufacturing
Para: A6.4mechanism-info@unfccc.int, Cc: ladelatorre@devitec-esg.com

Enviado - Exchange 8 de octubre de 2025, 11:30 p.m.
Detalles

Dear UNFCCC

Our organization, FICEM, is interested in contributing with a new methodology for your A6.4 mechanism. Our sector is related to cement production. This first methodology focuses on utilizing MSW as an alternative fuel for our kilns and reducing methane emissions. The reach is global, and our associates are willing to start the project soon.
FICEM associates all the cement enterprises of the cement industry in Latin America. We are working on a PDD, possibly in an operation of the Mexican firm CEMEX.
By now, we are interested in your opinion on this proposal, to start the public comments process and include any recommendations from your side.
I am the Director of Innovation and Climate Change at FICEM. My coordinates are included in the documents (001, 002, 004), dated September 22, 2025. I am based in Chile (UTC-03:00)
Best regards,
Mr. Ricardo Pareja

A6.4-FORM-METH-002.docx

A6.4-FORM-METH-002

PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL FORM FOR EMISSION REDUCTIONS ACTIVITIES (Version 02.0)

Information to be completed by the secretariat and Methodologies Expert Panel	
Type of standard	New baseline and monitoring methodology
Unique reference number and title of the proposed new methodology or new methodological tool	A6.4-PNM00xxxxx
Date when this form was received at UNFCCC secretariat:	22/09/2025
Date of posting in the UNFCCC A6.4 web site for global stakeholder consultation	30/09/2025

Version 02.0 Page 1 of 67

Guidelines for Estimation of the Cost of Equity in the Cement Industry

FICEM

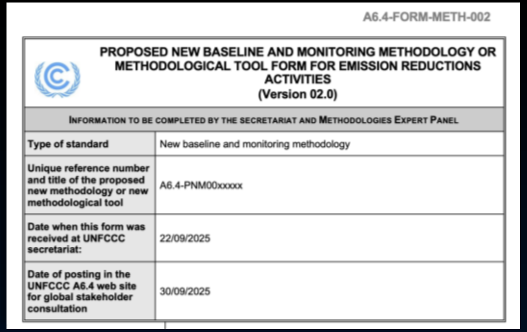
Photo: View of cement facility, FICEM archives 2025

Guidelines for Estimation of the Cost of Equity in the Cement Industry

Reference document for climate mitigation projects 2025, V1.0

1

Coprocesamiento & Metano Evitado



A6.4-FORM-METH-002

PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL FORM FOR EMISSION REDUCTIONS ACTIVITIES
(Version 02.0)

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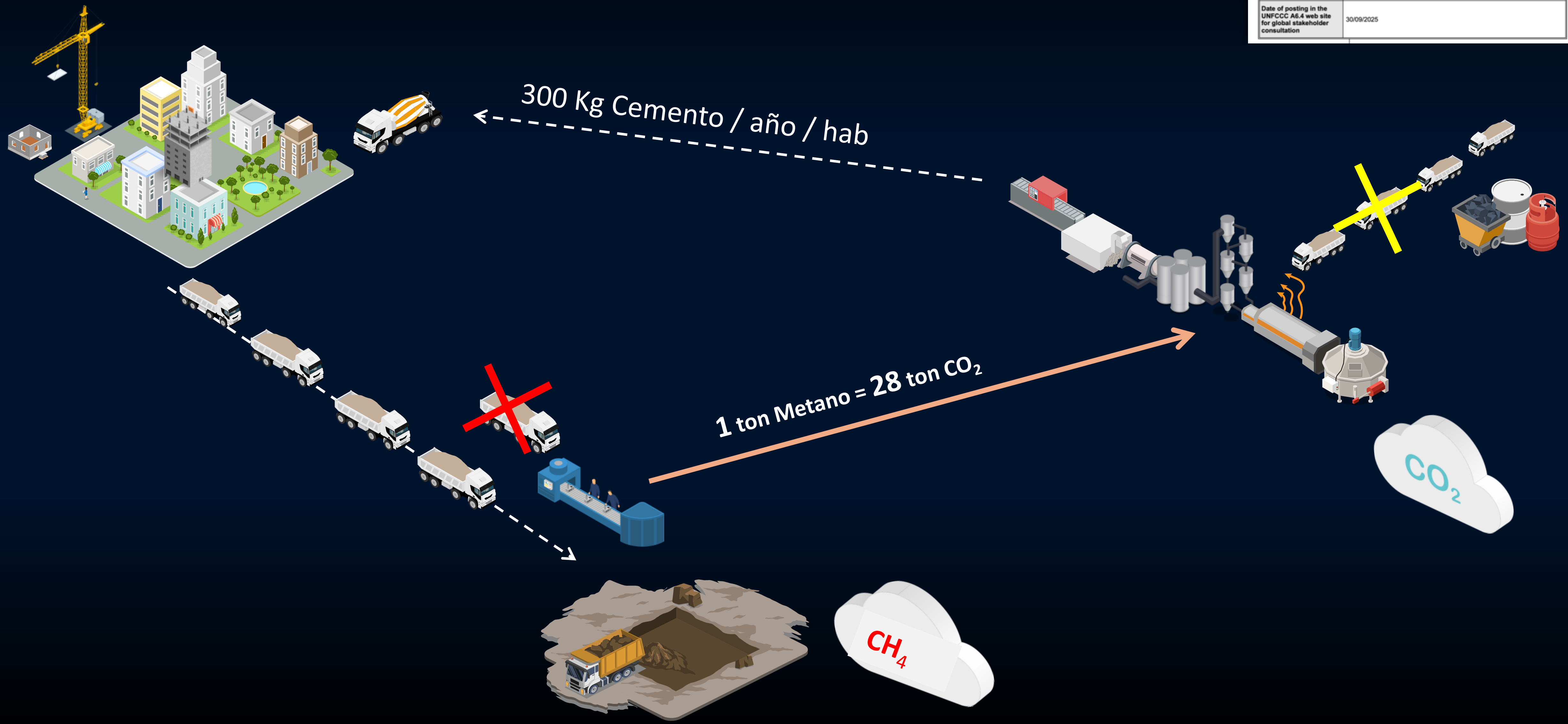

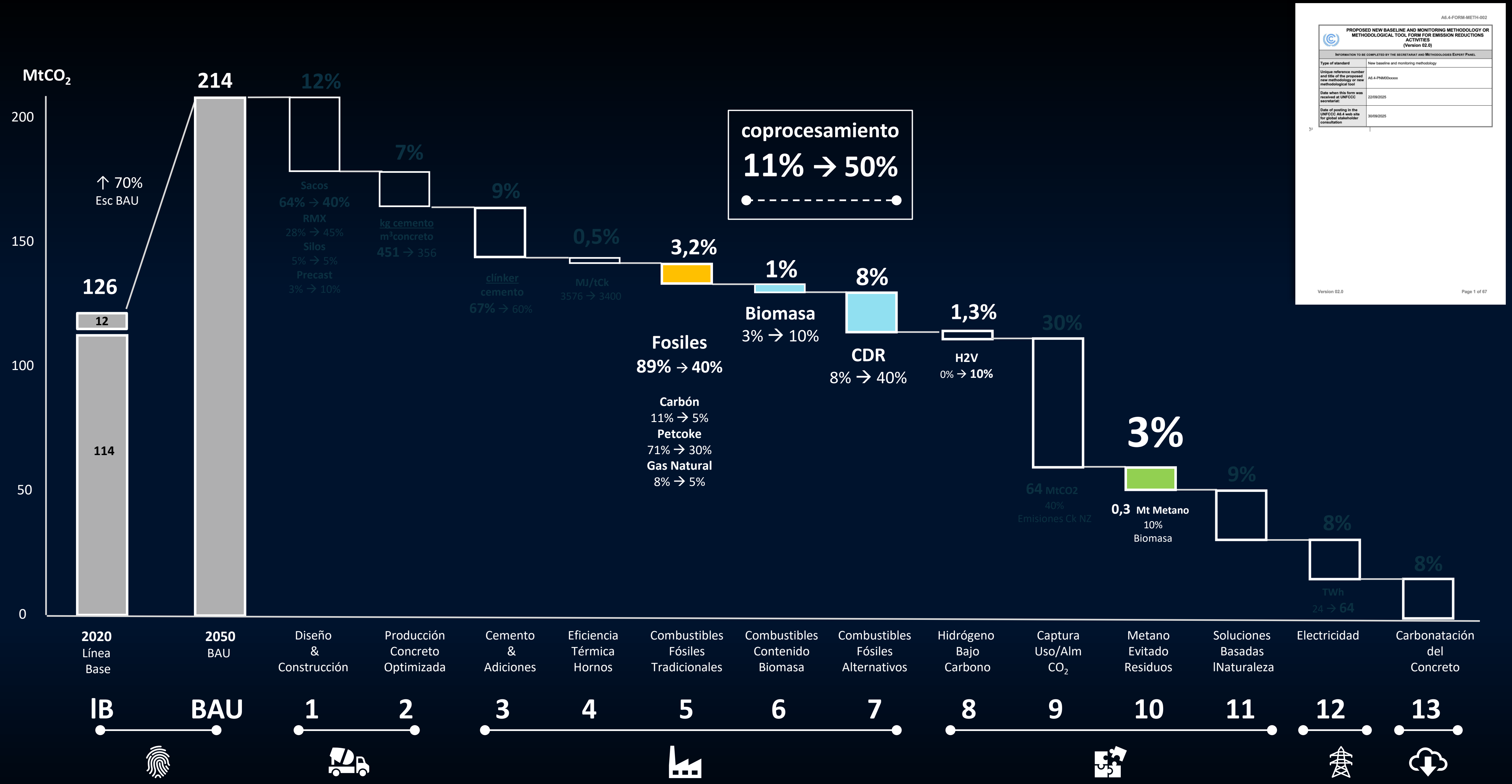

MtCO2
200
150
100
50
0
126
12
114
↑ 70%
Esc BAU
214
12%
Sacos
64% → 40%
RMX
28% → 45%
Silos
5% → 5%
Precast
3% → 10%
7%
kg cemento
m3concreto
451 → 356
9%
clinker
cemento
67% → 60%
0,5%
MJ/tCk
3576 → 3400
3,2%
Fosiles
89% → 40%
Carbón
11% → 5%
Petcoke
71% → 30%
Gas Natural
8% → 5%
coprocesamiento
11% → 50%
1%
Biomasa
3% → 10%
8%
CDR
8% → 40%
1,3%
H2V
0% → 10%
30%
64 MtCO2
40%
Emisiones Ck NZ
3%
0,3 Mt Metano
10%
Biomasa
9%
8%
TWh
24 → 64
8%
2020
Línea
Base
2050
BAU
Diseño
&
Construcción
Producción
Concreto
Optimizada
Cemento
&
Adiciones
Eficiencia
Térmica
Hornos
Combustibles
Fósiles
Tradicionales
Combustibles
Contenido
Biomasa
Combustibles
Fósiles
Alternativos
Hidrógeno
Bajo
Carbono
Captura
Uso/Alm
CO2
Metano
Evitado
Residuos
Soluciones
Basadas
lNaturaleza
Electricidad
Carbonatación
del
Concreto
lB
BAU
1
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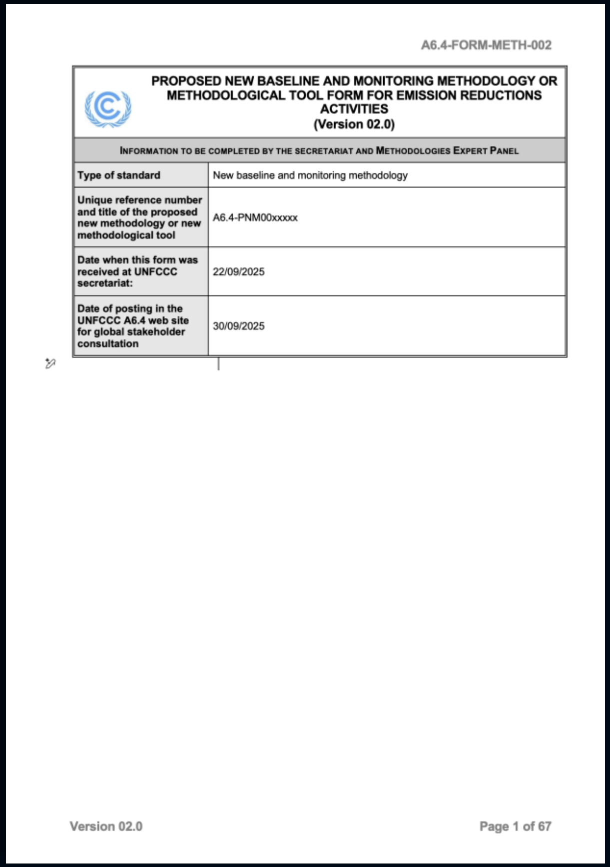

