NATURALLY HIGH PERFORMANCE INSULATION

isobio

How low (carbon) can you go? – Going below zero with bio-based materials

Callum Hill, NIBIO

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°636835.

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Why this matters

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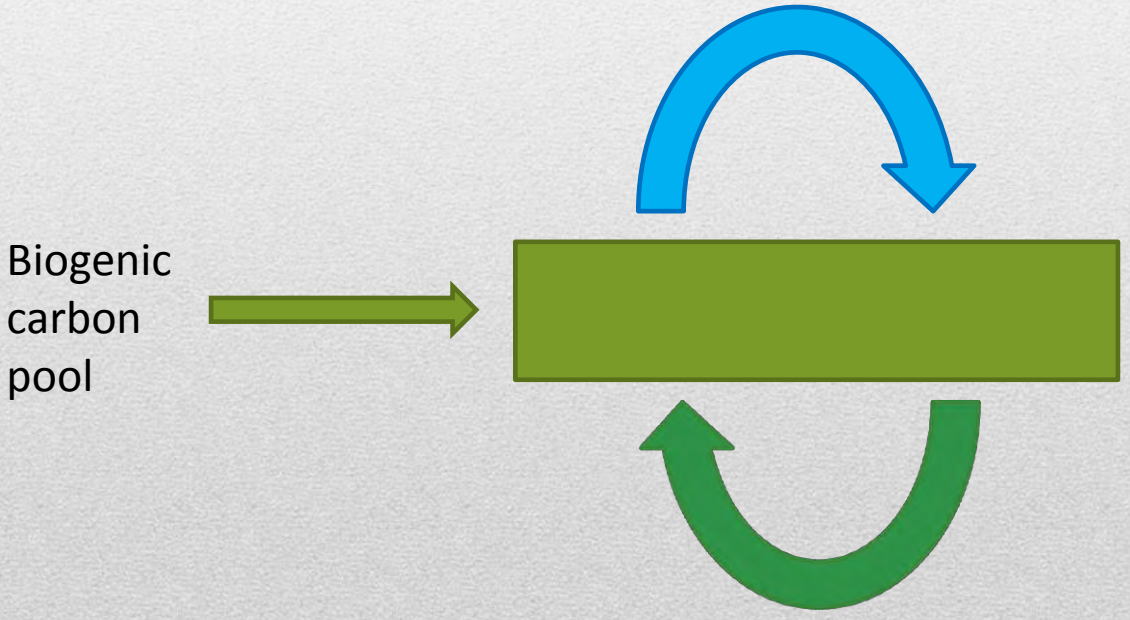
Why use biogenic materials in construction?

- Prior to the impact of the industrial revolution, the atmospheric carbon cycled through the biosphere, which was in equilibrium with the atmosphere



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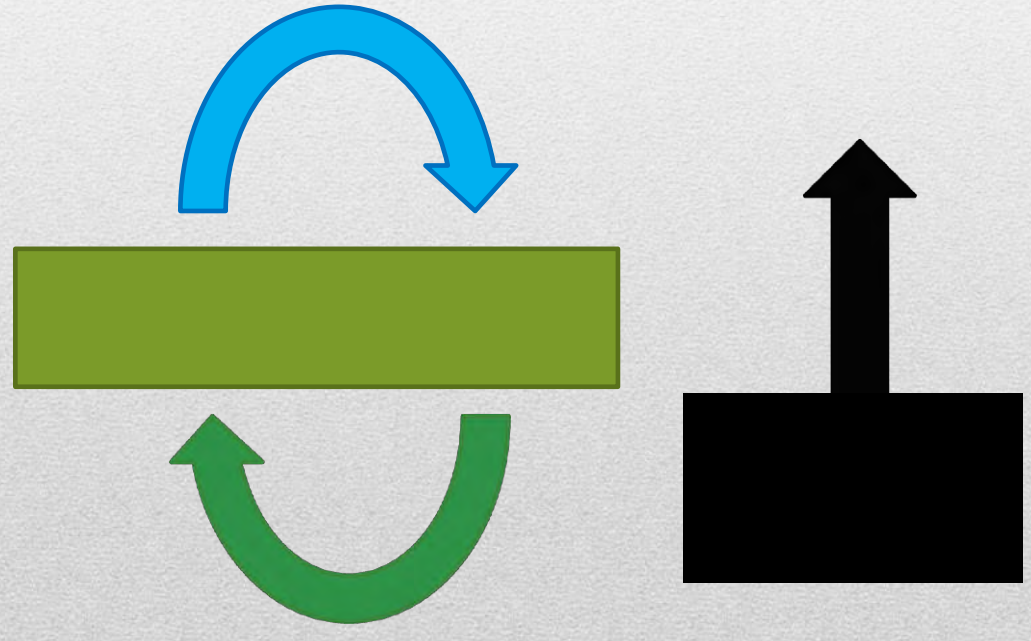
Impact of fossil CO_2

- With the advent of the industrial revolution, carbon from fossil sources was added to the atmosphere



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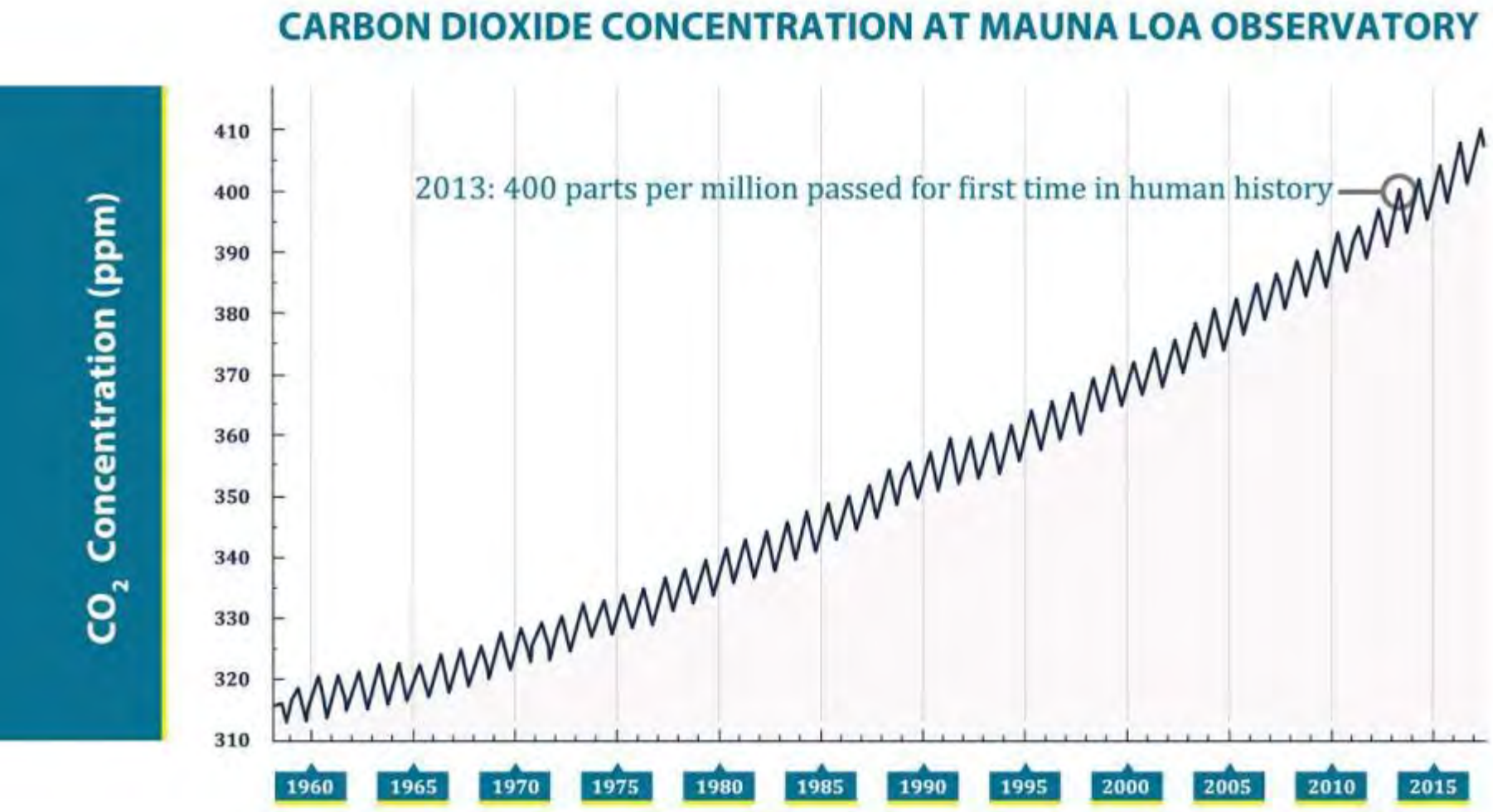
Keeling curve



