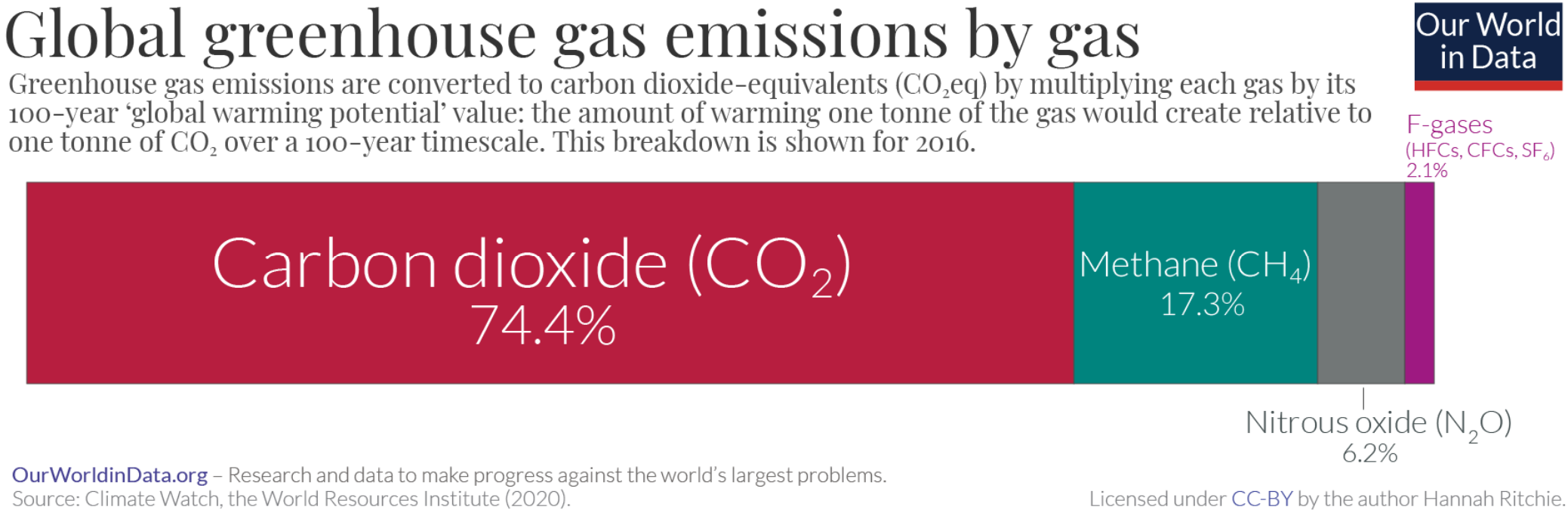
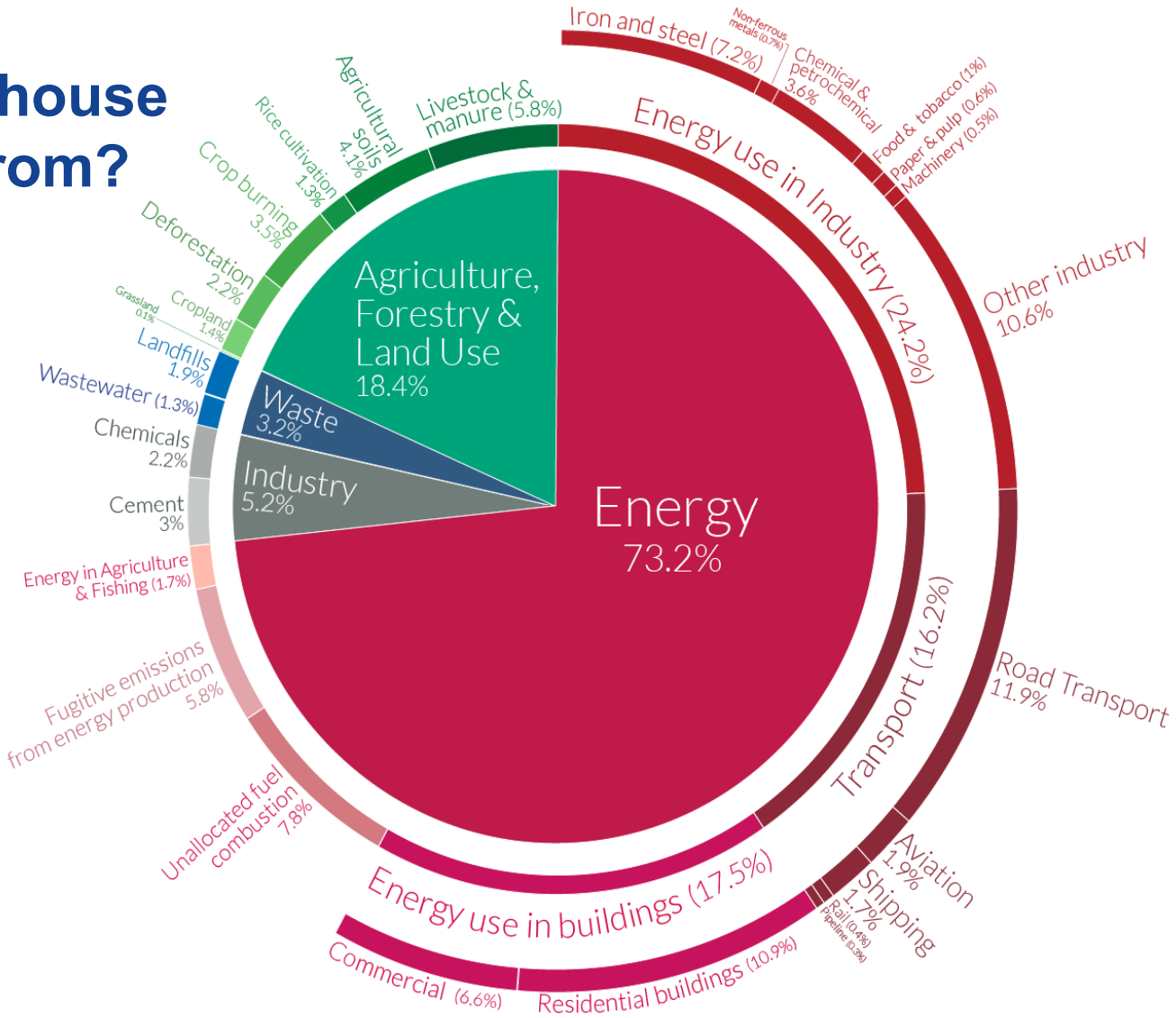
LES ÉMISSIONS DE CO2 ET LA NEUTRALITÉ CARBONE.