A6.4-FORM-METH-002

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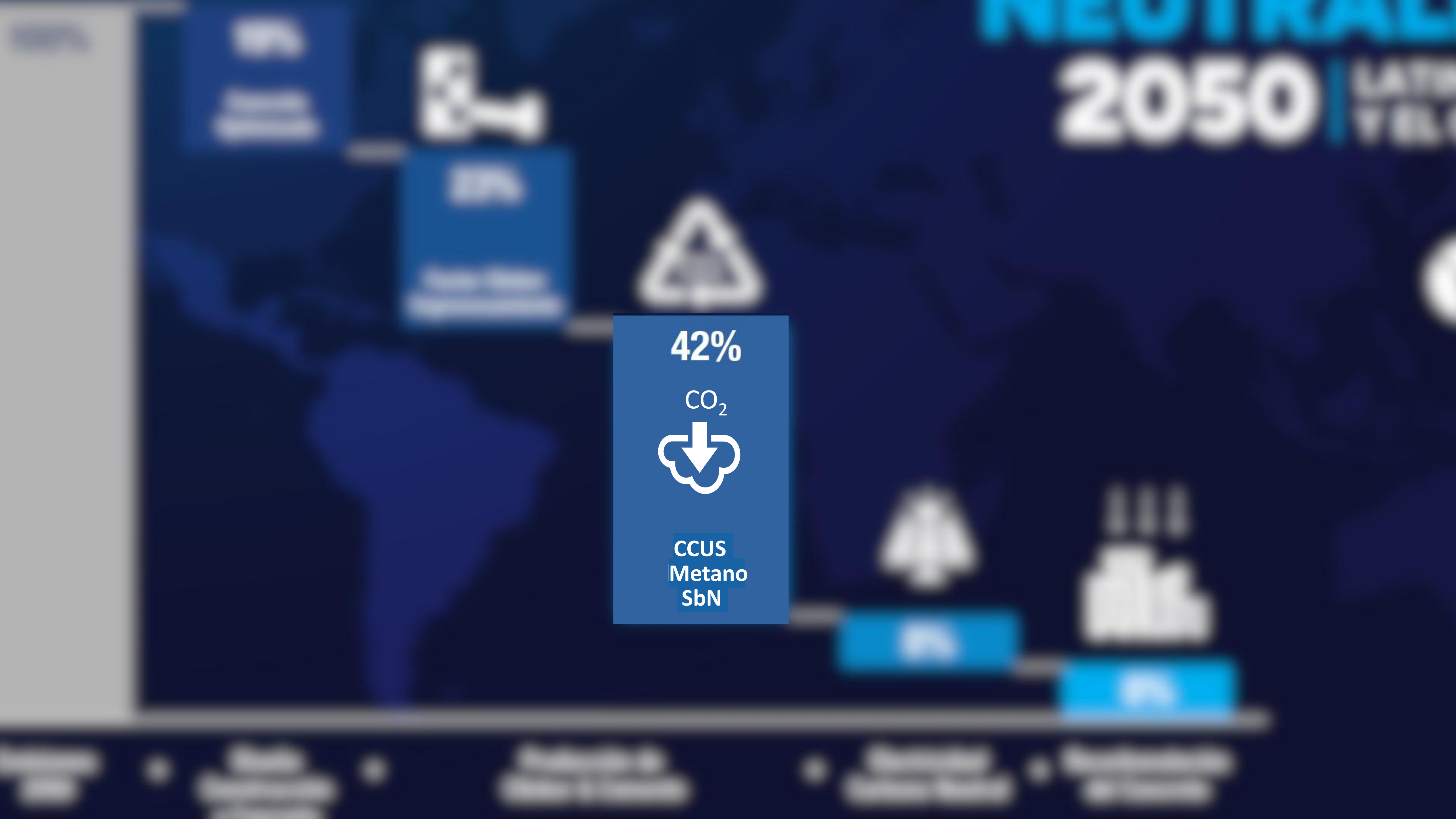
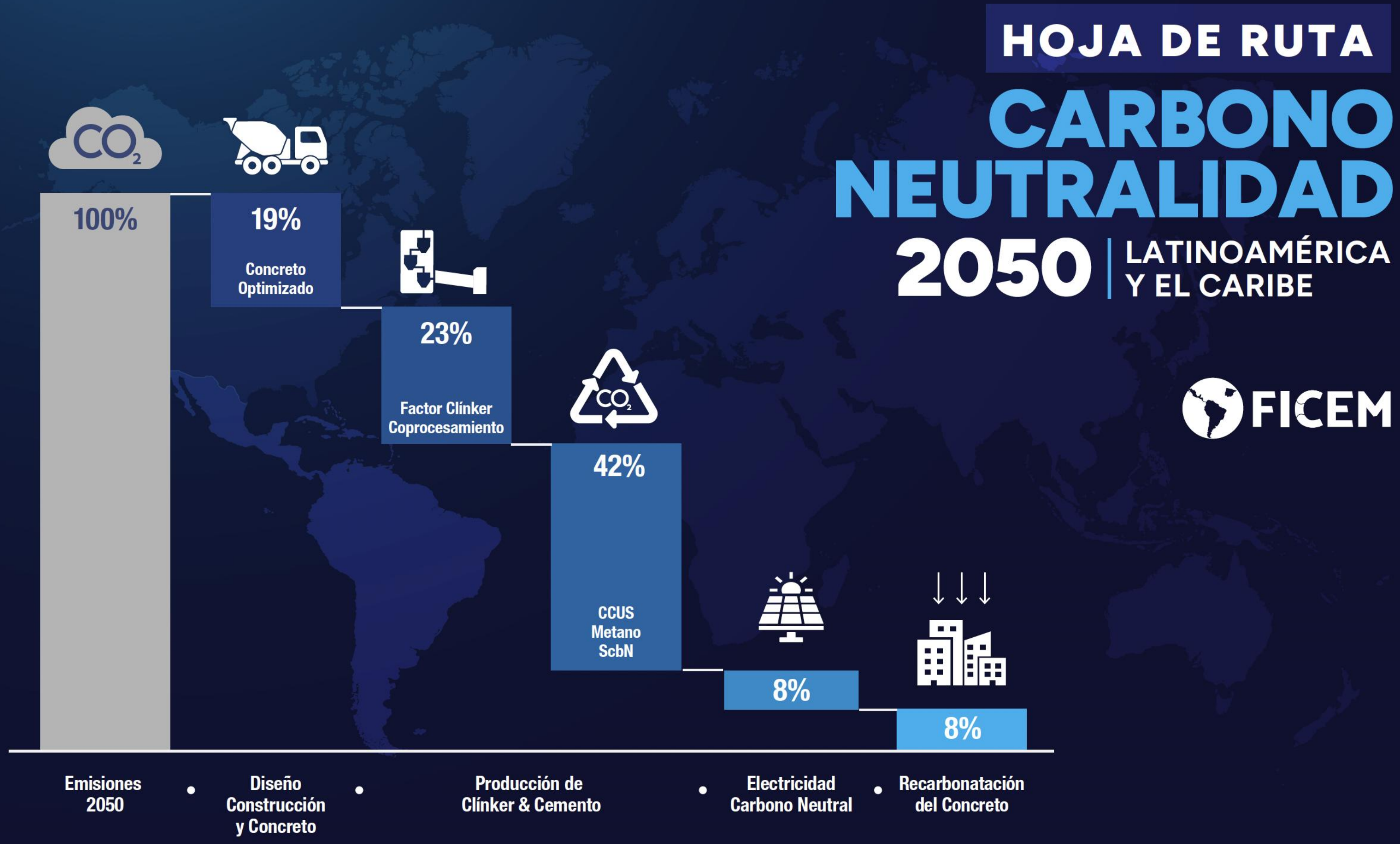
Version 02.0 Page 1 of 67

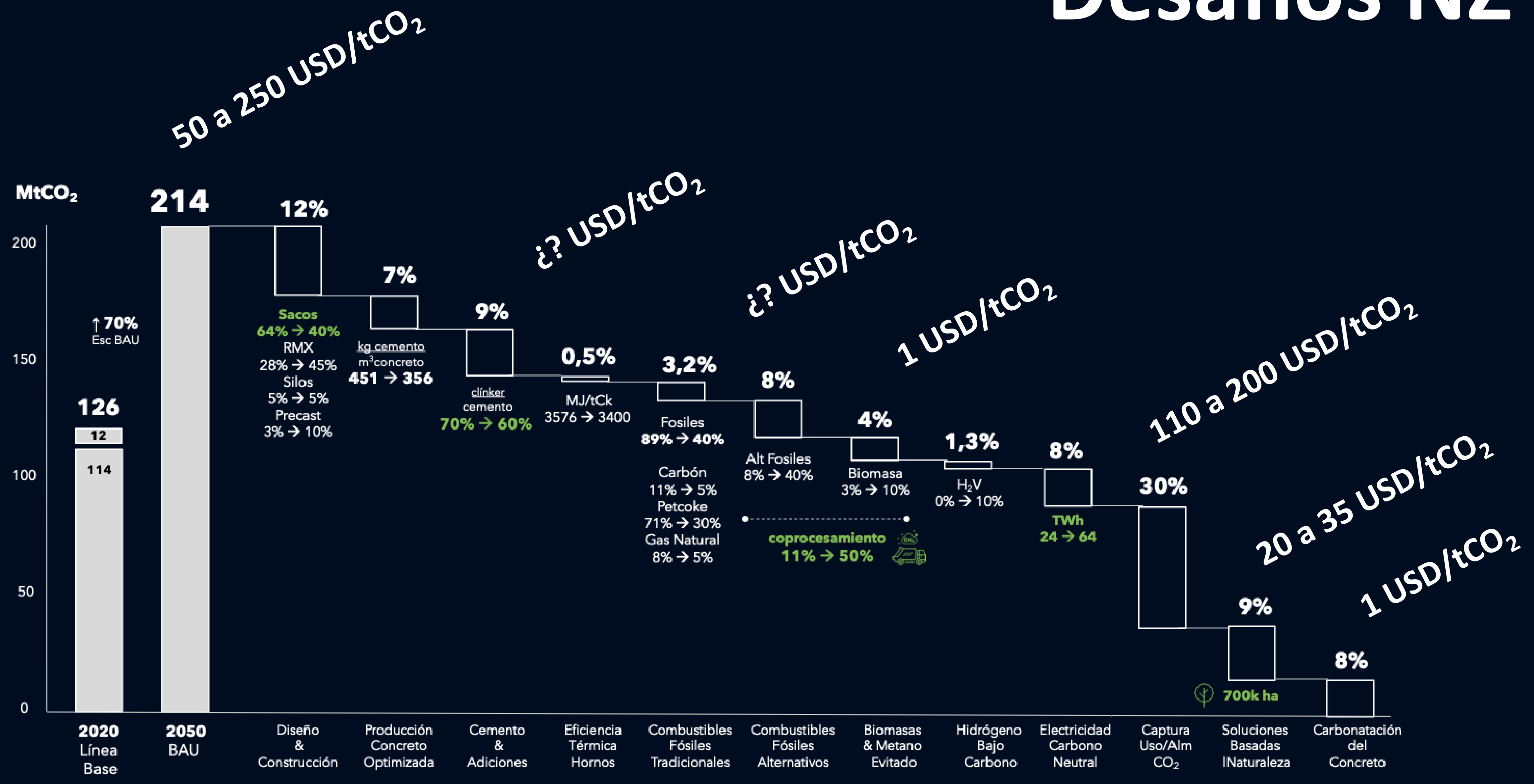

2050
42%
CO2
CCUS
Metano
SbN

Desafíos NZ



Net Zero FICEM

Desafíos NZ



50 a 250 USD/tCO2
¿? USD/tCO2
¿? USD/tCO2
1 USD/tCO2
110 a 200 USD/tCO2
20 a 35 USD/tCO2
1 USD/tCO2
MtCO2
200
150
100
50
0
126
12
114
↑70%
Esc BAU
214
12%
Sacos
64% → 40%
RMX
28% → 45%
Silos
5% → 5%
Precast
3% → 10%
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kg cemento
m3concreto
451 → 356
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clínker
cemento
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Fosiles
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Carbón
11% → 5%
Petcoke
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Gas Natural
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8%
Alt Fosiles
8% → 40%
4%
Biomasa
3% → 10%
coprocesamiento
11% → 50%
1,3%
H2V
0% → 10%
8%
TWh
24 → 64
30%
9%
700k ha
8%
2020 Línea Base
2050 BAU
Diseño & Construcción
Producción Concreto Optimizada
Cemento & Adiciones
Eficiencia Térmica Hornos
Combustibles Fósiles Tradicionales
Combustibles Fósiles Alternativos
Biomasas & Metano Evitado
Hidrógeno Bajo Carbono
Electricidad Carbono Neutral
Captura Uso/Alm CO2
Soluciones Basadas INaturaleza
Carbonatación del Concreto

Contexto

Net **Z**ero **FICEM**

Desafíos **NZ**

Herramientas **FICEM**

Herramientas FICEM

Hoja de Ruta Net Zero 2050

Cemento y Hormigón | Argentina

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION | NET ZERO PARTNERSHIP | GCCA Global Cement and Concrete Association | FICEM Federación Interamericana del Cemento | AFCP Asociación de Fabricantes de Cemento Portland

Herramientas FICEM

Herramientas FICEM

Capital humano

Innovación

Números correctos

Certeza Jurídica

CONGRESO FICEM Cemento & concreto verde 2050

CONGRESO TÉCNICO FICEM 2025

CONGRESO FICEM
Cemento & concreto verde 2050

CONGRESO TÉCNICO
FICEM 2025

QUITO 2025

LIMA 2025

740

Participantes

Herramientas FICEM

Capital humano

Innovación

Números correctos

Certeza Jurídica

ACADEMIA FICEM

www.academiaficem.com

1443 Usuarios	**+1250** Horas de formación en oferta académica
95 Cursos y programas en plataforma	**+1600** Horas de formación impartidas
14 Aliados académicos + Expertos Independientes	**3** Empresas con Licencia One Pass Incluye UNACEM Perú y Ecuador

Herramientas FICEM

Capital humano

Innovación

Números correctos

Certeza Jurídica

8VA MISIÓN MULTIPAÍS FICEM

Portugal – Octubre 2025

MISIÓN MULTIPAÍS FICEM

MISIÓN TECNOLÓGICA CEO

① AVE – Gestión ambiental y valorización energética

Propietarios: Cimpor, Secil, SGVR

Gestión integral de residuos para coprocesamiento, desde su captación hasta la entrega a la cementera. Cobertura: Portugal, España, Francia, Bélgica, Holanda, Reino Unido, Irlanda, Suecia

Opera ≈ 500.000 toneladas de AFR (60 %) y ARM (40 %)/año

Tipos de residuos:

- CDR en base a residuos de origen industrial
- Fracción ligera de residuos de vehículos al final de su vida útil
- Residuos de madera de origen forestal y urbano
- Residuos industriales peligrosos
- Neumáticos fuera de uso
- Residuos de transformación industrial de metales y minerales
- Cenizas volantes
- Residuos de construcción y demolición
- Residuos de la actividad metalúrgica
- Lodos de plantas de tratamiento de aguas residuales industriales

② SGR AMBIENTE

Opera dentro de los Parques de Ecología Industrial (PEI) ubicados en Maia, Seixal y Chamusca, promoviendo la clasificación, reciclaje, valorización energética y reutilización de residuos.

Provee un servicio de gestión integral de residuos, incluyendo a los residuos de construcción y demolición, industriales no peligrosos y sólidos urbanos, produciendo:

- Agregados reciclados.
- Combustibles derivados de residuos (CDR/RDF).

③ CIMPOR Souselas

Planta integrada con 3 líneas y 3,5 MM t cem/año (cap)

Produce 6 tipos de cemento

Coprocesa CDRs y residuos industriales peligrosos.

Temas de interés:

- Secadero de residuos con gases calientes de horno de clinker
- Autogeneración de energía eléctrica de fuente solar
- Proyecta St 70 % al 2030

④ C5Lab – Investigación e innovación para la Industria Cementera

Integra una red de recursos descentralizados para la investigación tecnológica

Temas: materias primas alternativas, captura y reutilización de CO2, combustibles sintéticos, eficiencia energética, cementos ecoeficientes, materiales cementiceos ecoeficientes, entre otros.

Expondrán resultados de investigaciones en:

- CCUS
- Transición energética y eficiencia
- Nuevos cementos

⑤ SECIL Outão

Planta integrada de 2 MM t cem/año (capacidad). Exporta 1,5 MM t clk y cem / año, a más de 20 países. Produce 6 tipos de cemento. ≈ 4 % MP son ARM; ≈ 47 % St actual

Temas de interés:

- Clean Cement Line Project: ↑20 % eficiencia energética, autogeneración eléctrica de fuente solar y por recuperación de gases calientes, ↓ 20 % CO2 / t cem, ↓ NOx.
- Certificación CSC Bronce.
- Proyectos de biodiversidad y naturaleza

MISIÓN CEO - CCUS

Noruega y Alemania – 21 al 24 de Octubre, 2024

Technology Centre Mongstad (TCM)
Mongstad, Noruega

- Provee infraestructura y medios profesionales para testear tecnologías de captura de CO_2 por postcombustión, antes de su escalamiento industrial.
- Además, cumple un rol en transferencia de conocimiento y ofrece asesoramiento a usuarios de las tecnologías.
- Ya testeó 11 tecnologías (+57.000 h)
- Propietarios: Gassnova, Equinor, Shell y TotalEnergies
- Inversión total: 1 billion USD

Northern Lights Project
Rong, Noruega

- Prestará servicio de transporte, inyección y almacenamiento permanente de CO_2 en un reservorio geológico
- Fase 1 concluida (1,5 MM t CO_2/año). Fase 2 ampliaría capacidad hasta 5 MM t CO_2
- 4 barcos de transporte de CO_2 (3 para la etapa inicial)
- Sociedad compartida entre Equinor, Shell y TotalEnergies.
- Inversión total: 1 billion USD (80% Estado Noruego)

Heidelberg Materials Brevik
Brevik, Noruega

- Primera planta de cemento con captura por postcombustión y almacenamiento geológico del CO_2, a ingresar en operación industrial en el mundo.
- Capturará alrededor de 400.000 t CO_2 / año (50 % del CO_2 que generan)
- CAPEX: 450 MM € (20% Heidelberg; 80% Estado Noruego)
- Avance a la fecha del 89%.
- Inicio de operación en 2Q 2025.