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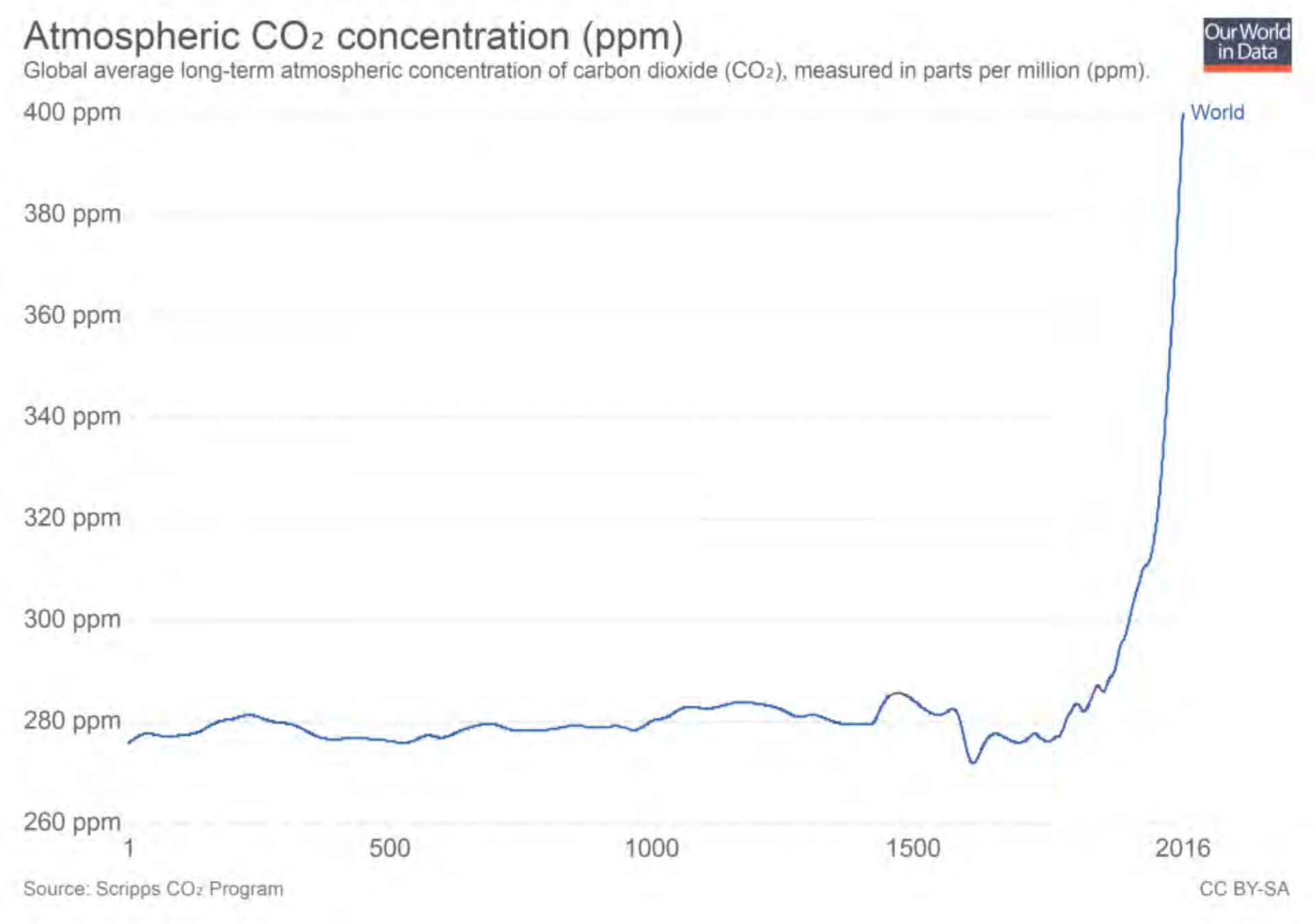
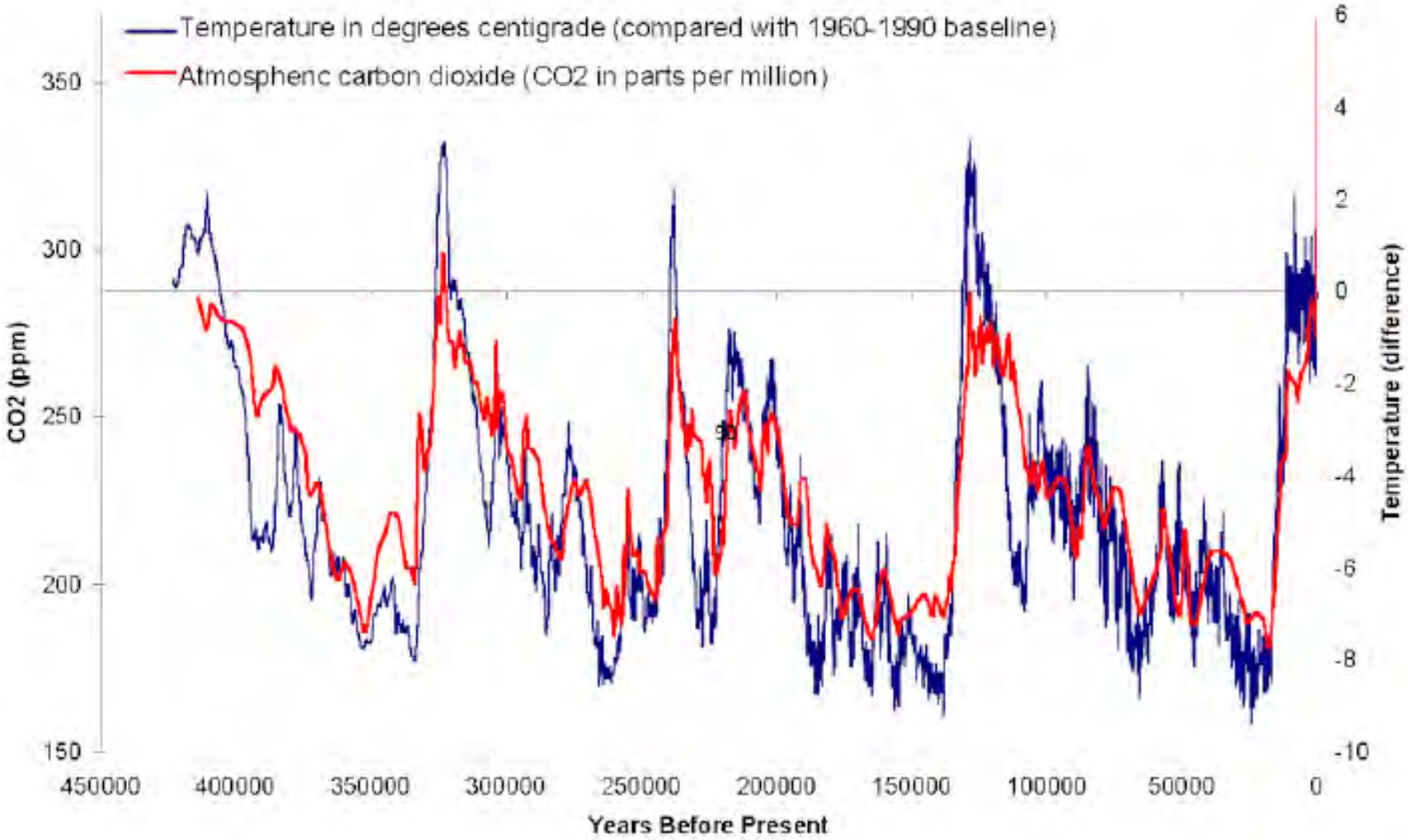

Atmospheric CO2 concentration (ppm)
Global average long-term atmospheric concentration of carbon dioxide (CO2), measured in parts per million (ppm).
Our World in Data
400 ppm
380 ppm
360 ppm
340 ppm
320 ppm
300 ppm
280 ppm
260 ppm
World
1
500
1000
1500
2016
Source: Scripps CO2 Program
CC BY-SA