David Nevicato, Direction Recherche & Developpement

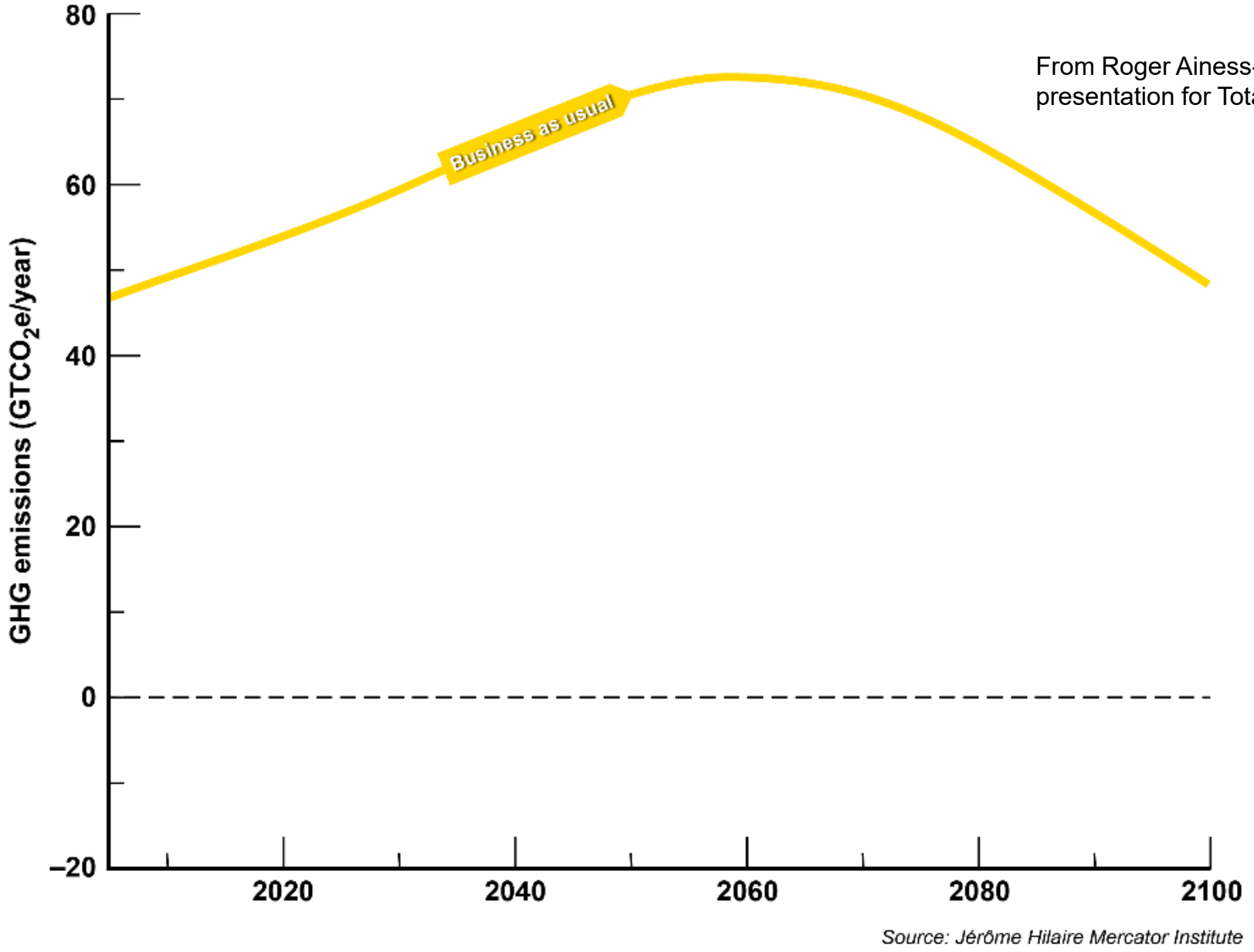