Schwenk Zement GmbH & Co. (CI4C)
Mergelstetten, Alemania

- Consorcio formado por Schwenk, Heidelberg Materials, Vicat y Buzzi-Dyckerkoff.
- Planta piloto de Oxyfuel Puro (450 tpd clinker)
- CAPEX: 130 mill € - OPEX 50 MM €. (Sin financiamiento externo)
- Purificación CO_2 al 99,9% con captura criogénica con enfriamiento de NH_3.
- CO_2 destinado a aplicaciones en Alemania.
- Hot Comissioning en Junio a Agosto 2025. Prevé cerca de 50 campañas durante unos 2 a 3 años.

Herramientas FICEM

Capital humano

CONGRESO FICEM Cemento & concreto verde 2050

CONGRESO TÉCNICO FICEM 2025

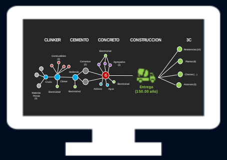
ACADEMIA FICEM

Innovación

MISIÓN MULTIPAÍS FICEM

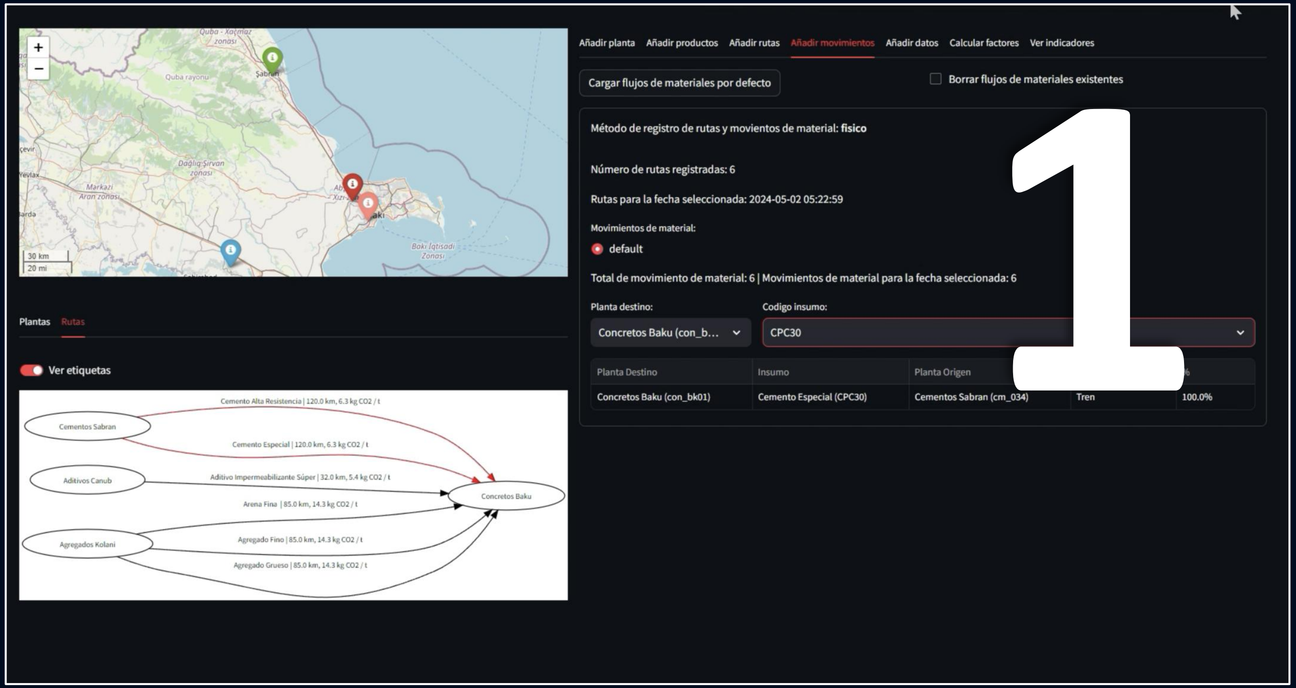
MISIÓN TECNOLÓGICA CEO

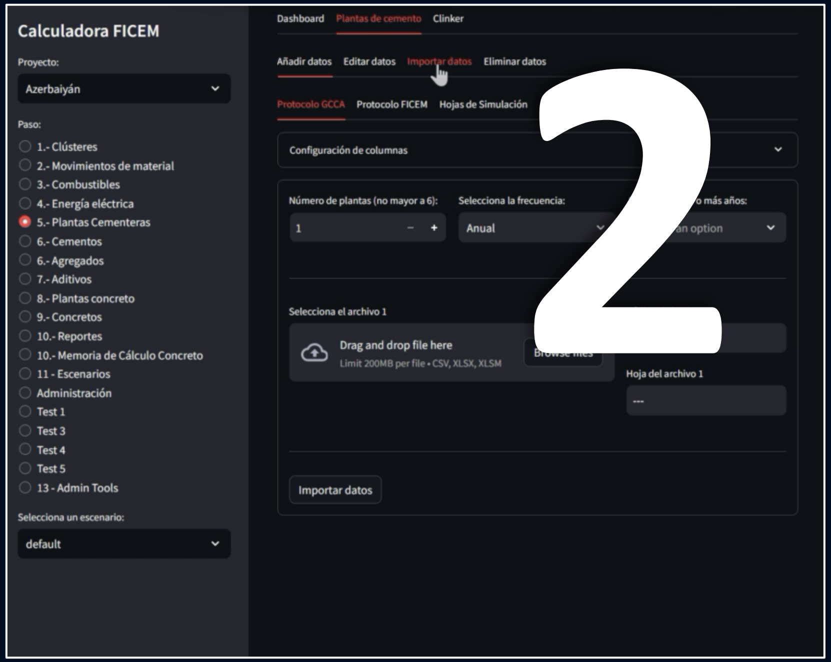
Números correctos



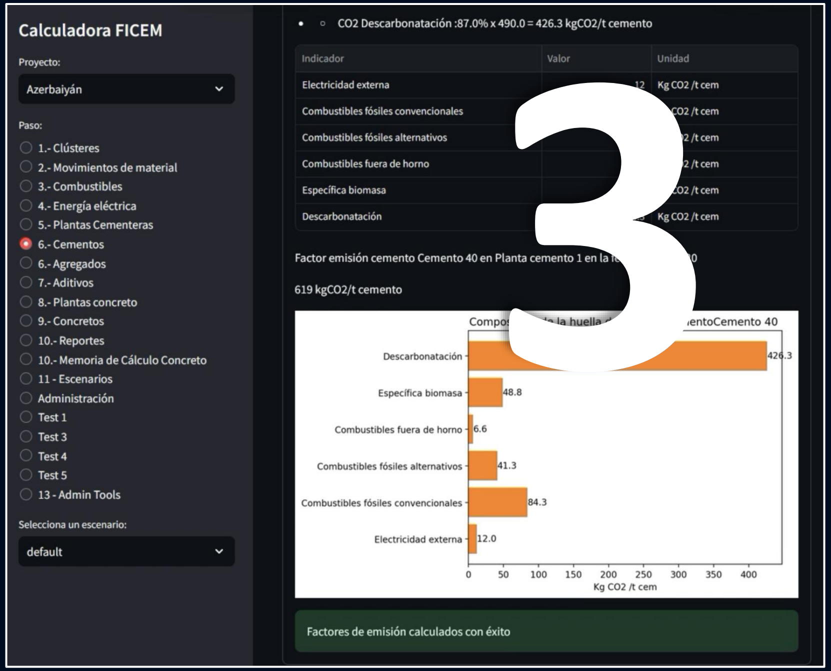
3C pilotos

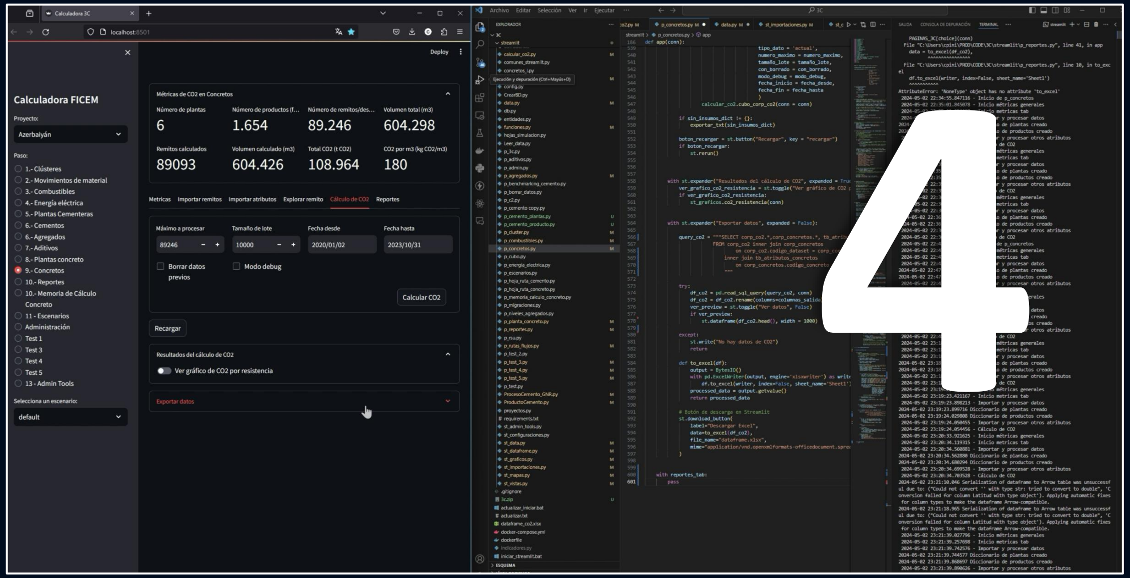
Certeza Jurídica

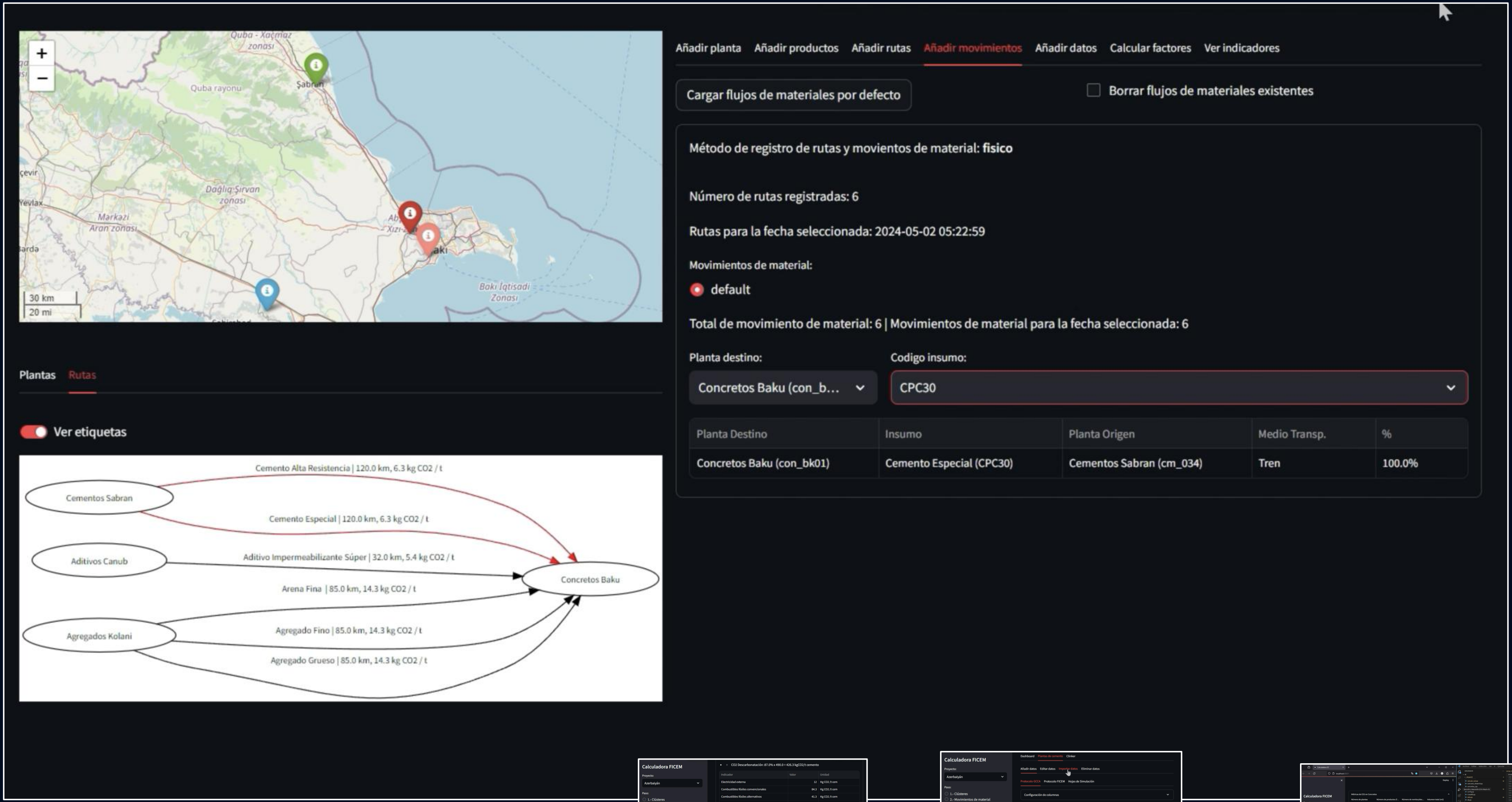

1
Añadir planta
Añadir productos
Añadir rutas
Añadir movimientos
Añadir datos
Calcular factores
Ver indicadores
Cargar flujos de materiales por defecto
Borrar flujos de materiales existentes
Método de registro de rutas y movientos de material: fisico
Número de rutas registradas: 6
Rutas para la fecha seleccionada: 2024-05-02 05:22:59
Movimientos de material:
default
Total de movimiento de material: 6 | Movimientos de material para la fecha seleccionada: 6
Planta destino:
Concretos Baku (con_b...
Codigo insumo:
CPC30
Planta Destino
Insumo
Planta Origen
Concretos Baku (con_bk01)
Cemento Especial (CPC30)
Cementos Sabran (cm_034)
Tren
100.0%
Plantas
Rutas
Ver etiquetas
Cementos Sabran
Aditivos Canub
Agregados Kolani
Concretos Baku
Cemento Alta Resistencia | 120.0 km, 6.3 kg CO2 / t
Cemento Especial | 120.0 km, 6.3 kg CO2 / t
Aditivo Impermeabilizante Súper | 32.0 km, 5.4 kg CO2 / t
Arena Fina | 85.0 km, 14.3 kg CO2 / t
Agregado Fino | 85.0 km, 14.3 kg CO2 / t
Agregado Grueso | 85.0 km, 14.3 kg CO2 / t

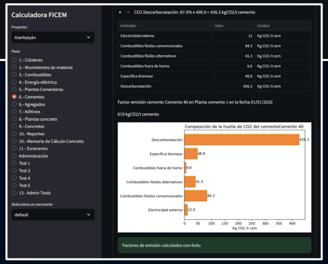

2
Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
Dashboard
Plantas de cemento
Clinker
Añadir datos
Editar datos
Importar datos
Eliminar datos
Protocolo GCCA
Protocolo FICEM
Hojas de Simulación
Configuración de columnas
Número de plantas (no mayor a 6):
1
Selecciona la frecuencia:
Anual
Selecciona el archivo 1
Drag and drop file here
Limit 200MB per file • CSV, XLSX, XLSM
Hoja del archivo 1
Importar datos