CO_2 levels and global temperature



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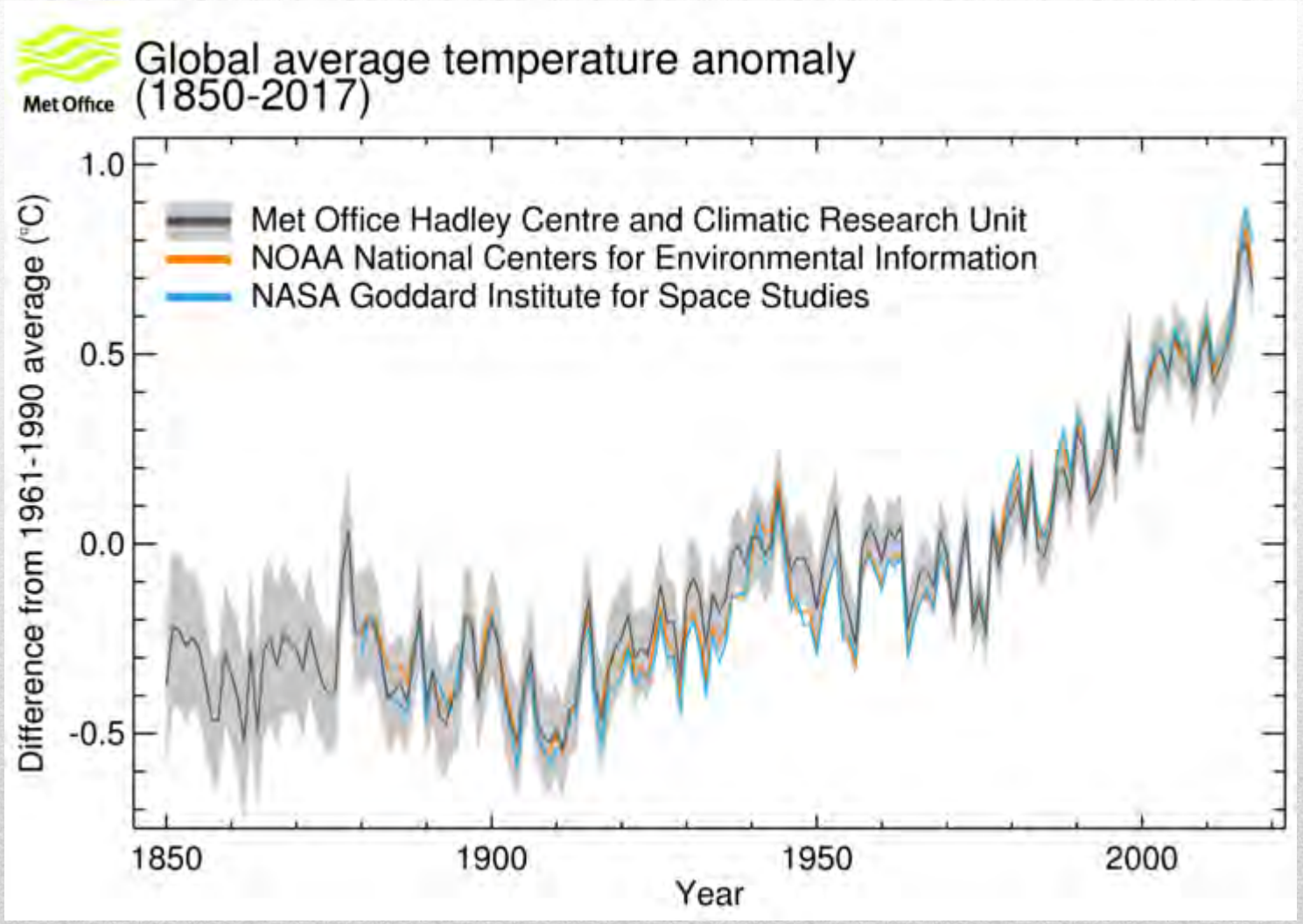

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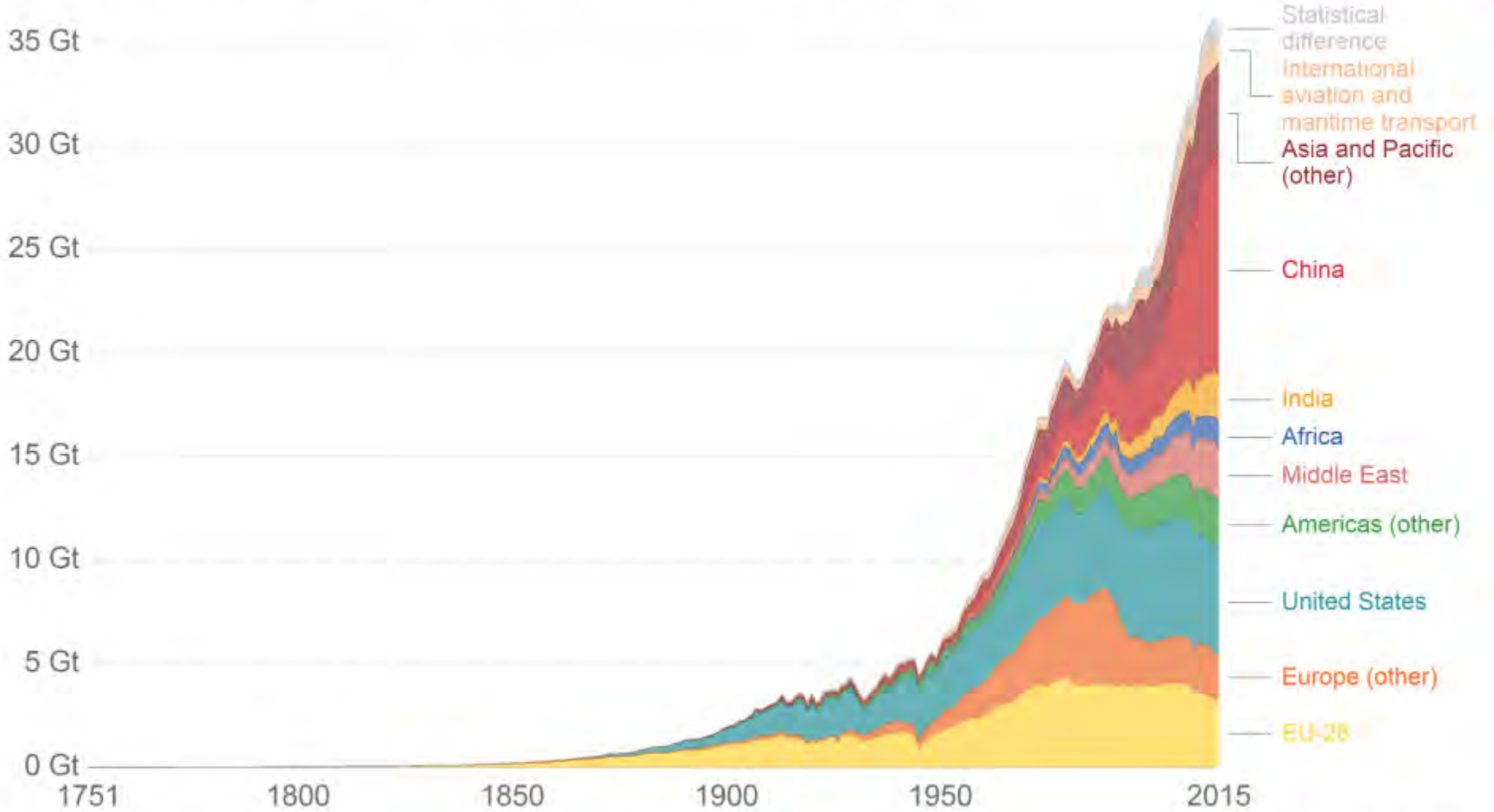
Annual CO_2 emissions by world region

Annual carbon dioxide (CO_2) emissions measured in billion tonnes (Gt) per year



Source: Carbon Dioxide Information Analysis Center (CDIAC)

Note: Emissions data have been converted from units of carbon to carbon dioxide (CO2) using a conversion factor of 3.67. Regions denoted "other" are given as regional totals minus emissions from the EU-28, USA, China and India. Here, we have rephrased the general term "bunker (fuels)" as "international aviation and maritime transport" for clarity.

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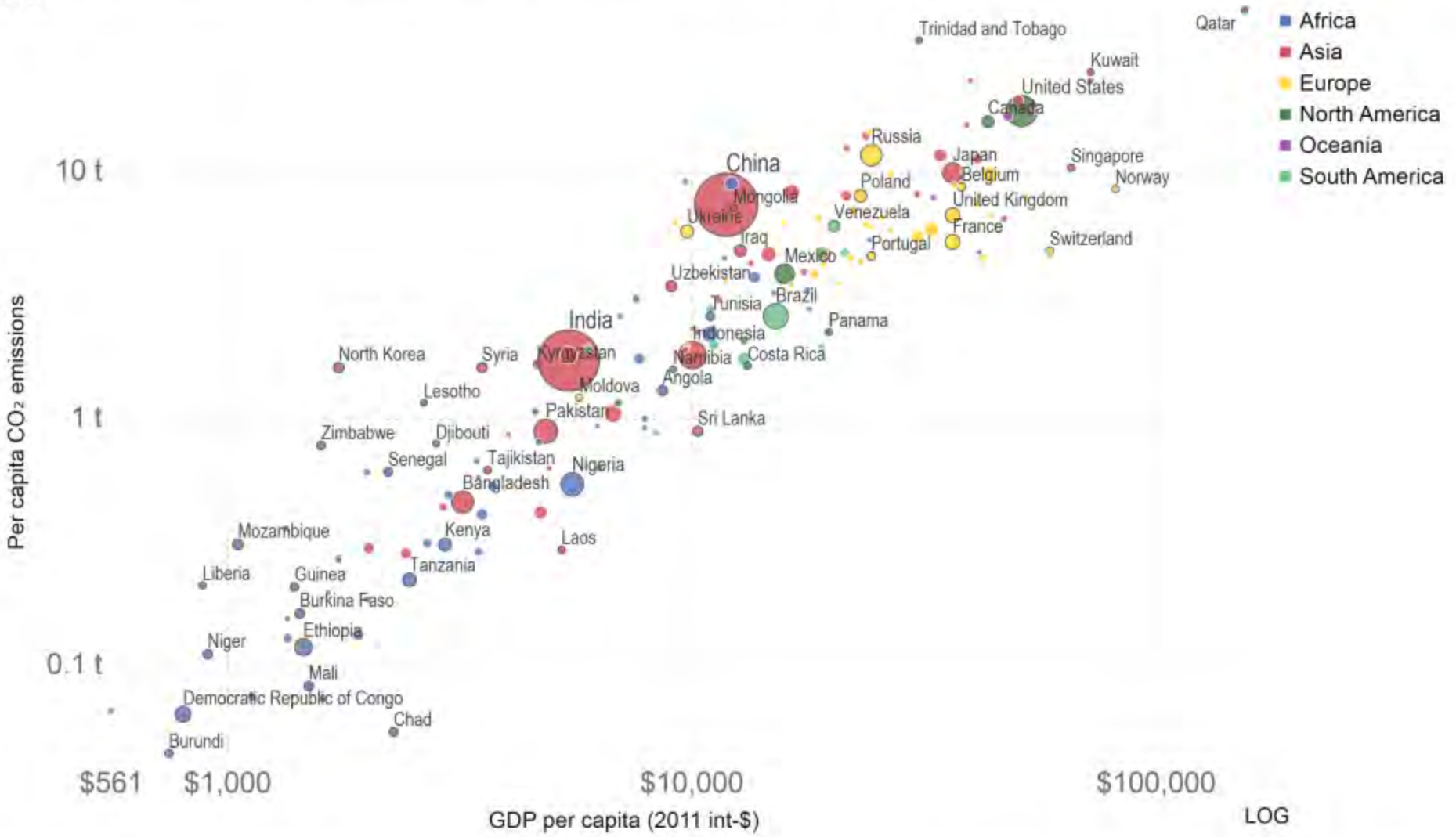
CO_2 emissions per capita vs GDP per capita, 2014