The World emits around 50 billion tCO2eq/y



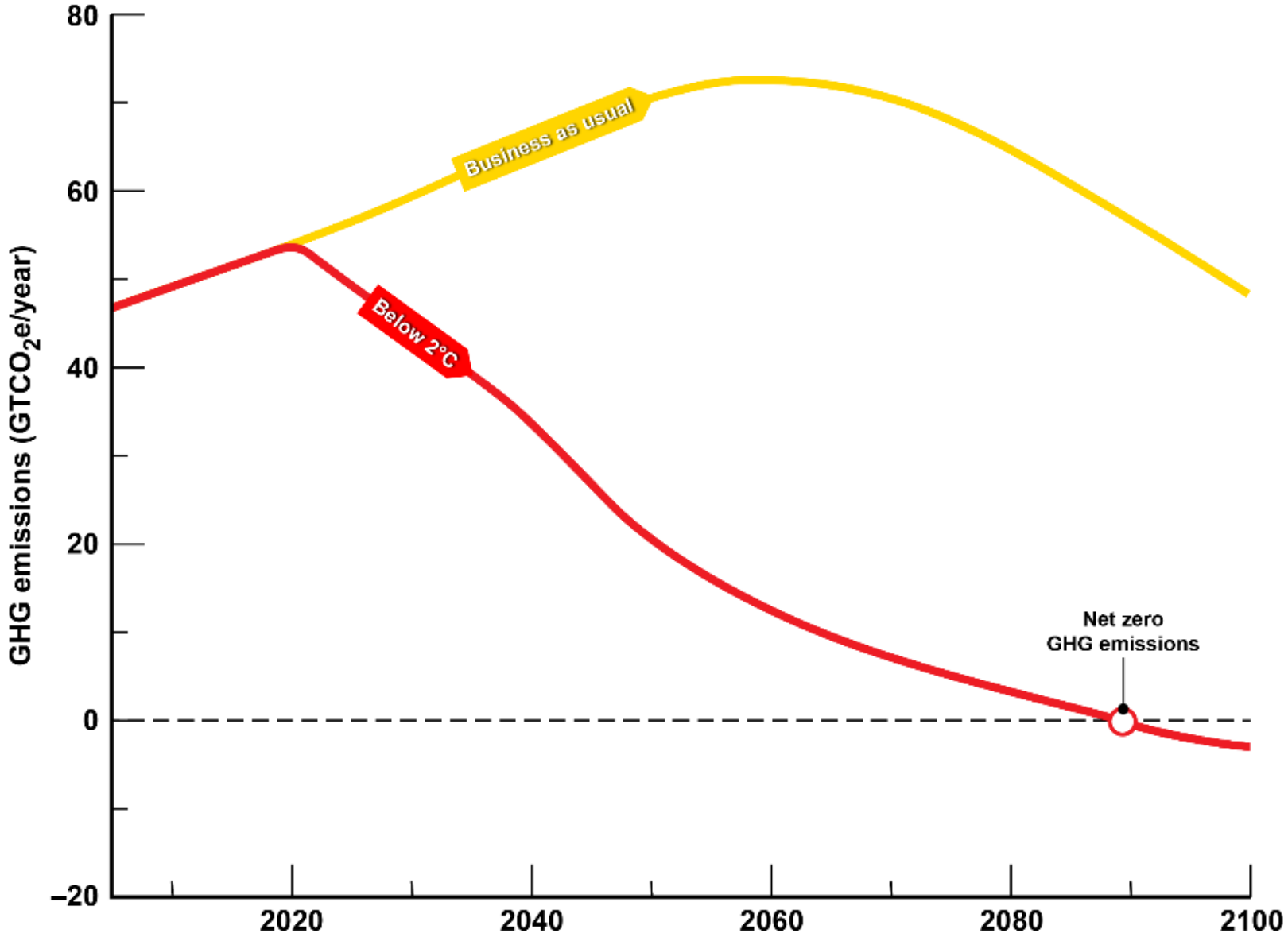
where do global greenhouse gas emissions come from?