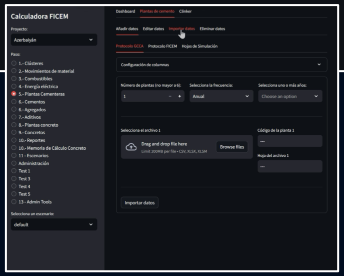
3Cpilotos

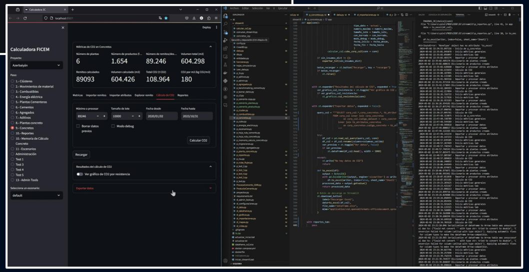

3
Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
CO2 Descarbonatación :87.0% x 490.0 = 426.3 kgCO2/t cemento
Indicador
Valor
Unidad
Electricidad externa
Kg CO2 /t cem
Combustibles fósiles convencionales
Combustibles fósiles alternativos
Combustibles fuera de horno
Específica biomasa
Descarbonatación
Factor emisión cemento Cemento 40 en Planta cemento 1 en la
619 kgCO2/t cemento
Descarbonatación
Específica biomasa
Combustibles fuera de horno
Combustibles fósiles alternativos
Combustibles fósiles convencionales
Electricidad externa
426.3
48.8
6.6
41.3
84.3
12.0
Kg CO2 /t cem
Factores de emisión calculados con éxito

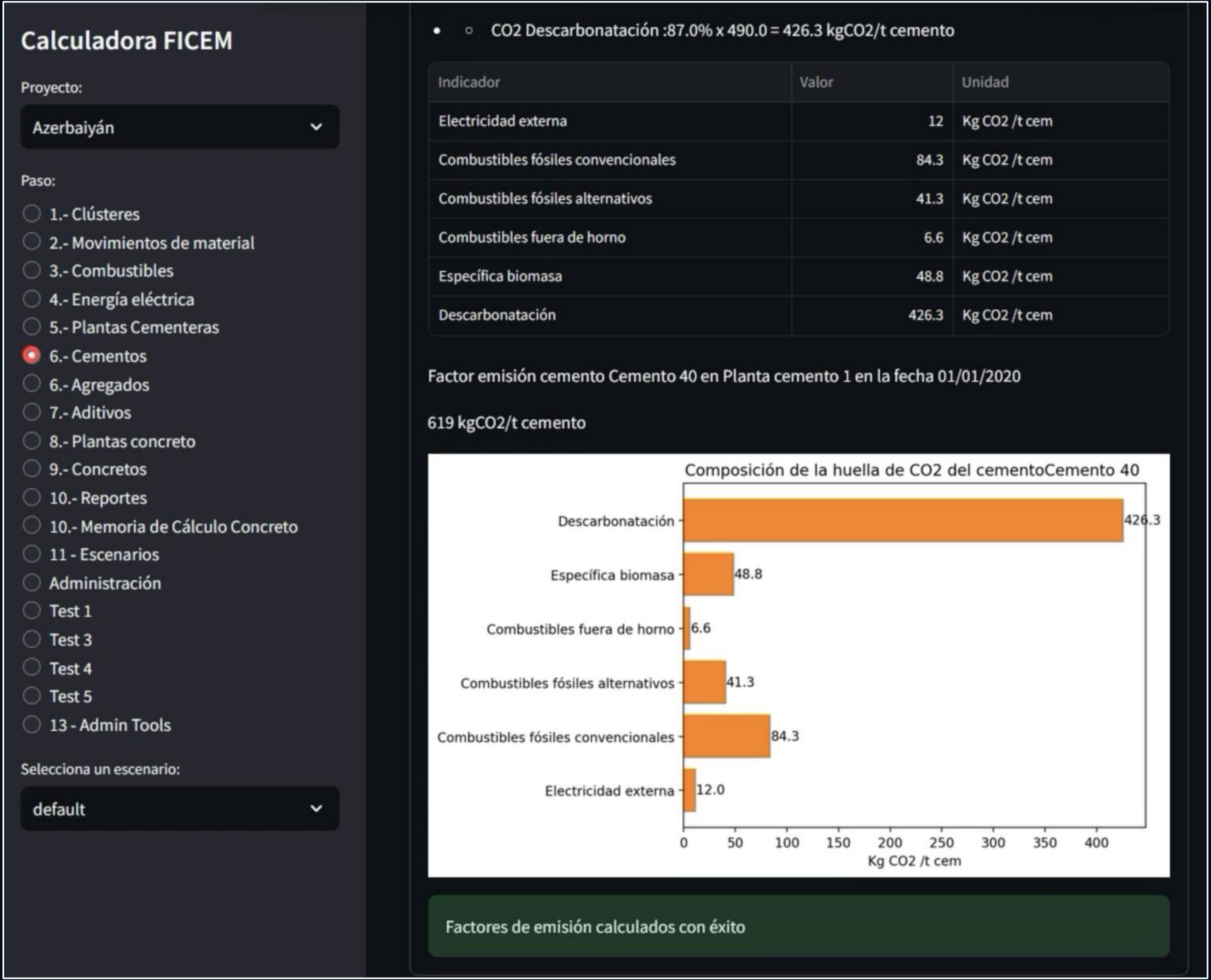

4
Calculadora FICEM
Métricas de CO2 en Concretos
Número de plantas
6
1.654
89.246
604.298
Remitos calculados
89093
Volumen calculado (m3)
604.426
Total CO2 (t CO2)
108.964
CO2 por m3 (kg CO2/m3)
180
Calcular CO2
Recargar
Resultados del cálculo de CO2
Exportar datos

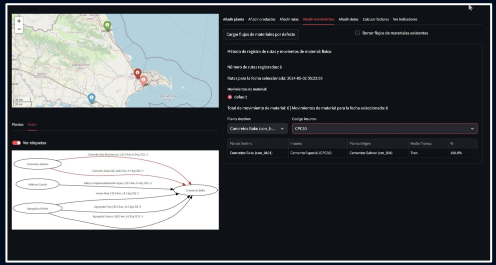

Quba - Xaçmaz zonası
Quba rayonu
Şabran
Dağlıq Şirvan zonası
Markazi Aran zonası
Bakı İqtisadi Zonası
30 km
20 mi
Plantas
Rutas
Ver etiquetas
Cementos Sabran
Cemento Alta Resistencia | 120.0 km, 6.3 kg CO2 / t
Cemento Especial | 120.0 km, 6.3 kg CO2 / t
Aditivos Canub
Aditivo Impermeabilizante Súper | 32.0 km, 5.4 kg CO2 / t
Arena Fina | 85.0 km, 14.3 kg CO2 / t
Agregados Kolani
Agregado Fino | 85.0 km, 14.3 kg CO2 / t
Agregado Grueso | 85.0 km, 14.3 kg CO2 / t
Concretos Baku
Añadir planta
Añadir productos
Añadir rutas
Añadir movimientos
Añadir datos
Calcular factores
Ver indicadores
Cargar flujos de materiales por defecto
Borrar flujos de materiales existentes
Método de registro de rutas y movientos de material: fisico
Número de rutas registradas: 6
Rutas para la fecha seleccionada: 2024-05-02 05:22:59
Movimientos de material:
default
Total de movimiento de material: 6 | Movimientos de material para la fecha seleccionada: 6
Planta destino:
Concretos Baku (con_b...
Codigo insumo:
CPC30
Planta Destino
Insumo
Planta Origen
Medio Transp.
%
Concretos Baku (con_bk01)
Cemento Especial (CPC30)
Cementos Sabran (cm_034)
Tren
100.0%

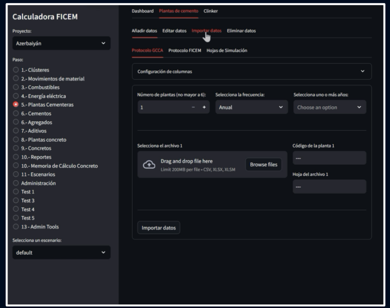


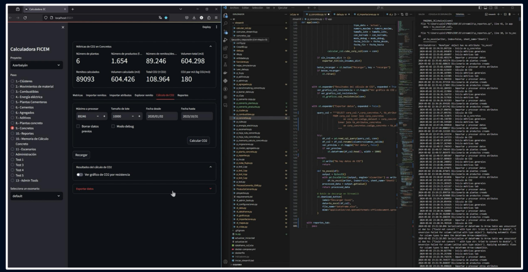


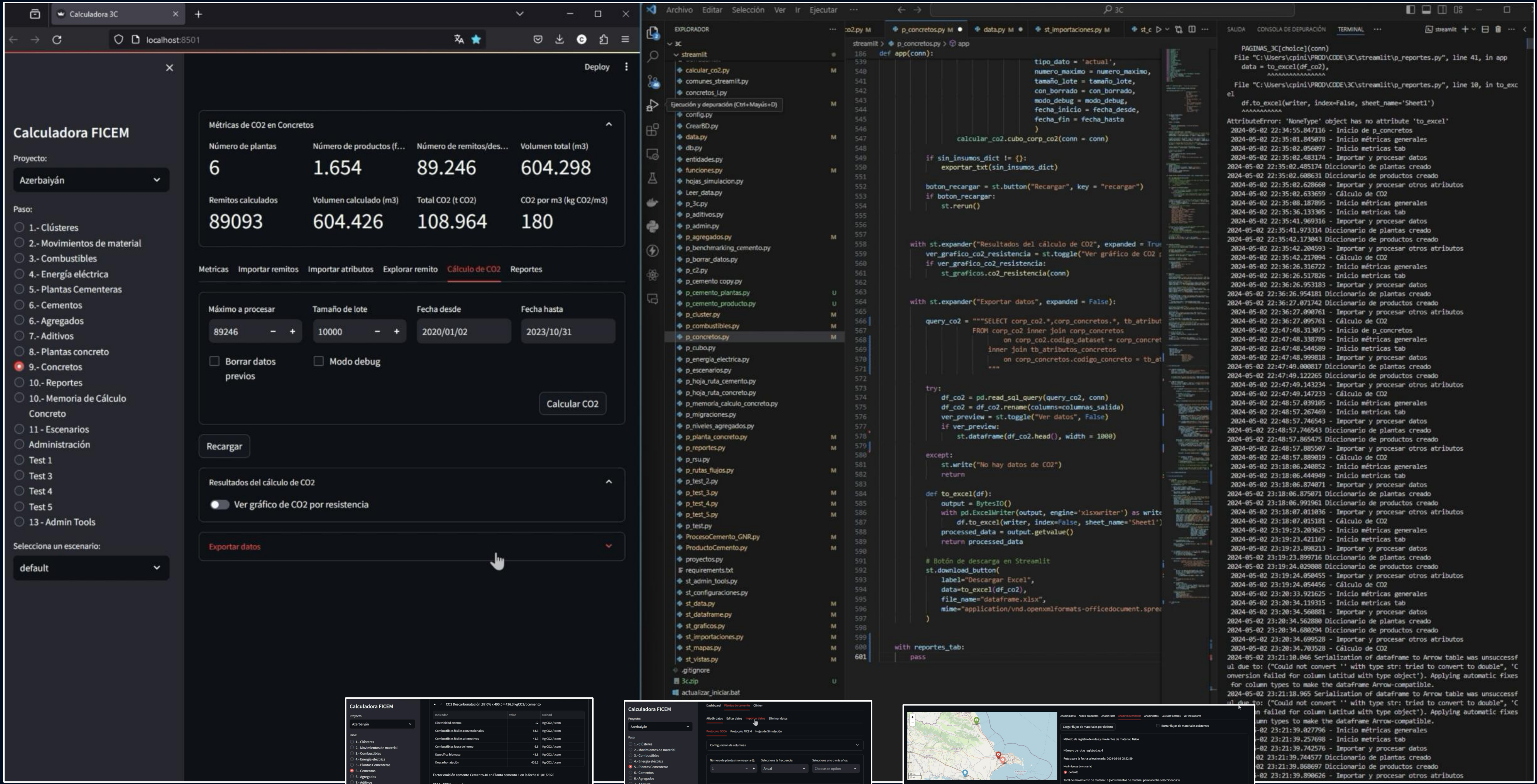


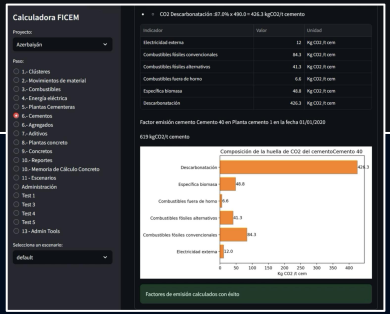

Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
CO2 Descarbonatación :87.0% x 490.0 = 426.3 kgCO2/t cemento
Indicador
Valor
Unidad
Electricidad externa
12
Kg CO2 /t cem
Combustibles fósiles convencionales
84.3
Kg CO2 /t cem
Combustibles fósiles alternativos
41.3
Kg CO2 /t cem
Combustibles fuera de horno
6.6
Kg CO2 /t cem
Específica biomasa
48.8
Kg CO2 /t cem
Descarbonatación
426.3
Kg CO2 /t cem
Factor emisión cemento Cemento 40 en Planta cemento 1 en la fecha 01/01/2020
619 kgCO2/t cemento
Composición de la huella de CO2 del cementoCemento 40
Descarbonatación
426.3
Específica biomasa
48.8
Combustibles fuera de horno
6.6
Combustibles fósiles alternativos
41.3
Combustibles fósiles convencionales
84.3
Electricidad externa
12.0
0
50
100
150
200
250
300
350
400
Kg CO2 /t cem
Factores de emisión calculados con éxito