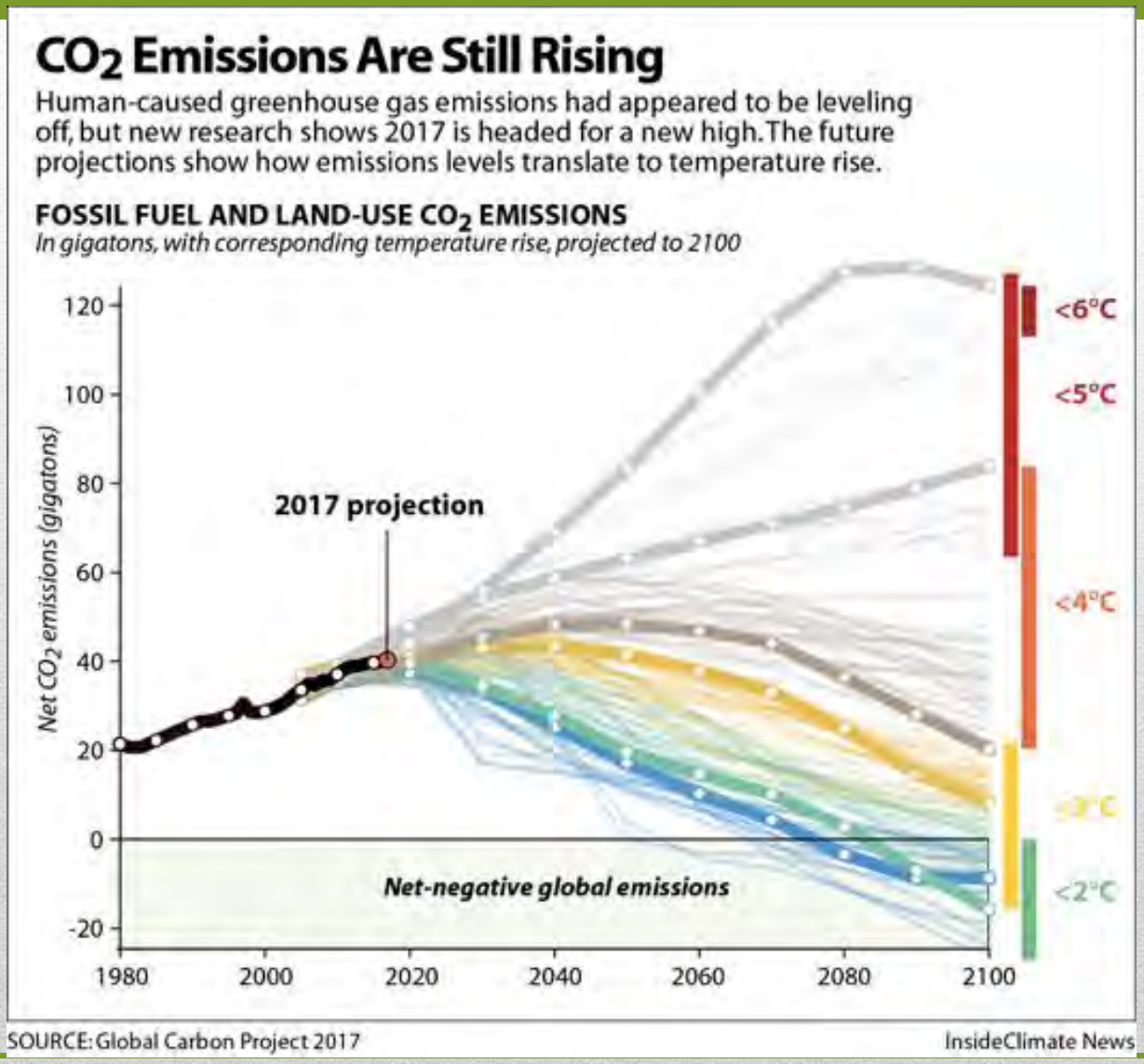
Carbon dioxide (CO_2) emissions per capita, measured in tonnes per person per year, versus gross domestic product (GDP) per capita, measured in 2011 international-$.

LOG



Source: Global Carbon Project, Maddison (2017)

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY-SA



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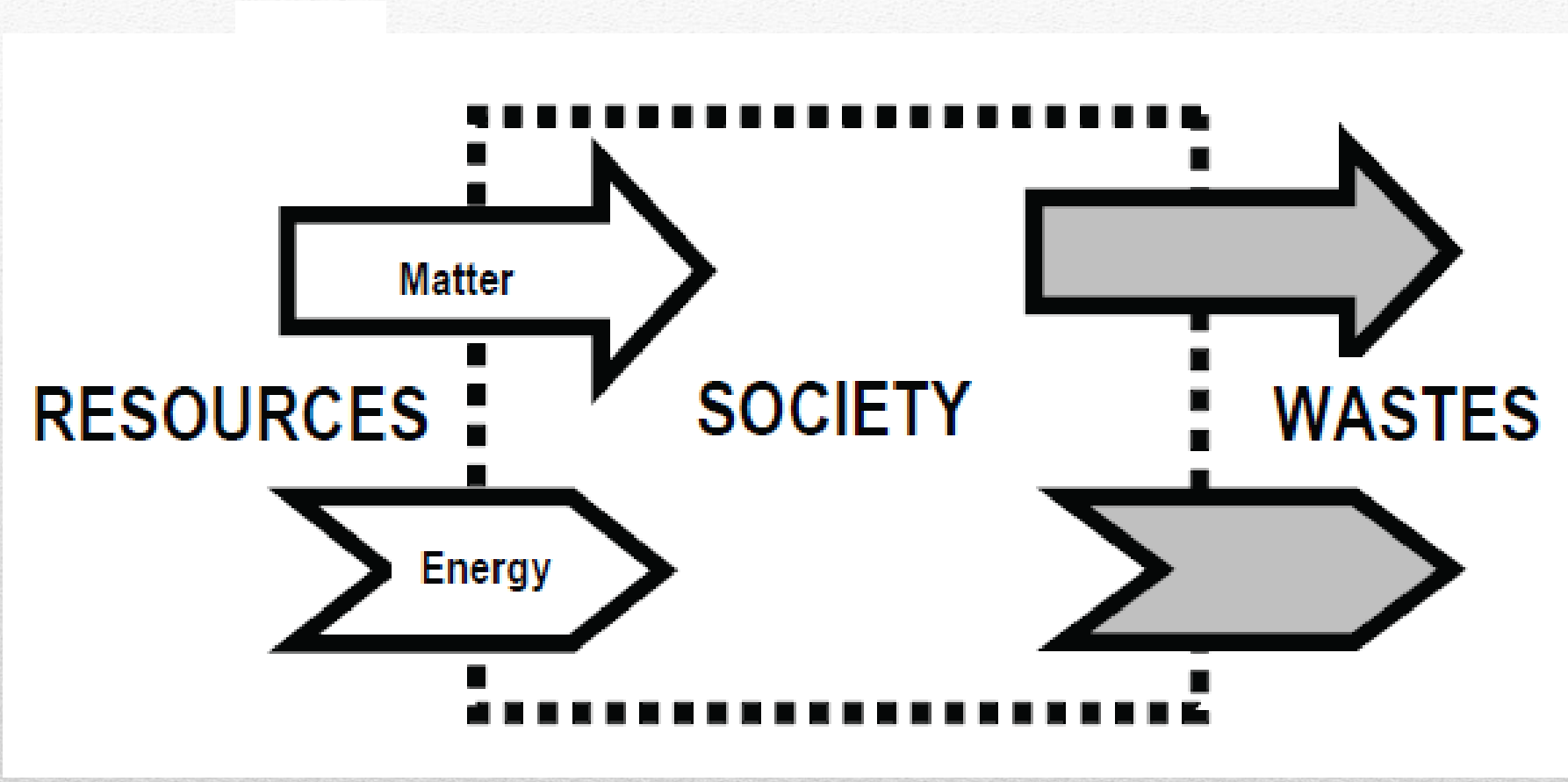
Linear flow