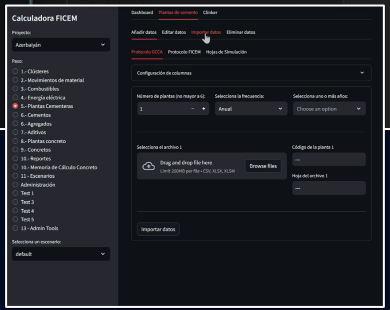


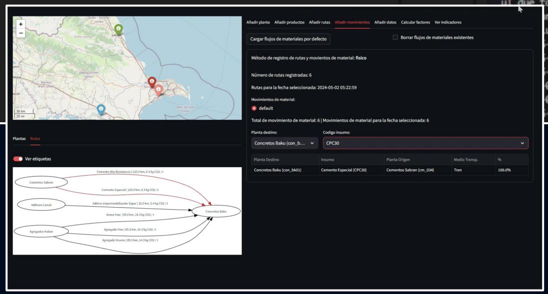


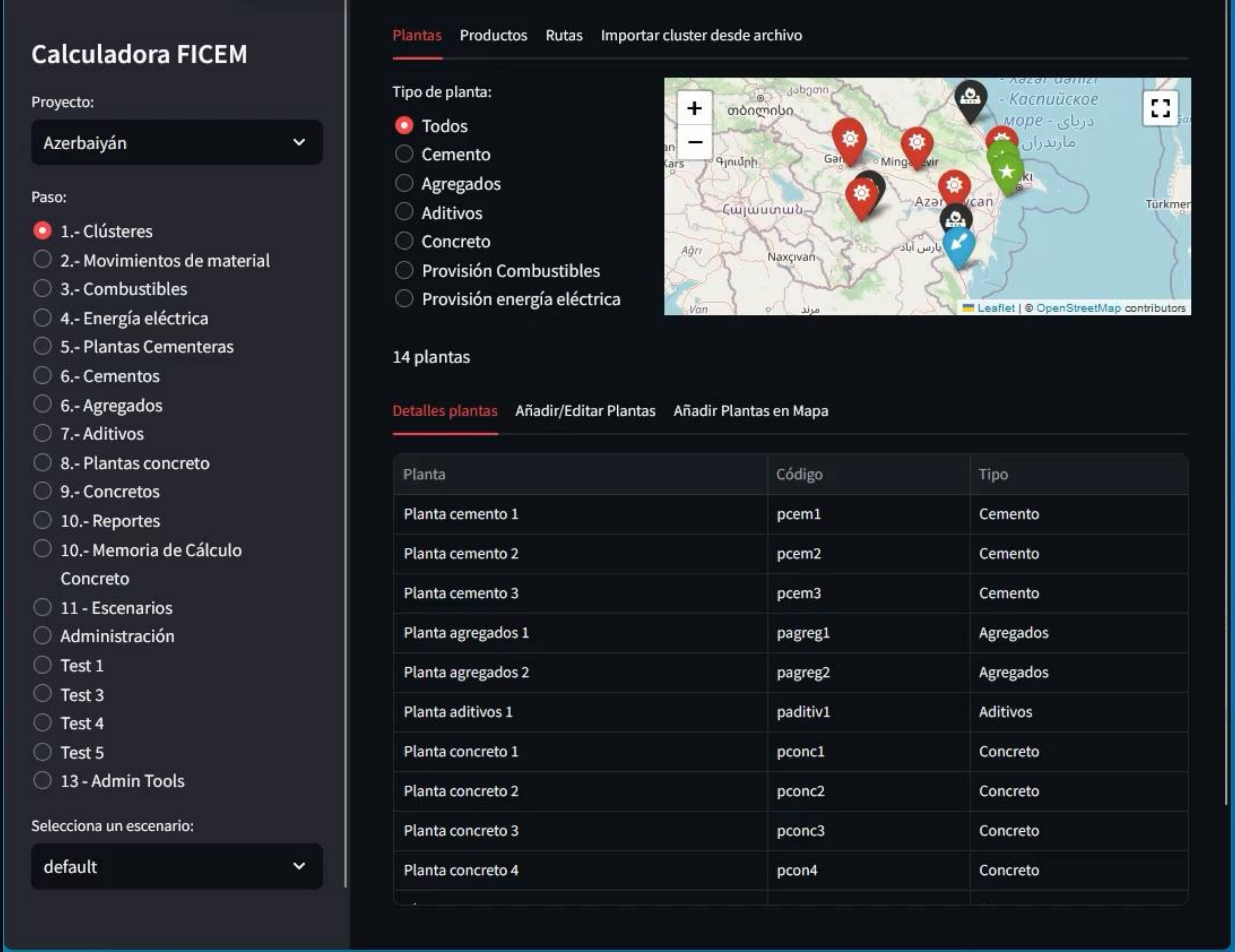


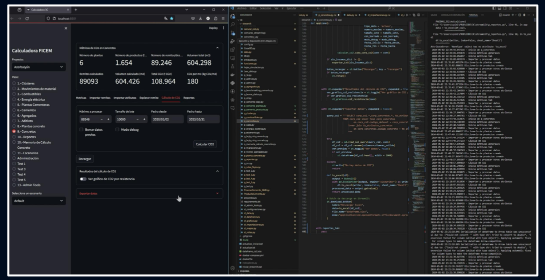

Calculadora 3C
localhost:8501
Deploy
Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
Métricas de CO2 en Concretos
Número de plantas
6
Número de productos (f...
1.654
Número de remitos/des...
89.246
Volumen total (m3)
604.298
Remitos calculados
89093
Volumen calculado (m3)
604.426
Total CO2 (t CO2)
108.964
CO2 por m3 (kg CO2/m3)
180
Metricas
Importar remitos
Importar atributos
Explorar remito
Cálculo de CO2
Reportes
Máximo a procesar
89246
Tamaño de lote
10000
Fecha desde
2020/01/02
Fecha hasta
2023/10/31
Borrar datos previos
Modo debug
Calcular CO2
Recargar
Resultados del cálculo de CO2
Ver gráfico de CO2 por resistencia
Exportar datos
Archivo Editar Selección Ver Ir Ejecutar
EXPLORADOR
p_concretos.py
def app(conn):
calcular_co2.cubo_corp_co2(conn = conn)
if sin_insumos_dict != {}:
exportar_txt(sin_insumos_dict)
boton_recargar = st.button("Recargar", key = "recargar")
if boton_recargar:
st.rerun()
with st.expander("Exportar datos", expanded = False):
def to_excel(df):
output = BytesIO()
processed_data = output.getvalue()
return processed_data
Botón de descarga en Streamlit
st.download_button(
label="Descargar Excel",
data=to_excel(df_co2),
file_name="dataframe.xlsx",
with reportes_tab:
pass
TERMINAL
AttributeError: 'NoneType' object has no attribute 'to_excel'

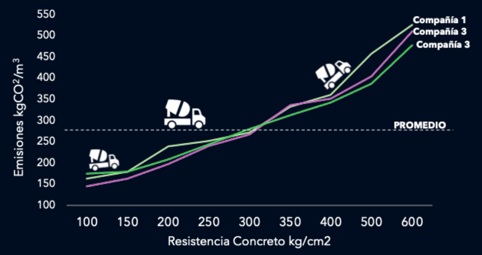


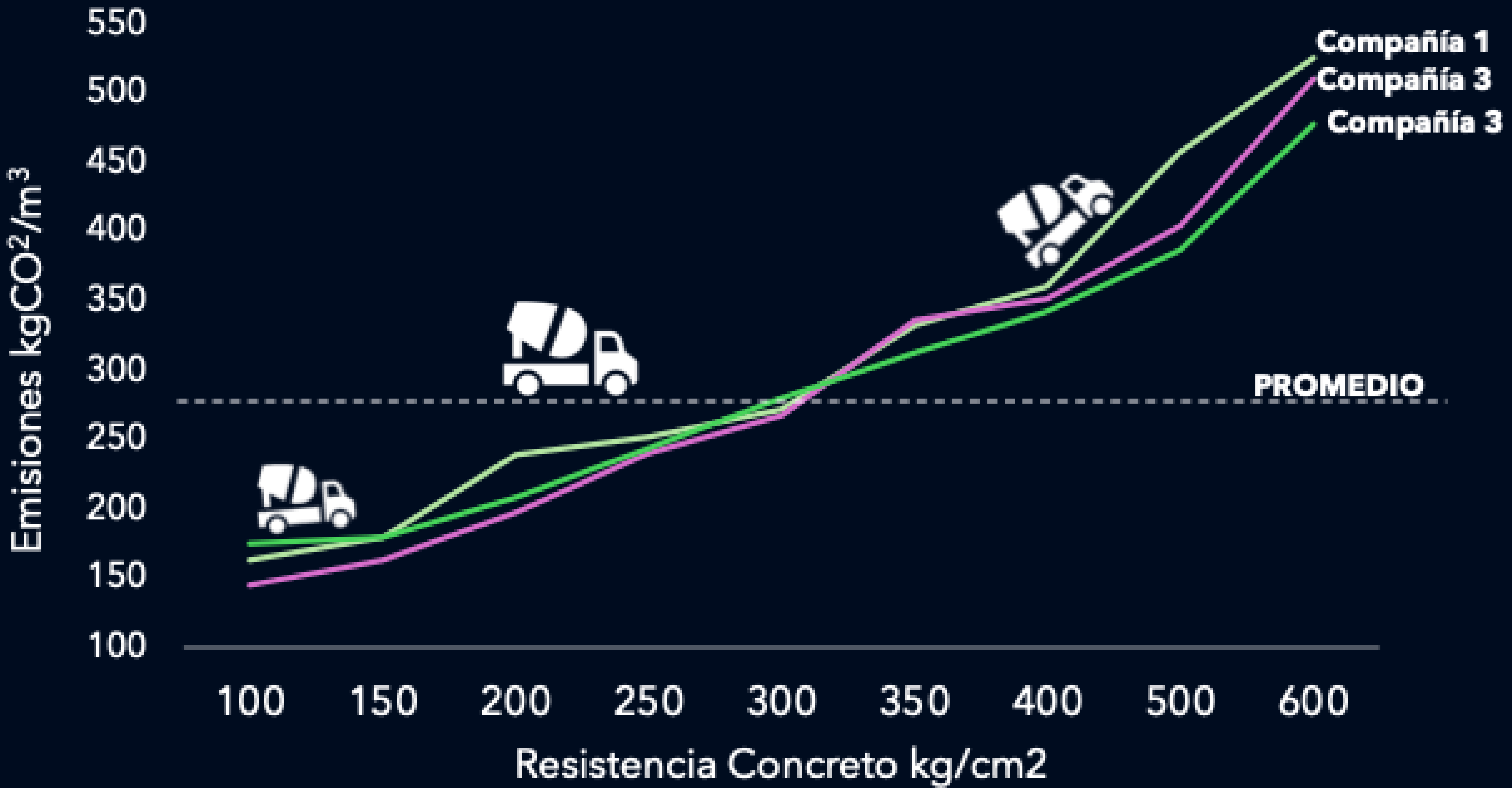


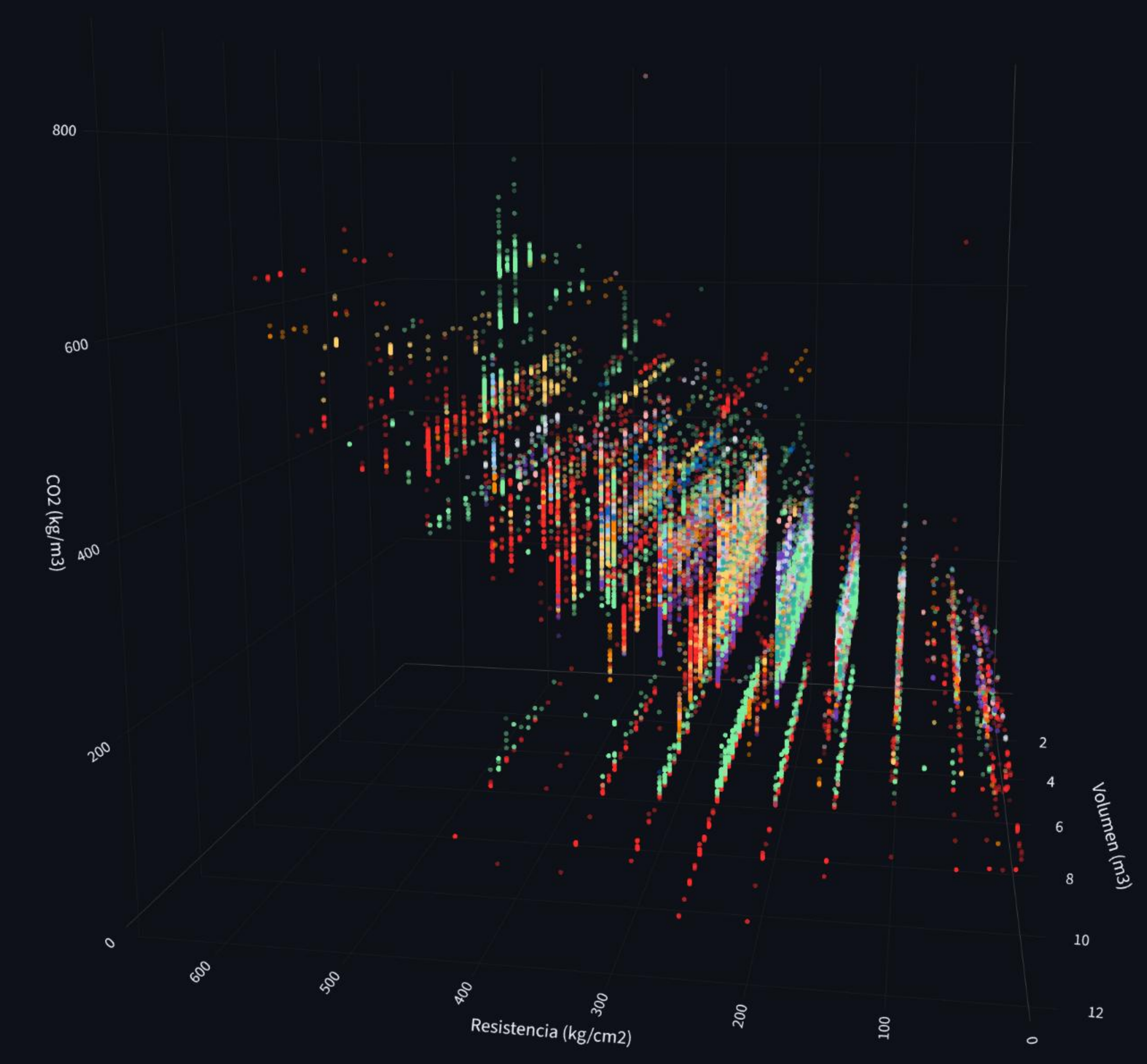



Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
Plantas
Productos
Rutas
Importar cluster desde archivo
Tipo de planta:
Todos
Cemento
Agregados
Aditivos
Concreto
Provisión Combustibles
Provisión energía eléctrica
Leaflet | © OpenStreetMap contributors
14 plantas
Detalles plantas
Añadir/Editar Plantas
Añadir Plantas en Mapa
Planta | Código | Tipo
Planta cemento 1 | pcem1 | Cemento
Planta cemento 2 | pcem2 | Cemento
Planta cemento 3 | pcem3 | Cemento
Planta agregados 1 | pagreg1 | Agregados
Planta agregados 2 | pagreg2 | Agregados
Planta aditivos 1 | paditiv1 | Aditivos
Planta concreto 1 | pconc1 | Concreto
Planta concreto 2 | pconc2 | Concreto
Planta concreto 3 | pconc3 | Concreto
Planta concreto 4 | pcon4 | Concreto

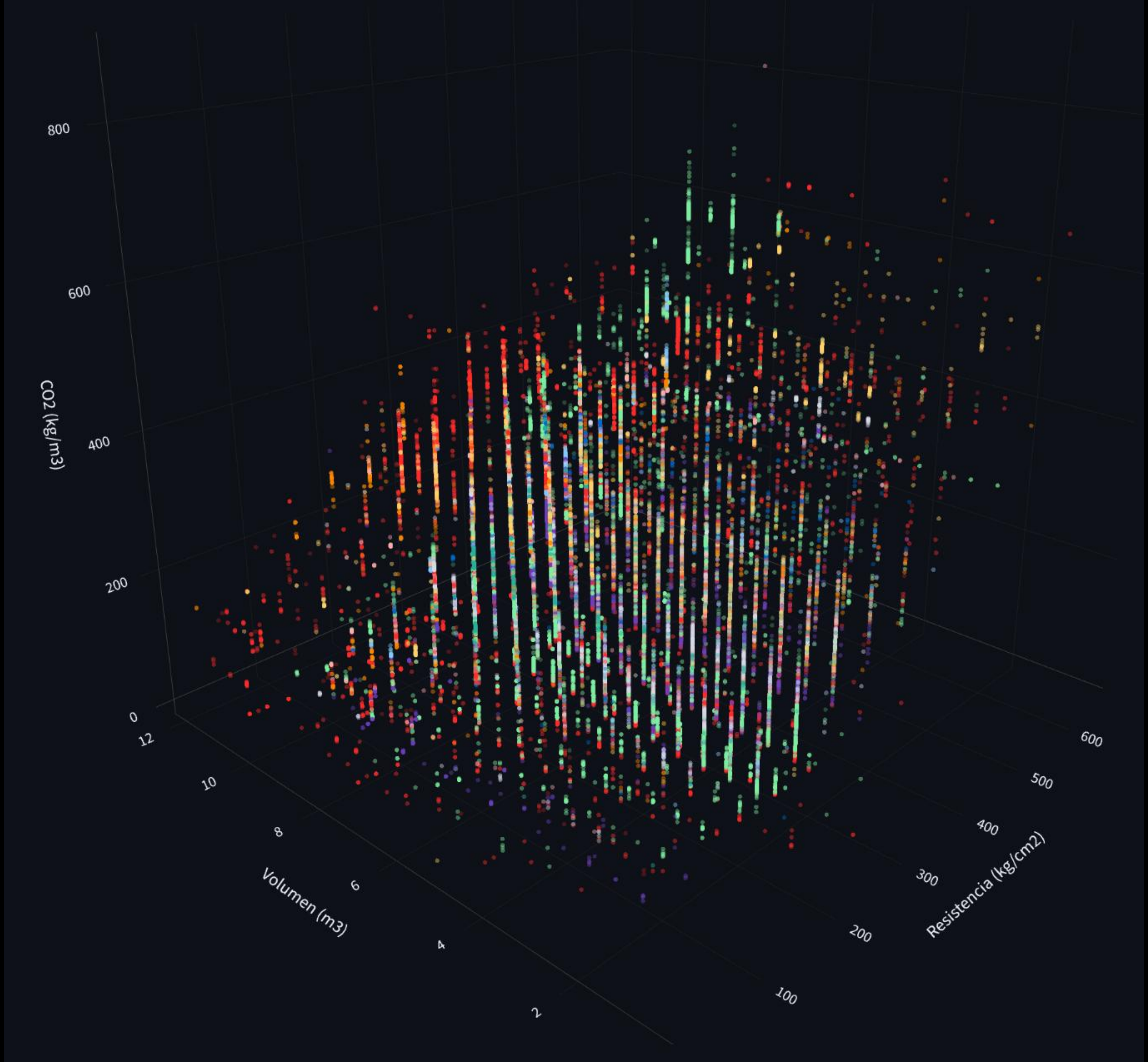



Compañía 1
Compañía 3
Compañía 3
PROMEDIO
Emisiones kgCO2/m3
550
500
450
400
350
300
250
200
150
100
100 150 200 250 300 350 400 500 600
Resistencia Concreto kg/cm2

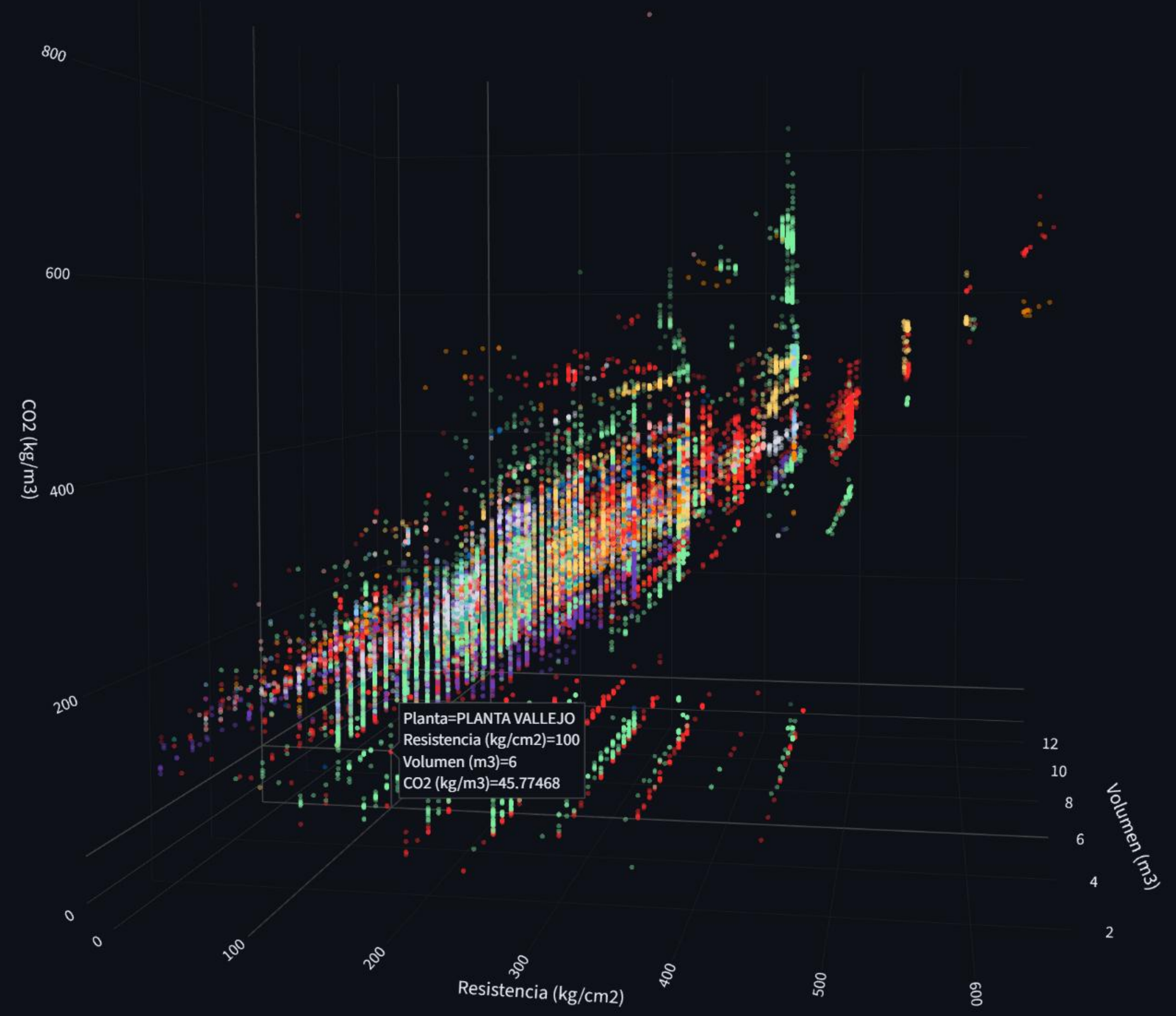

Compañía 1
Compañía 3
Compañía 3
PROMEDIO
550
500
450
400
350
300
250
200
150
100
Emisiones kgCO2/m3
100
150
200
250
300
350
400
500
600
Resistencia Concreto kg/cm2



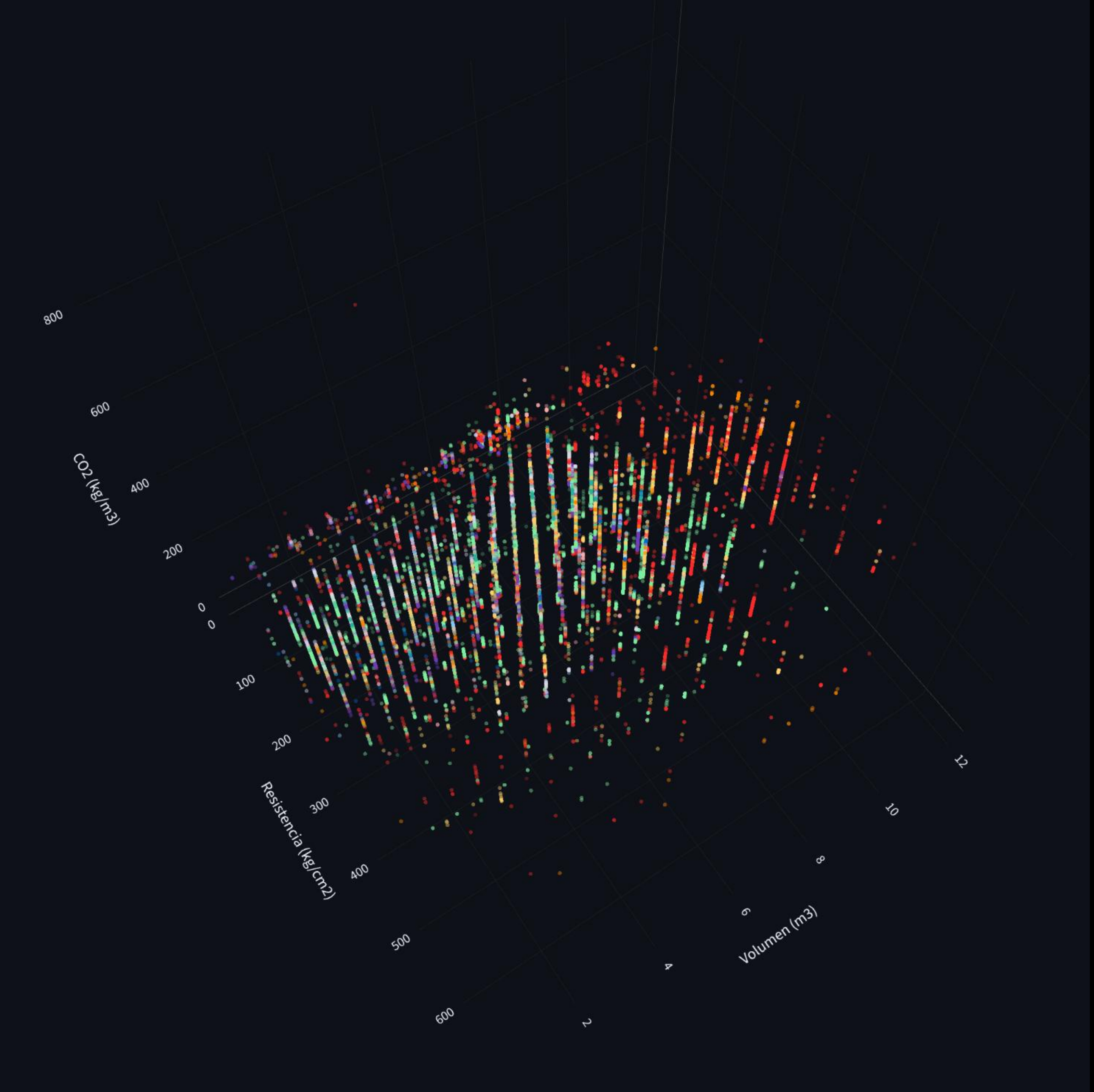
800
600
400
200
0
CO2 (kg/m3)
600
500
400
300
200
100
0
Resistencia (kg/cm2)
2
4
6
8
10
12
Volumen (m3)



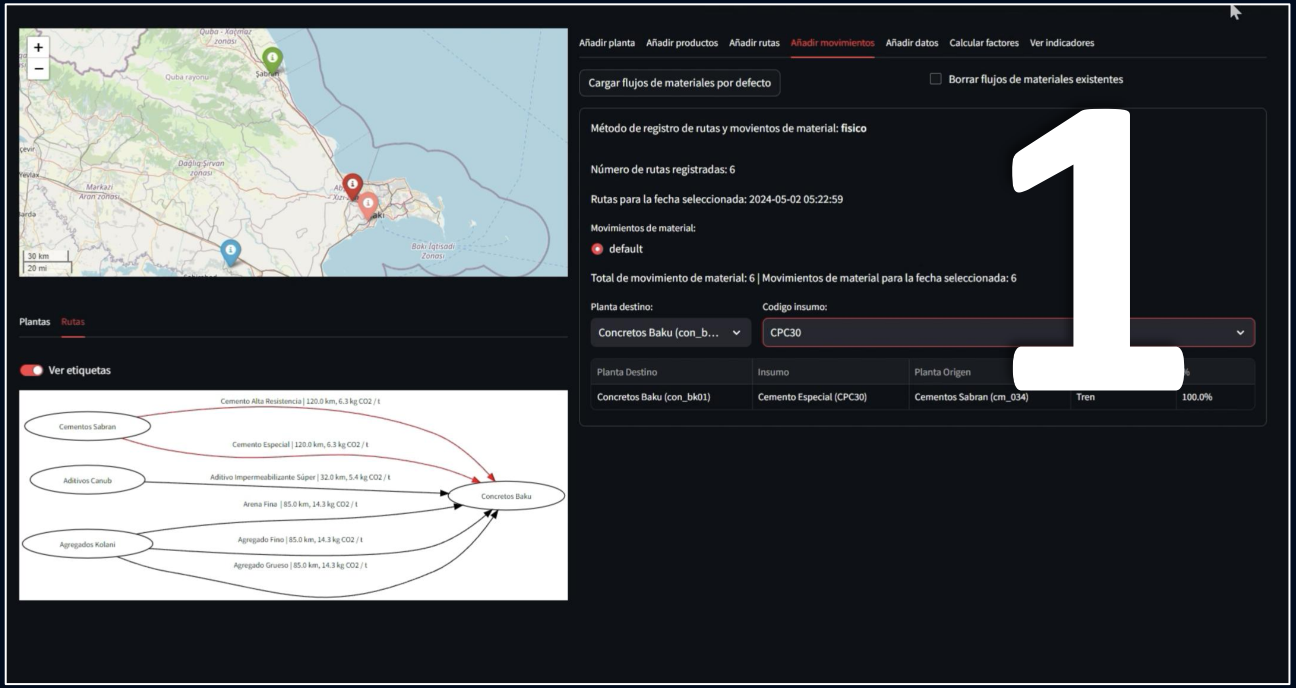
CO2 (kg/m3)
800
600
400
200
0
Volumen (m3)
12
10
8
6
4
2
Resistencia (kg/cm2)
600
500
400
300
200
100

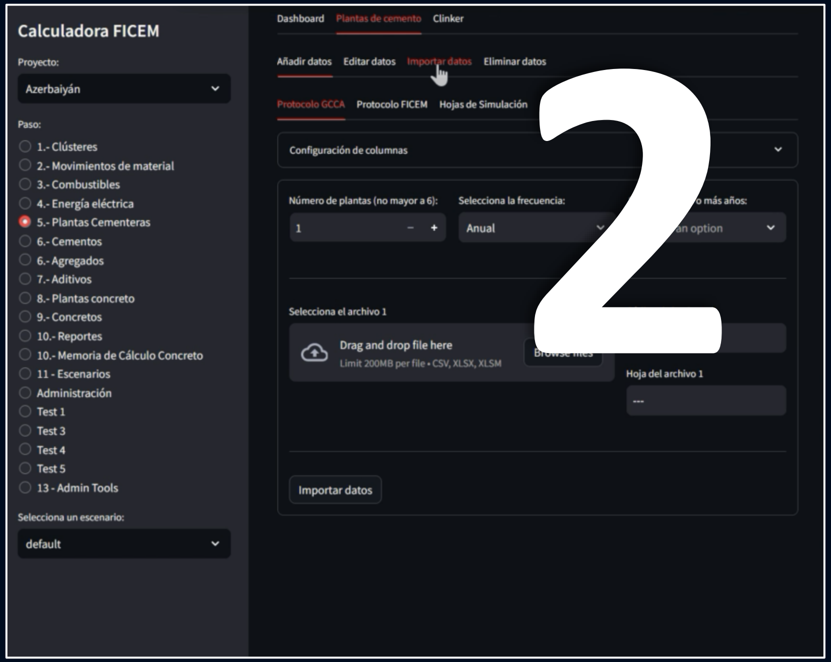


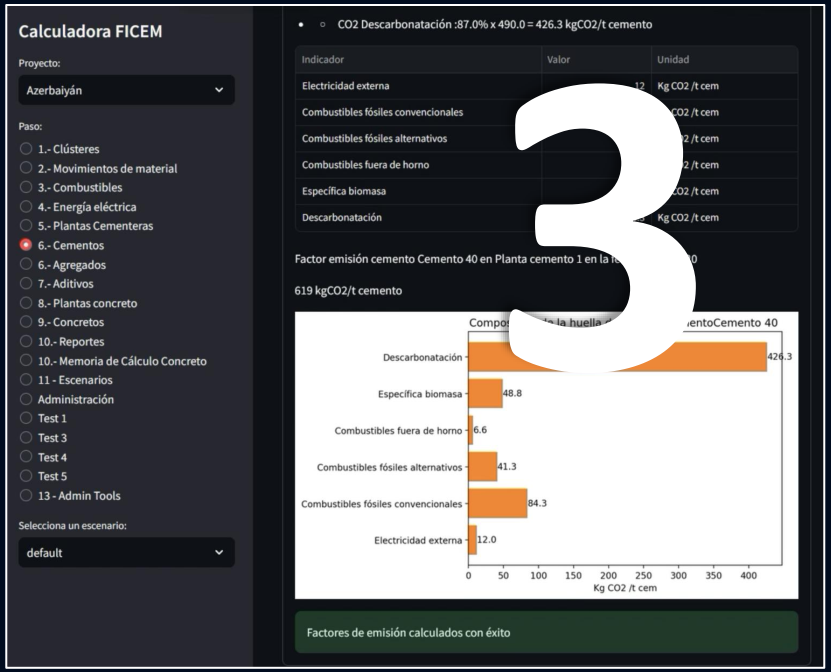
CO2 (kg/m3)
800
600
400
200
0
Resistencia (kg/cm2)
0
100
200
300
400
500
600
Volumen (m3)
2
4
6
8
10
12
Planta=PLANTA VALLEJO
Resistencia (kg/cm2)=100
Volumen (m3)=6
CO2 (kg/m3)=45.77468