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The circular economy

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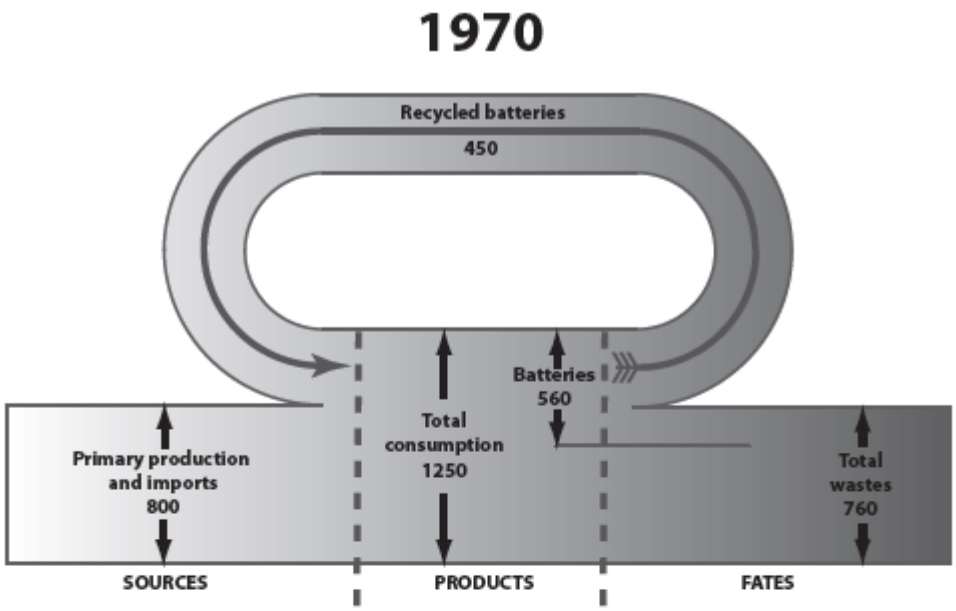
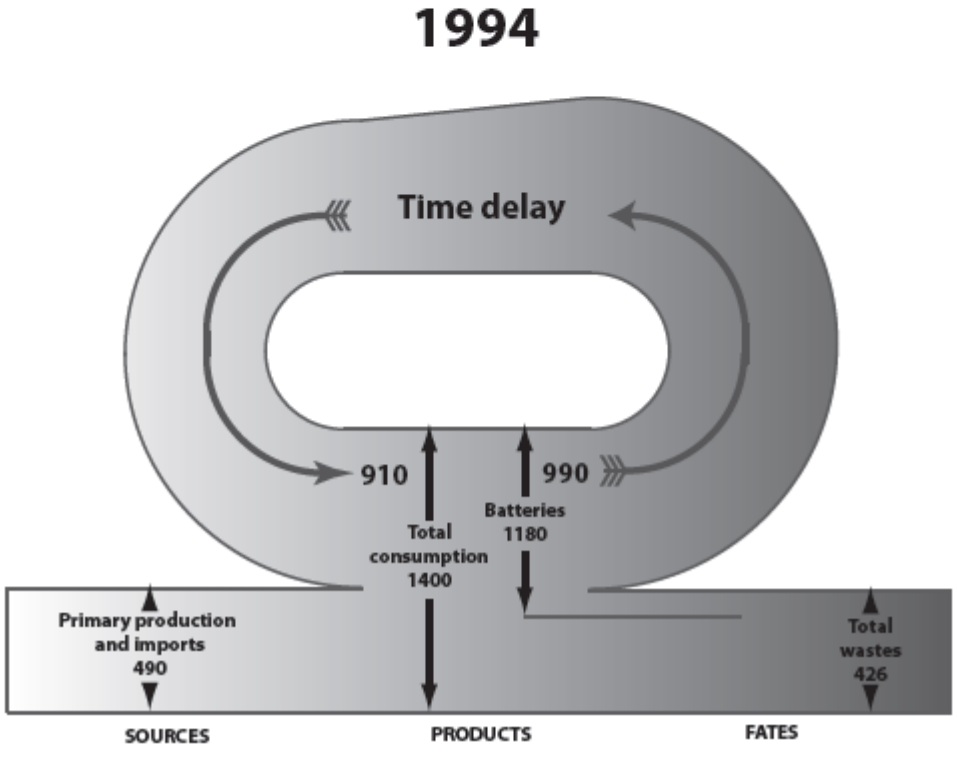
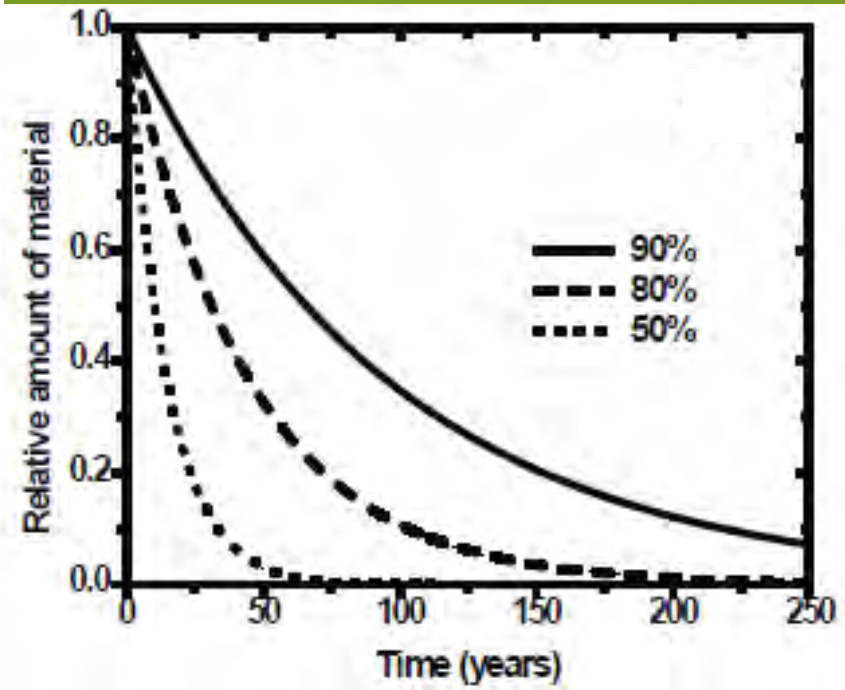
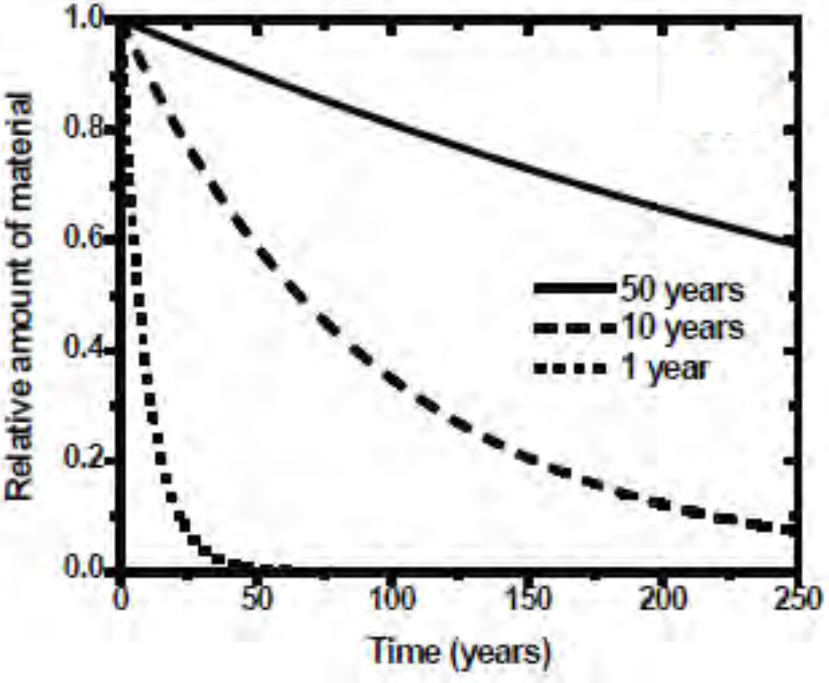
Pb in US


1970
Recycled batteries
450
Batteries
560
Total
consumption
1250
Primary production
and imports
800
Total
wastes
760
SOURCES
PRODUCTS
FATES


1994
Time delay
910
990
Batteries
1180
Total
consumption
1400
Primary production
and imports
490
Total
wastes
426
SOURCES
PRODUCTS
FATES



10 year lifetime



90% recycling rate

pean Union's Horizon 2020
t agreement N°636835.