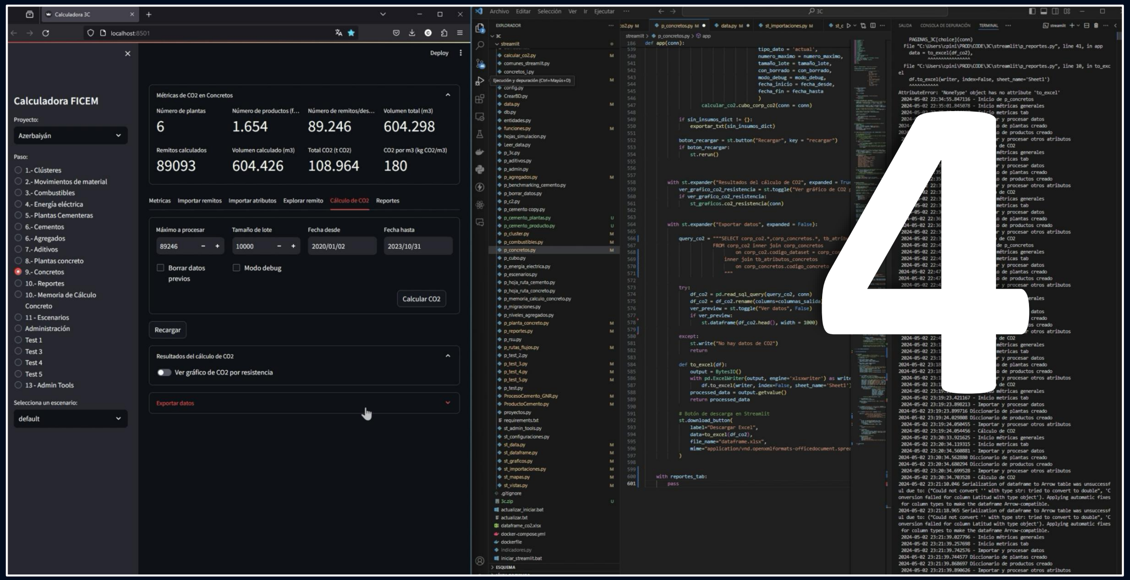


CO2 (kg/m3)
800
600
400
200
0
0
100
200
300
400
500
600
Resistencia (kg/cm2)
Volumen (m3)
2
4
6
8
10
12


1
Añadir planta
Añadir productos
Añadir rutas
Añadir movimientos
Añadir datos
Calcular factores
Ver indicadores
Cargar flujos de materiales por defecto
Borrar flujos de materiales existentes
Método de registro de rutas y movientos de material: fisico
Número de rutas registradas: 6
Rutas para la fecha seleccionada: 2024-05-02 05:22:59
Movimientos de material:
default
Total de movimiento de material: 6 | Movimientos de material para la fecha seleccionada: 6
Planta destino:
Concretos Baku (con_b...
Codigo insumo:
CPC30
Planta Destino
Insumo
Planta Origen
Concretos Baku (con_bk01)
Cemento Especial (CPC30)
Cementos Sabran (cm_034)
Tren
100.0%
Plantas
Rutas
Ver etiquetas
Cementos Sabran
Aditivos Canub
Agregados Kolani
Concretos Baku
Cemento Alta Resistencia | 120.0 km, 6.3 kg CO2 / t
Cemento Especial | 120.0 km, 6.3 kg CO2 / t
Aditivo Impermeabilizante Súper | 32.0 km, 5.4 kg CO2 / t
Arena Fina | 85.0 km, 14.3 kg CO2 / t
Agregado Fino | 85.0 km, 14.3 kg CO2 / t
Agregado Grueso | 85.0 km, 14.3 kg CO2 / t


2
Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
Dashboard
Plantas de cemento
Clinker
Añadir datos
Editar datos
Importar datos
Eliminar datos
Protocolo GCCA
Protocolo FICEM
Hojas de Simulación
Configuración de columnas
Número de plantas (no mayor a 6):
Selecciona la frecuencia:
Anual
Selecciona el archivo 1
Drag and drop file here
Limit 200MB per file • CSV, XLSX, XLSM
Hoja del archivo 1
Importar datos


3
Calculadora FICEM
Proyecto:
Azerbaiyán
Paso:
1.- Clústeres
2.- Movimientos de material
3.- Combustibles
4.- Energía eléctrica
5.- Plantas Cementeras
6.- Cementos
6.- Agregados
7.- Aditivos
8.- Plantas concreto
9.- Concretos
10.- Reportes
10.- Memoria de Cálculo Concreto
11 - Escenarios
Administración
Test 1
Test 3
Test 4
Test 5
13 - Admin Tools
Selecciona un escenario:
default
CO2 Descarbonatación :87.0% x 490.0 = 426.3 kgCO2/t cemento
Indicador
Valor
Unidad
Electricidad externa
Combustibles fósiles convencionales
Combustibles fósiles alternativos
Combustibles fuera de horno
Específica biomasa
Descarbonatación
Kg CO2 /t cem
619 kgCO2/t cemento
Descarbonatación
Específica biomasa
Combustibles fuera de horno
Combustibles fósiles alternativos
Combustibles fósiles convencionales
Electricidad externa
426.3
48.8
6.6
41.3
84.3
12.0
Kg CO2 /t cem
Factores de emisión calculados con éxito


4
Calculadora FICEM
Métricas de CO2 en Concretos
Número de plantas
6
1.654
89.246
604.298
89093
604.426
108.964
180
Calcular CO2
Recargar
Resultados del cálculo de CO2
Exportar datos

3C pilotos

Herramientas FICEM

Capital humano

CONGRESO FICEM Cemento & concreto verde 2050

CONGRESO TÉCNICO FICEM 2025

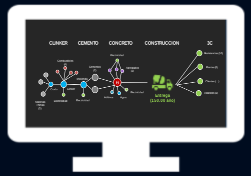
ACADEMIA FICEM

Innovación

MISIÓN MULTIPAÍS FICEM

MISIÓN TECNOLÓGICA CEO

Números correctos



3C pilotos

Certeza Jurídica

Estrategía Marcos Regulatorios

Herramientas FICEM

Capital humano

CONGRESO FICEM Cemento & concreto verde 2050

CONGRESO TÉCNICO FICEM 2025

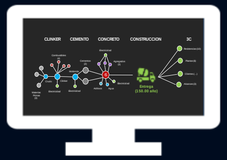
ACADEMIA FICEM

Innovación

MISIÓN MULTIPAÍS FICEM

MISIÓN TECNOLÓGICA CEO

Números correctos



3C pilotos

Certeza Jurídica


Informe Marcos Regulatorios:
Descarbonización Sector Cemento
2025

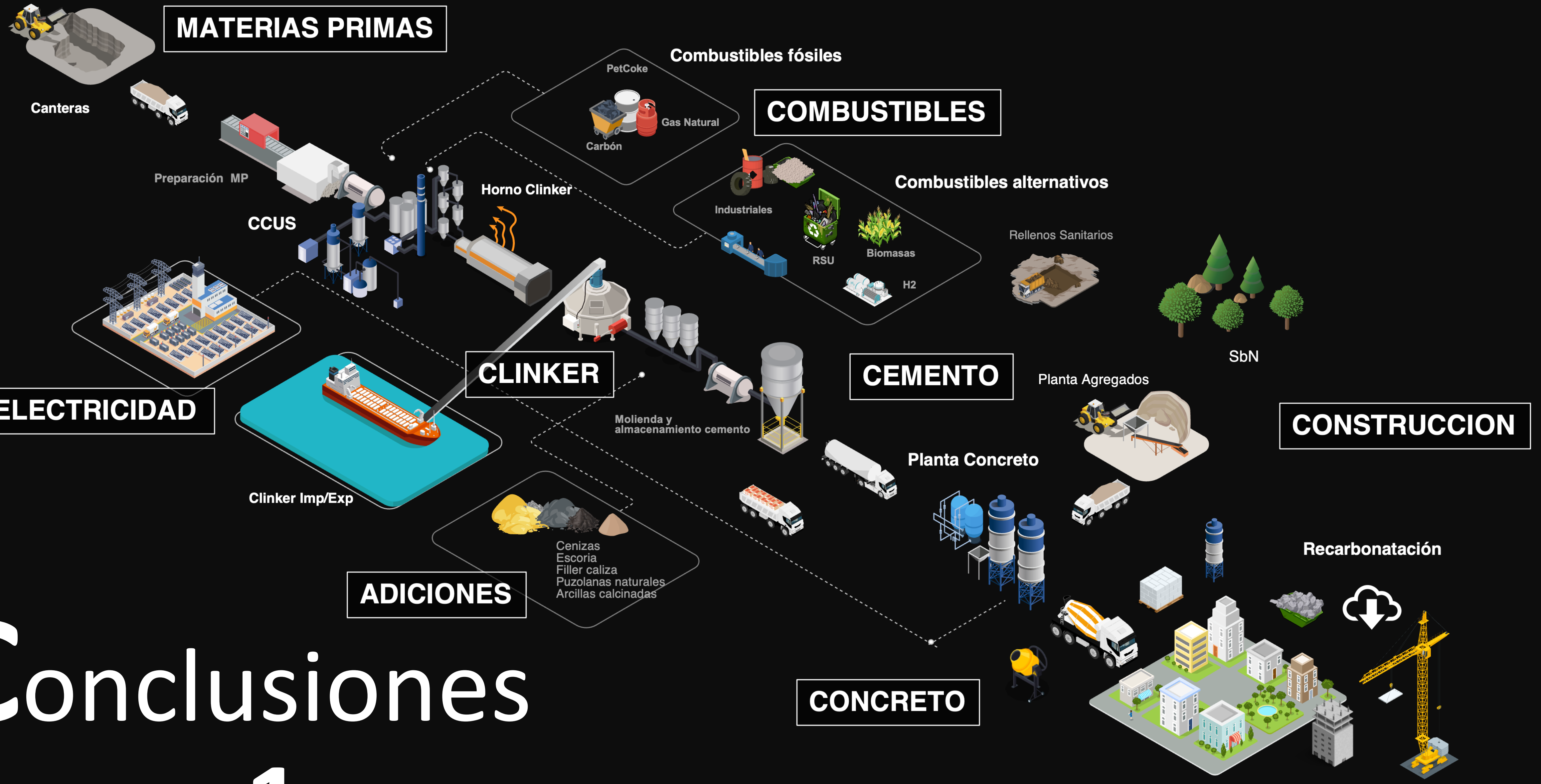
Contexto

Net **Z**ero **FICEM**

Desafíos **NZ**

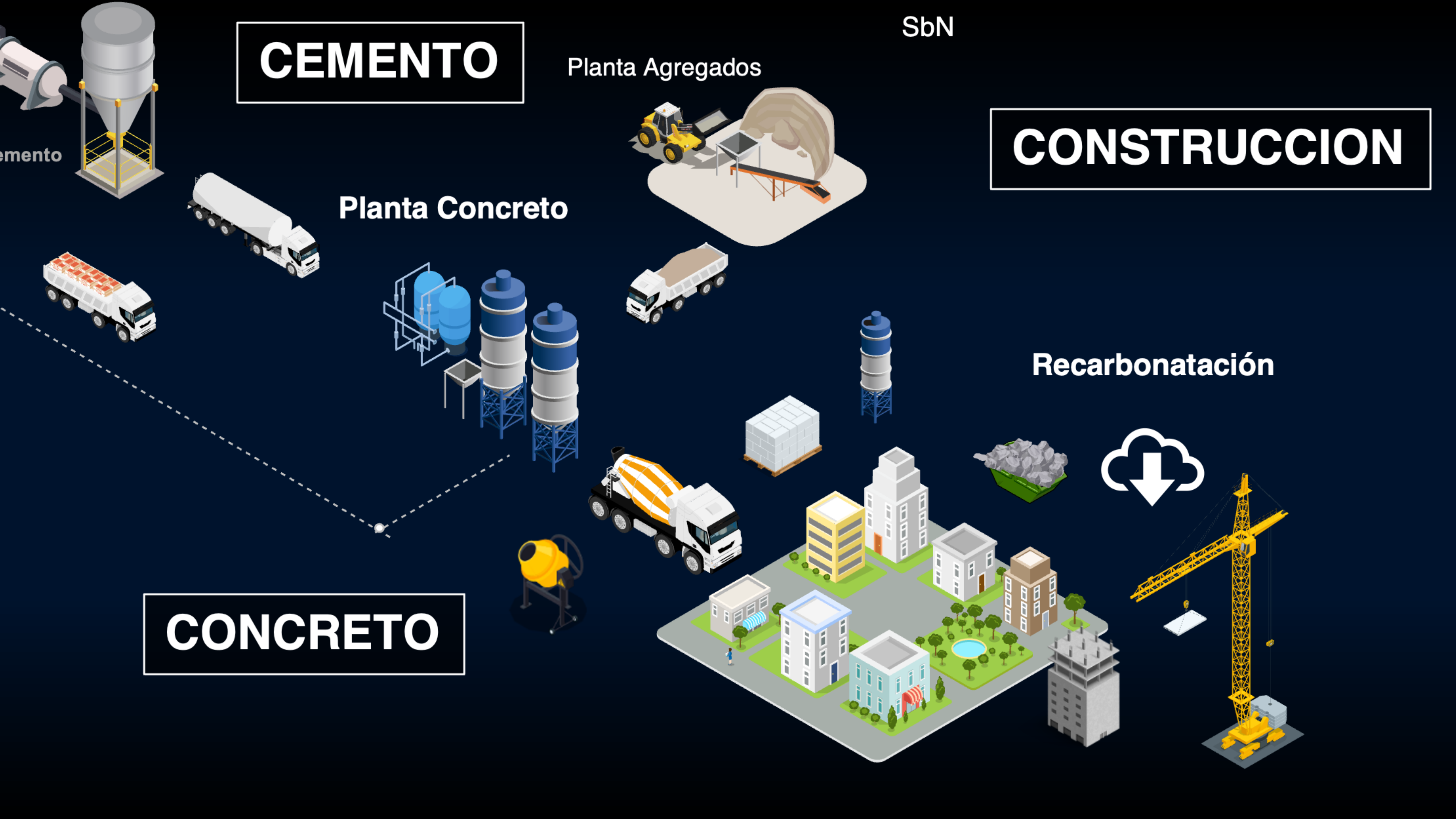
Herramientas **FICEM**

Conclusiones



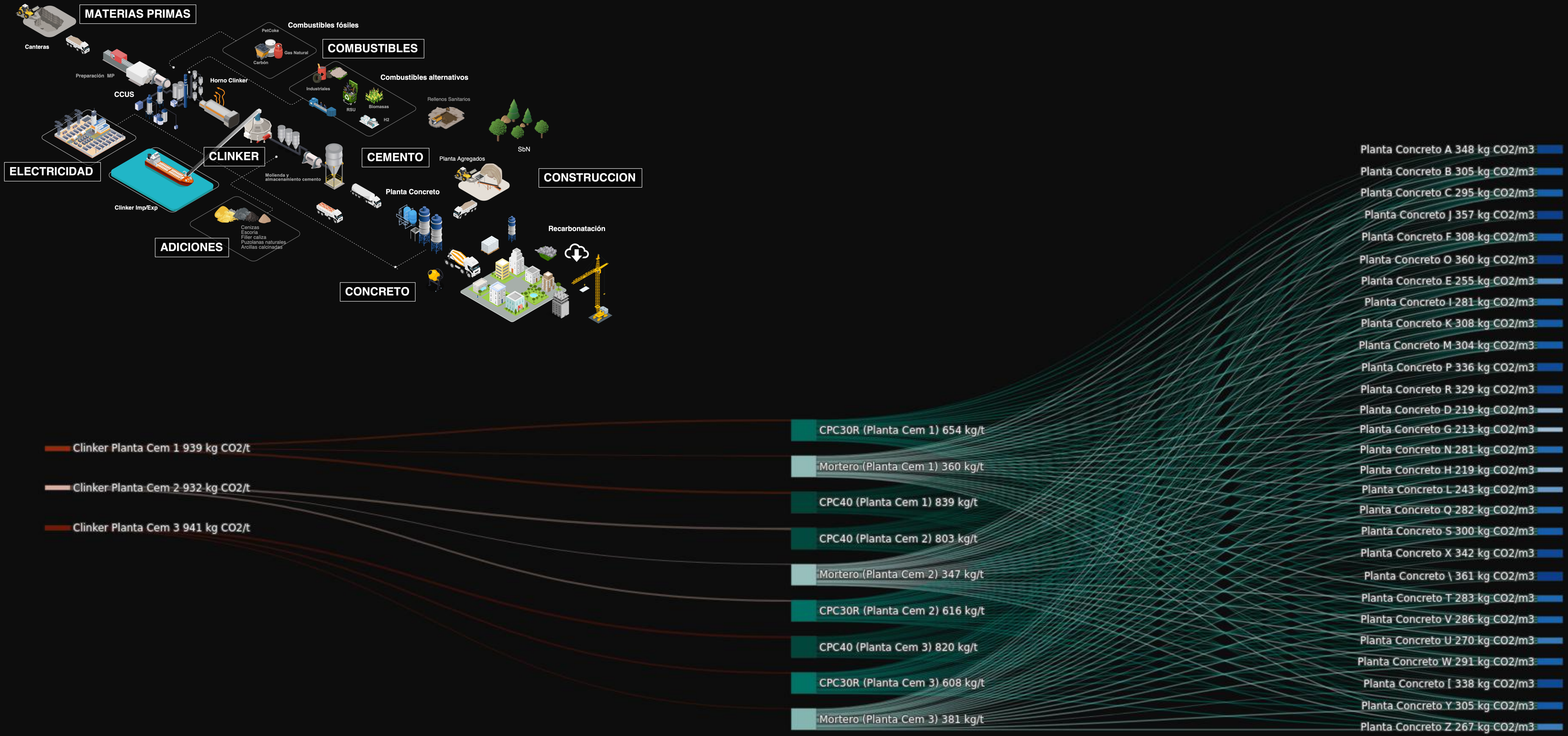
Conclusiones

1/4



CEMENTO
SbN
Planta Agregados
CONSTRUCCION
emento
Planta Concreto
Recarbonatación
CONCRETO

Biomasas
H2
Rellenos Sanitarios
SbN
CEMENTO
Planta Agregados
CONSTRUC
Planta Concreto

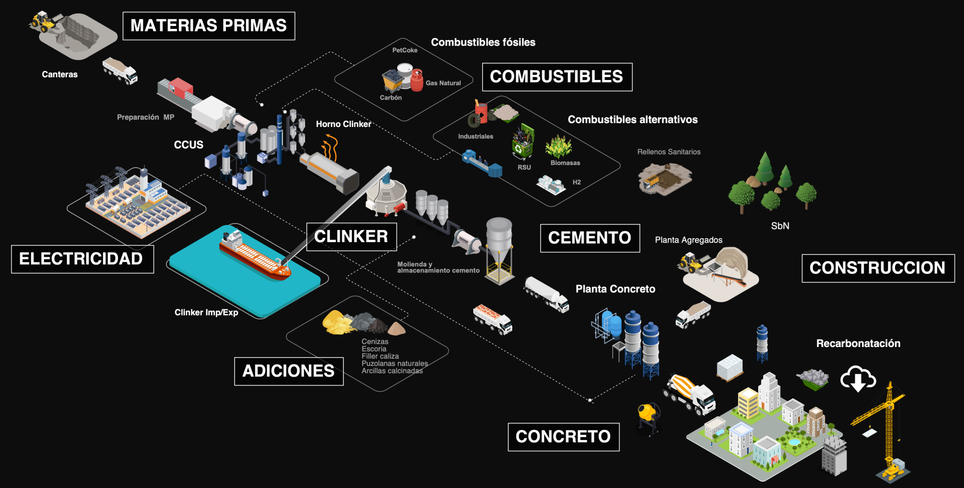


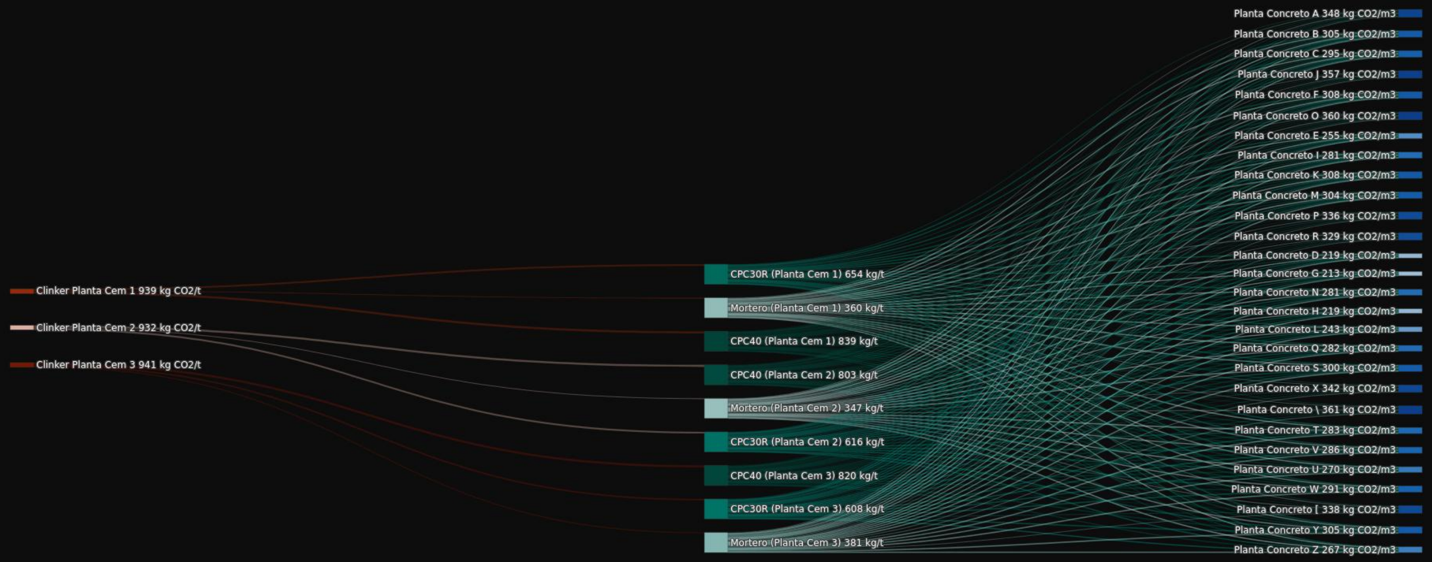
3 plantas · 932-941 kg CO2/t

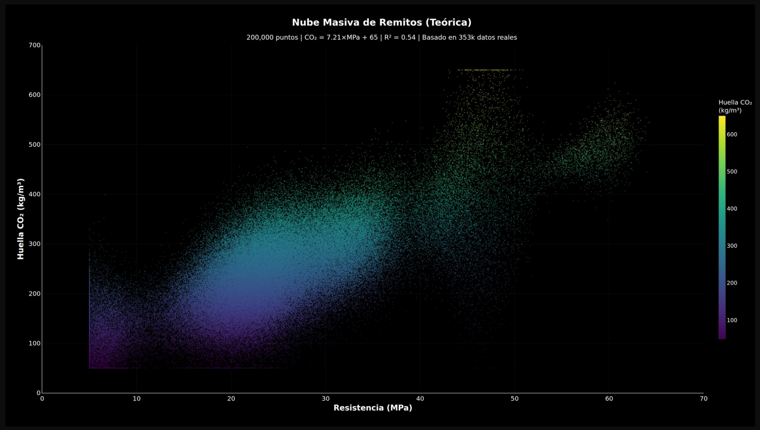
9 tipos · 347-839 kg CO2/t · 8.1M t producidas

218,480 remitos · 1,451,300 m3 · 28 plantas

Intensidad de color proporcional a emisiones CO2. Año 2025.







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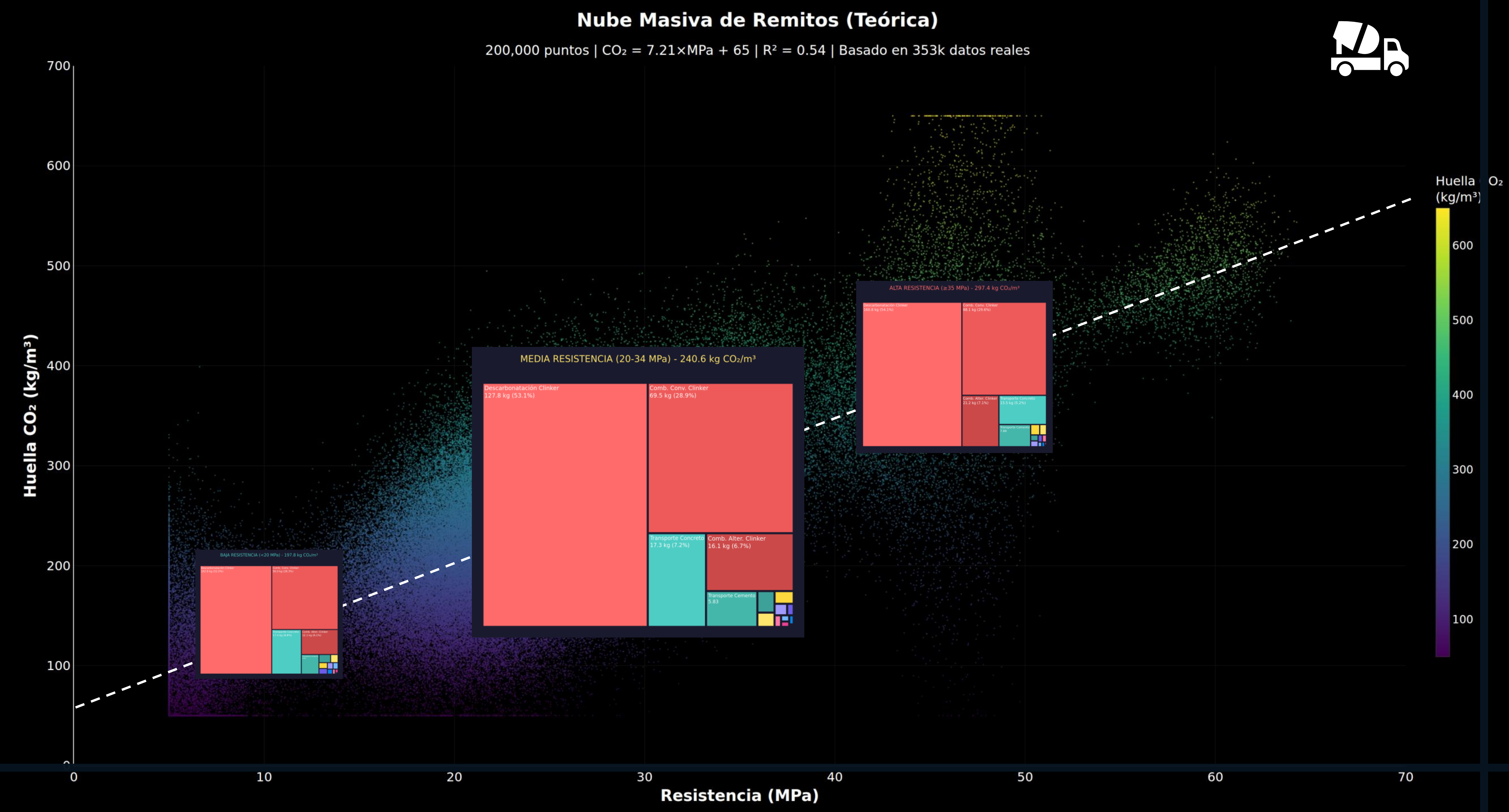

Nube Masiva de Remitos (Teórica)
200,000 puntos | CO₂ = 7.21×MPa + 65 | R² = 0.54 | Basado en 353k datos reales
Huella CO₂ (kg/m³)
Resistencia (MPa)
0
10
20
30
40
50
60
70
100
200
300
400
500
600
700
BAJA RESISTENCIA (<20 MPa) - 197.8 kg CO₂/m³
Descarbonatación Clinker
Comb. Conv. Clinker
Transporte Concreto
Comb. Alter. Clinker
MEDIA RESISTENCIA (20-34 MPa) - 240.6 kg CO₂/m³
Descarbonatación Clinker
127.8 kg (53.1%)
Comb. Conv. Clinker
69.5 kg (28.9%)
Transporte Concreto
17.3 kg (7.2%)
Comb. Alter. Clinker
16.1 kg (6.7%)
Transporte Cemento
5.83
ALTA RESISTENCIA (≥35 MPa) - 297.4 kg CO₂/m³
Descarbonatación Clinker
160.8 kg (54.1%)
Comb. Conv. Clinker
88.1 kg (29.6%)
Comb. Alter. Clinker
21.2 kg (7.1%)
Transporte Concreto
15.5 kg (5.2%)
Transporte Cemento

Conclusiones

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Conclusiones
2/4

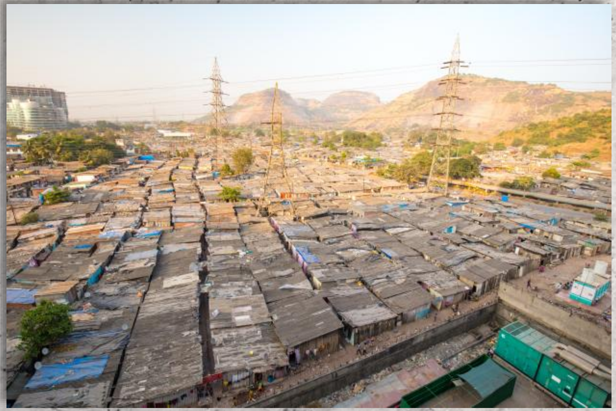
Conclusiones 3/4












Conclusiones

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FICEM
FEDERACIÓN INTERAMERICANA
DEL CEMENTO
Muchas gracias