The global carbon cycle and biogenic materials

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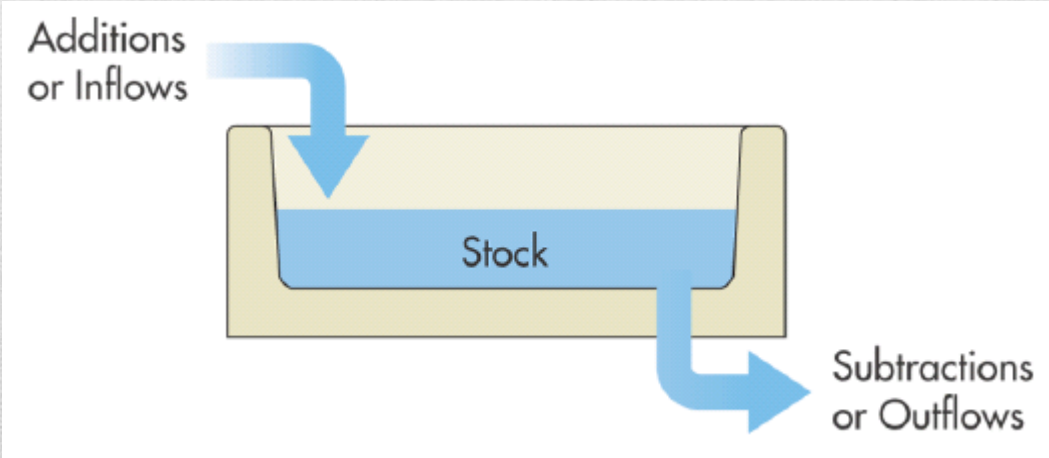
Stocks and flows



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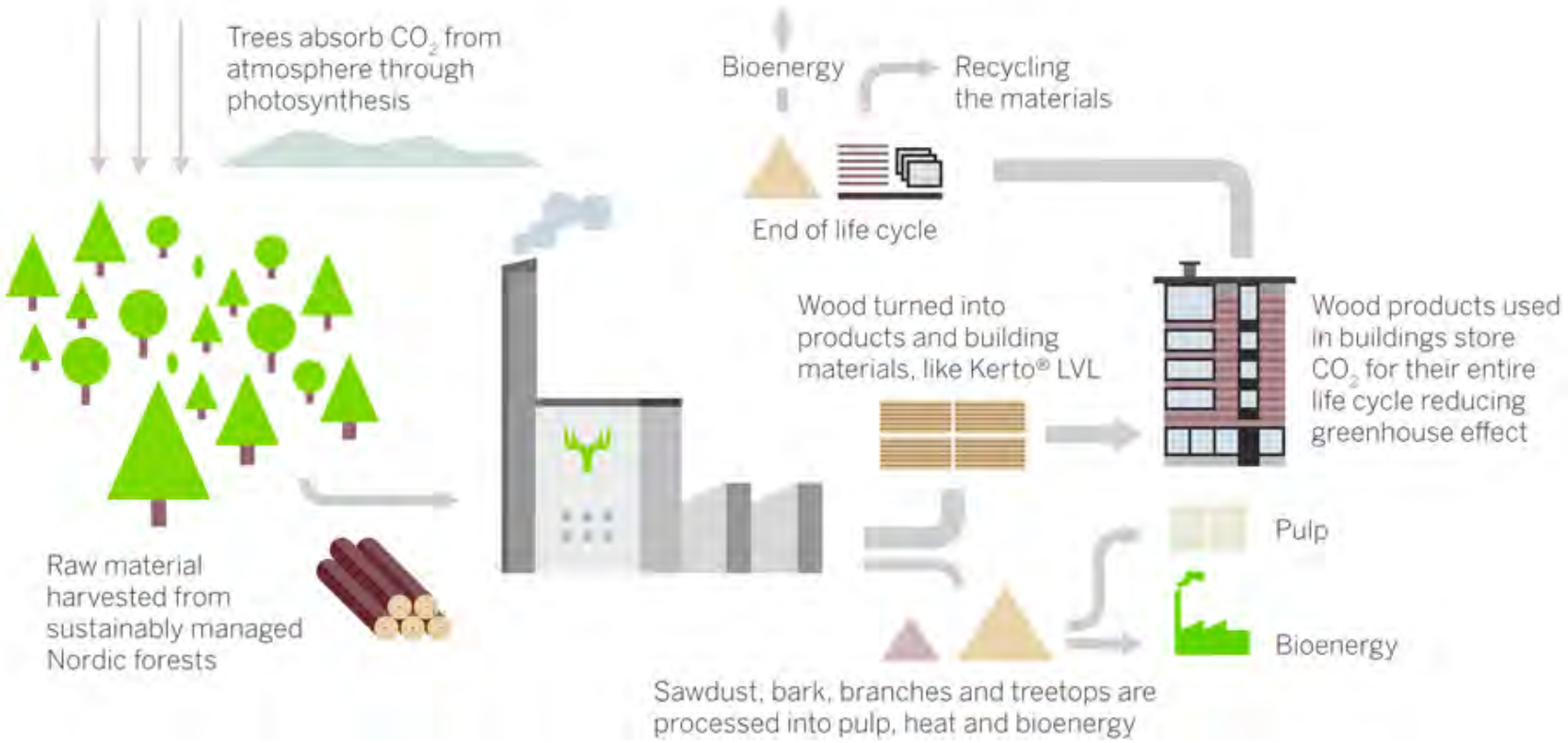
Storing atmospheric carbon in buildings



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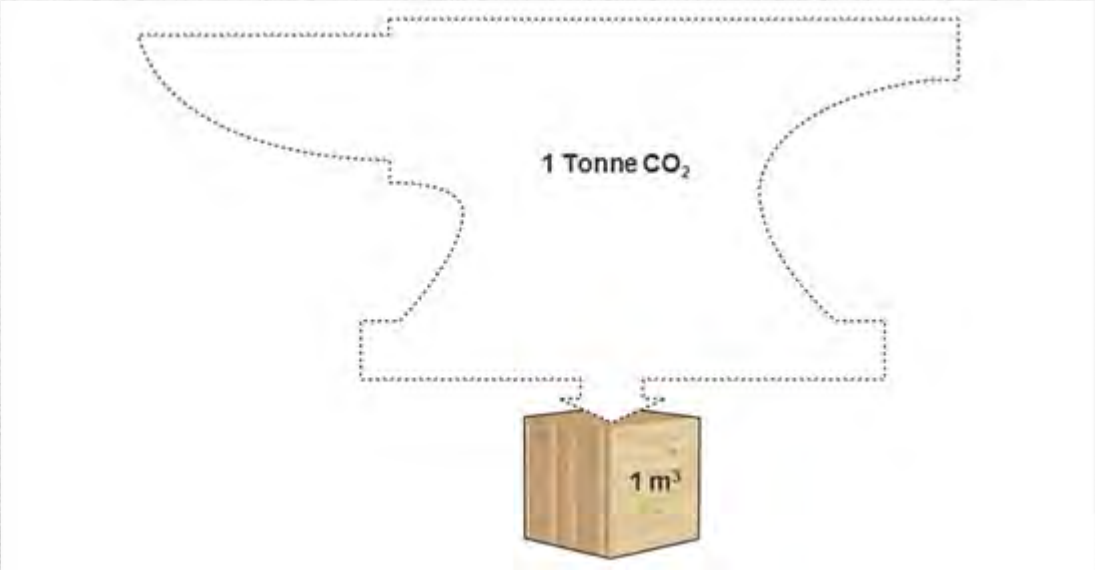
Sequestered carbon in wood



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ISOBIO objectives

‘To complete, by M48, life cycle assessment (LCA) and life cycle costing (LCC) of the ISOBIO products with the aim to deliver 50% reductions in embodied energy and carbon levels, ….’

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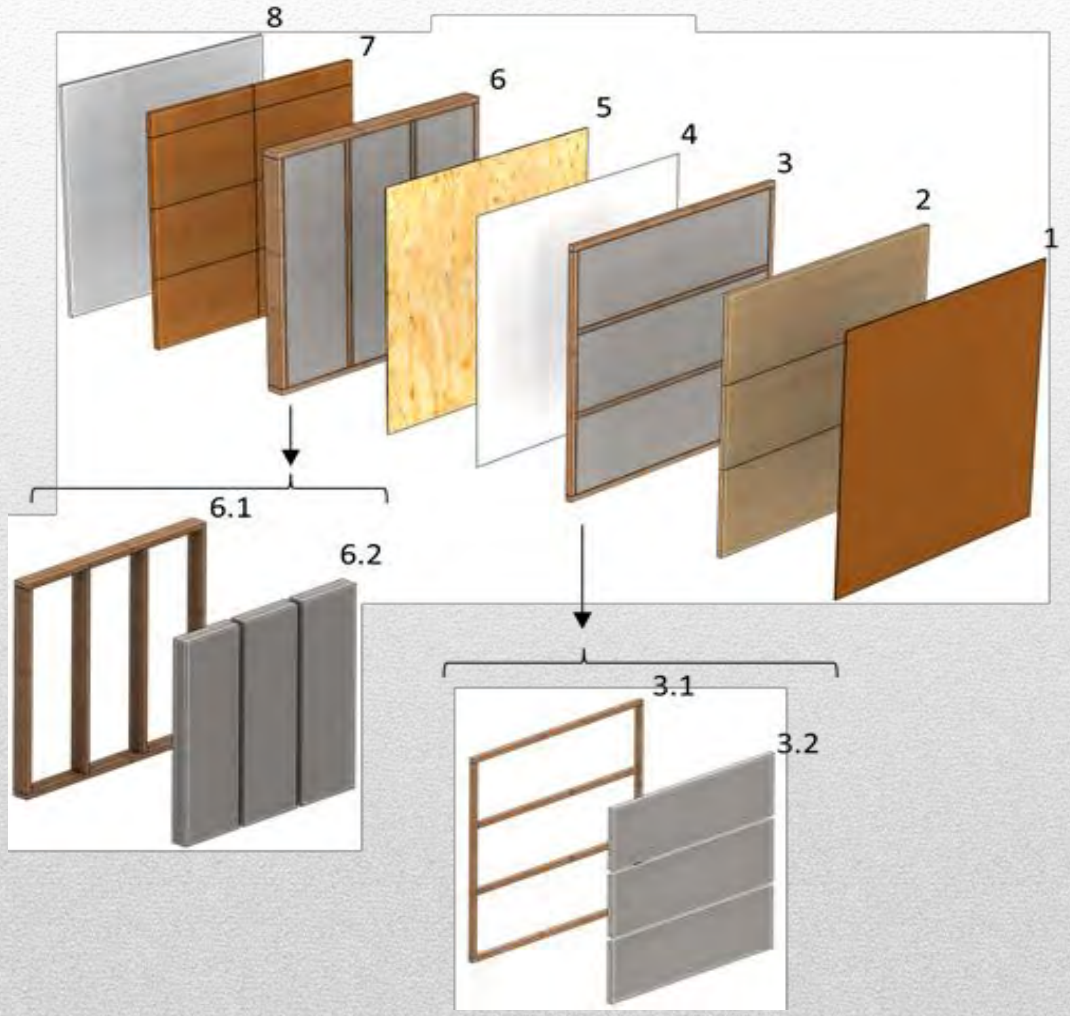
ISOBIO structural panel



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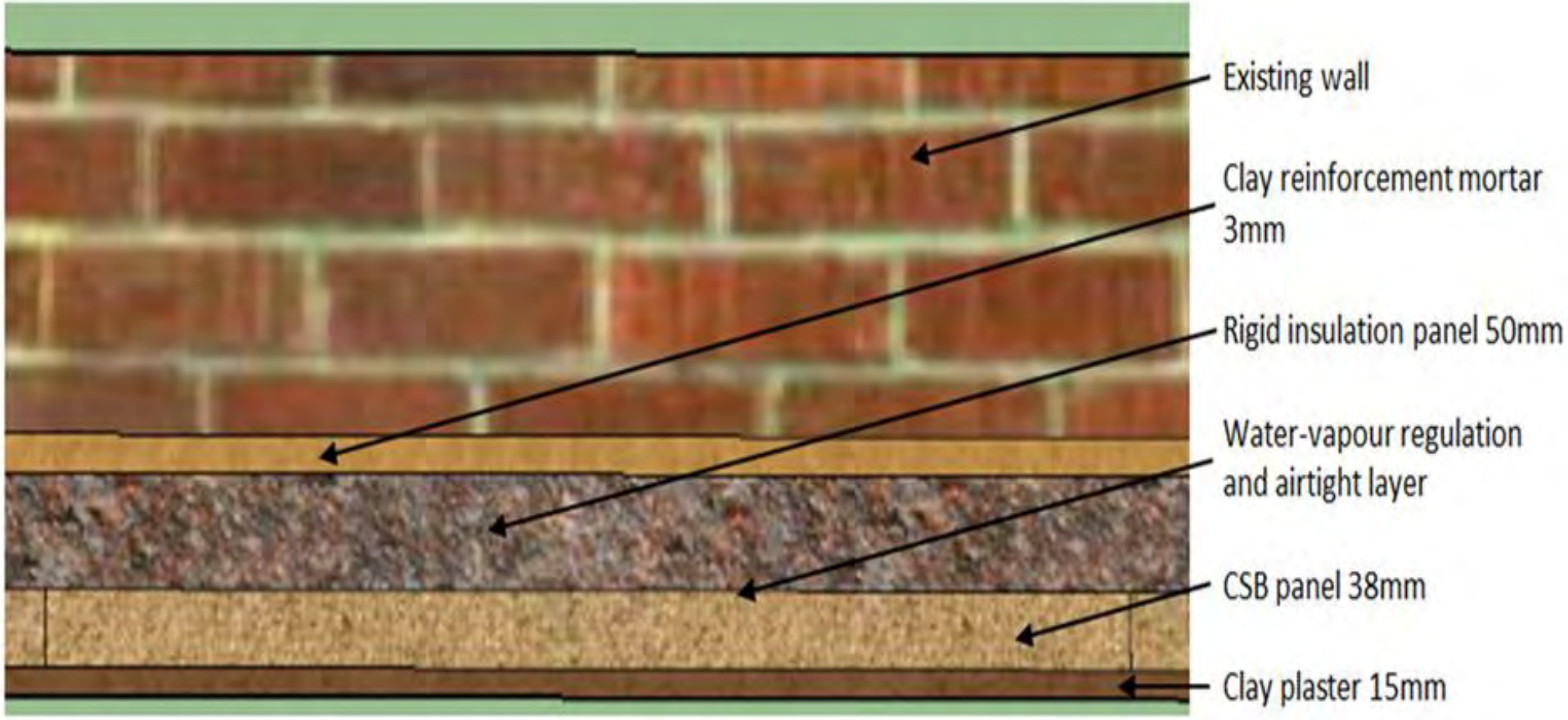
ISOBIO internal retrofit



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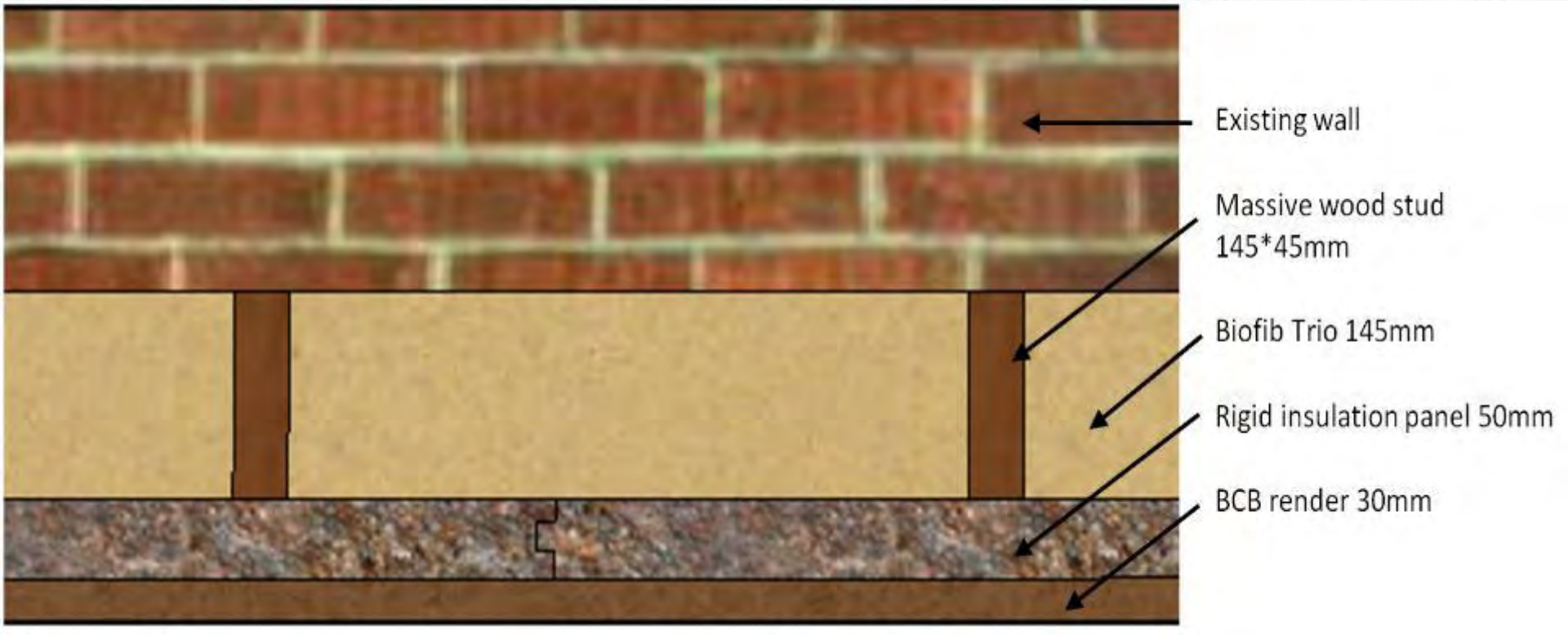
ISIBIO external retrofit



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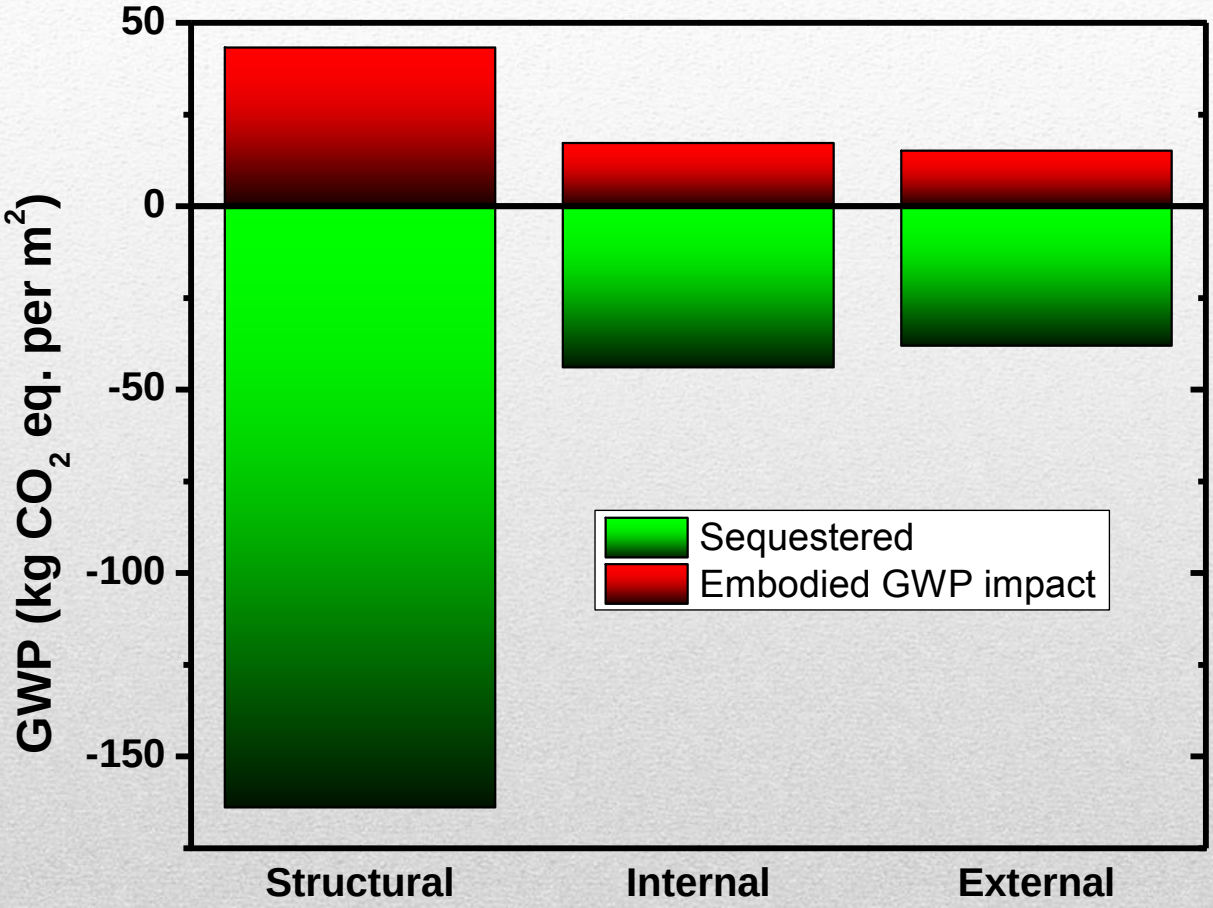
GWP of the three ISOBIO panels



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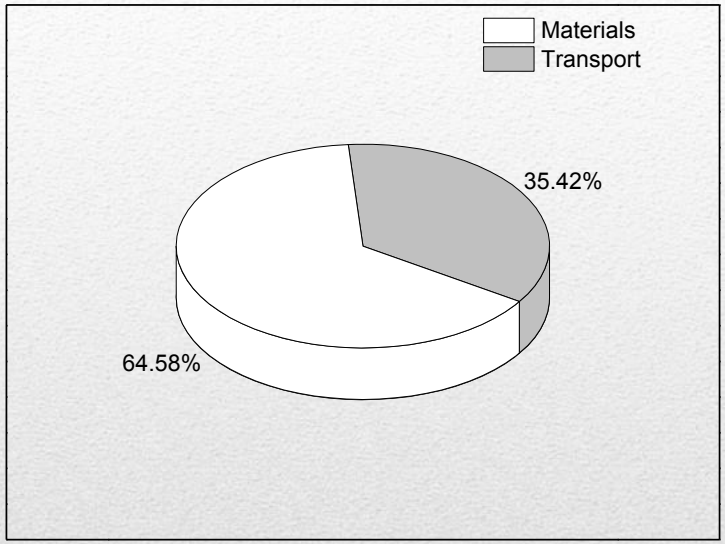
But – this includes project transport!



The total GWP impact of the ISOBIO demonstration panel is 43.2 kg CO_2 eq. per m^2. Of which 15.3 kg CO_2 eq. is due to transportation

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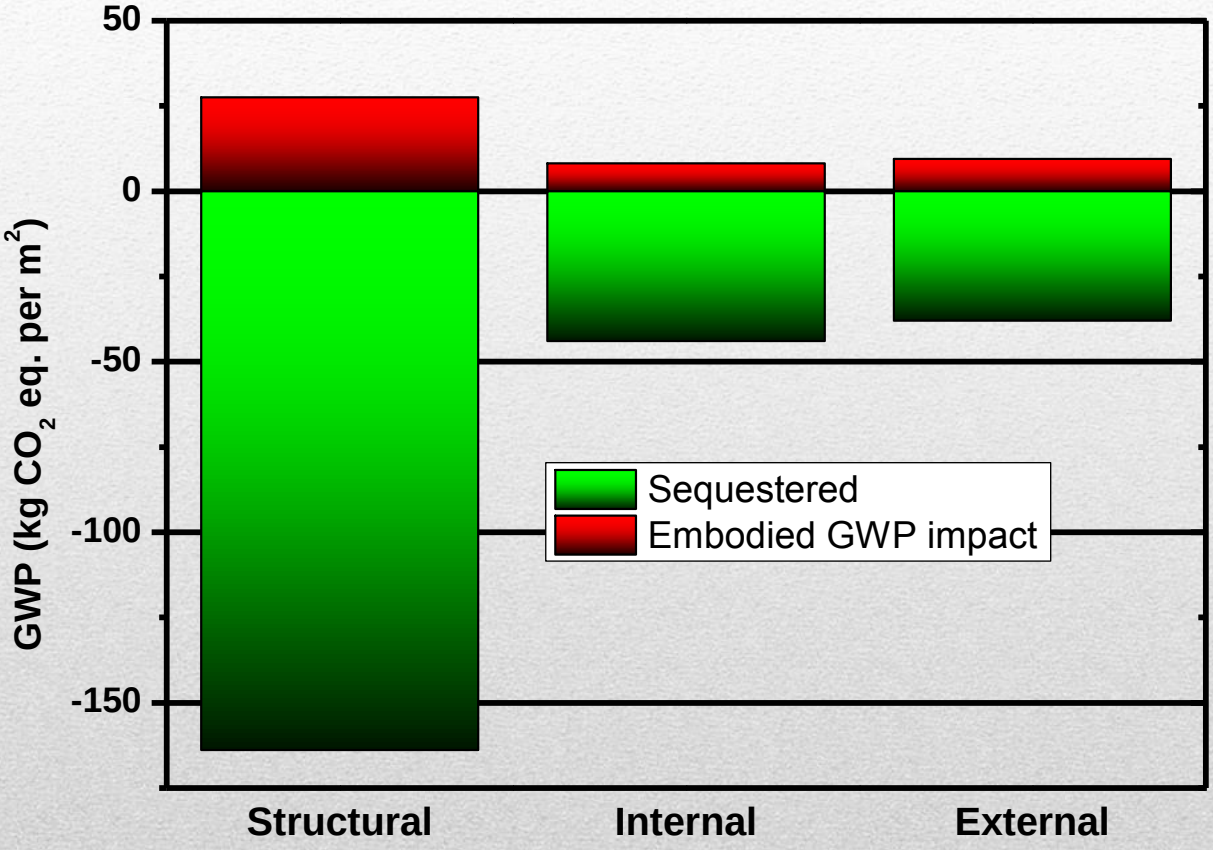
Without project transport



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50% reduction in carbon levels

- Compare ISOBIO structural panel with state of the art reference walls in UK and Spain
- 1m^2 of wall

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GWP ISOBIO structural panel vs reference

System	U (W/m².K)	GWP (kg CO_2e)
ISOBIO	0.18	27.5
UK reference	0.28	102
UK reference	0.18	114
ES reference	1.20	67
ES reference	0.18	102

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Embodied energy

System	U ($W/m^2.K$)	EE (MJ/m^2)
ISOBIO	0.18	1260
UK reference	0.28	1090
UK reference	0.18	1170
ES reference	1.20	712
ES reference	0.18	799

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Calorific content of biological material

Panel	Embodied energy (MJ/m^2)	Inherent energy (MJ/m^2)
ISOBIO structural	1260	1681
ISOBIO internal retrofit	410	386
ISOBIO external retrofit	435	296

If recoverable energy stored in the ISOBIO panels is taken into account, the structural panel total is – 421 MJ/m^2 (negative) – more energy can be recovered at end of life compared with energy used in production

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Questions?

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