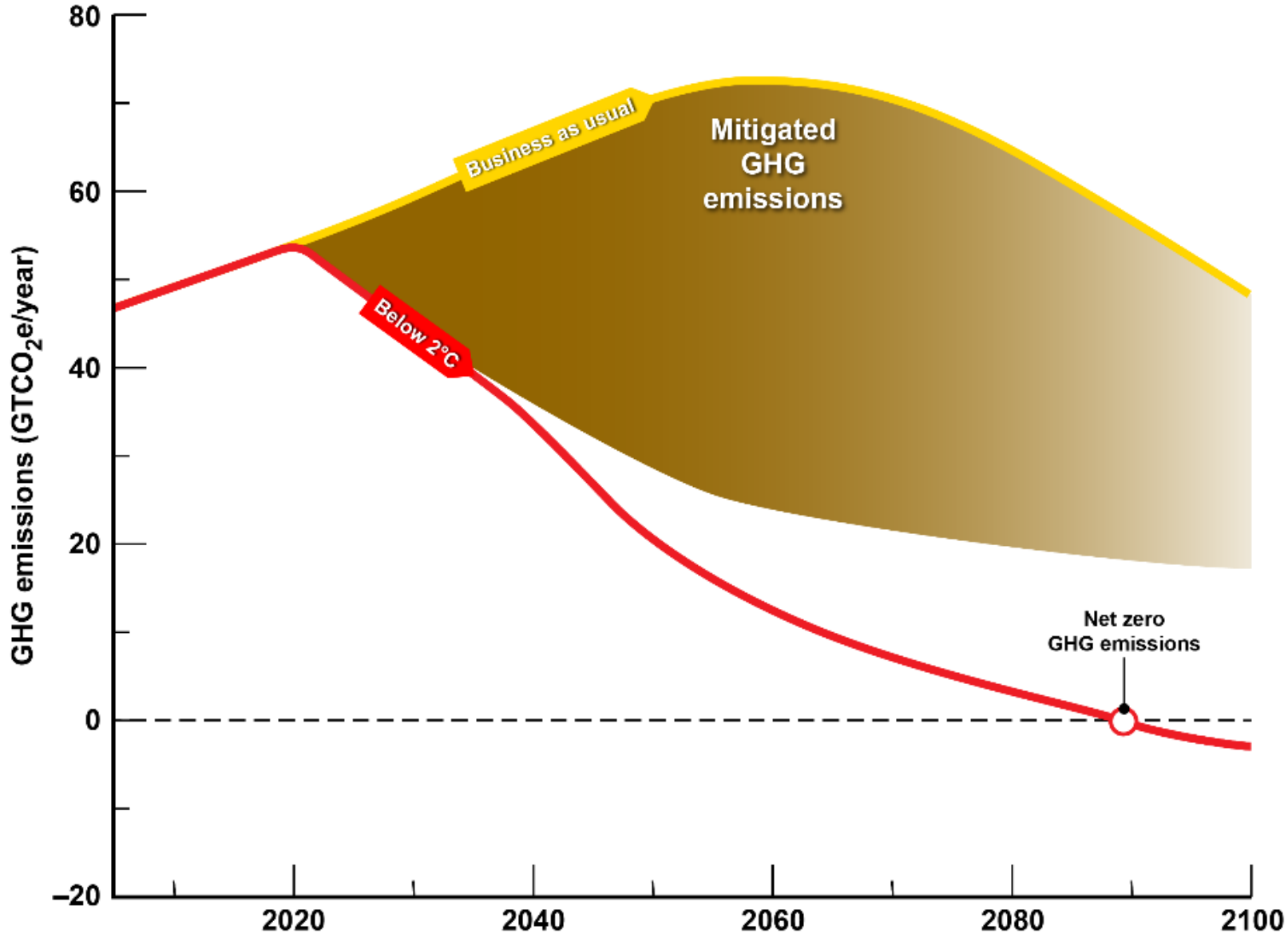
From Roger Ainess- LLNL presentation for Total



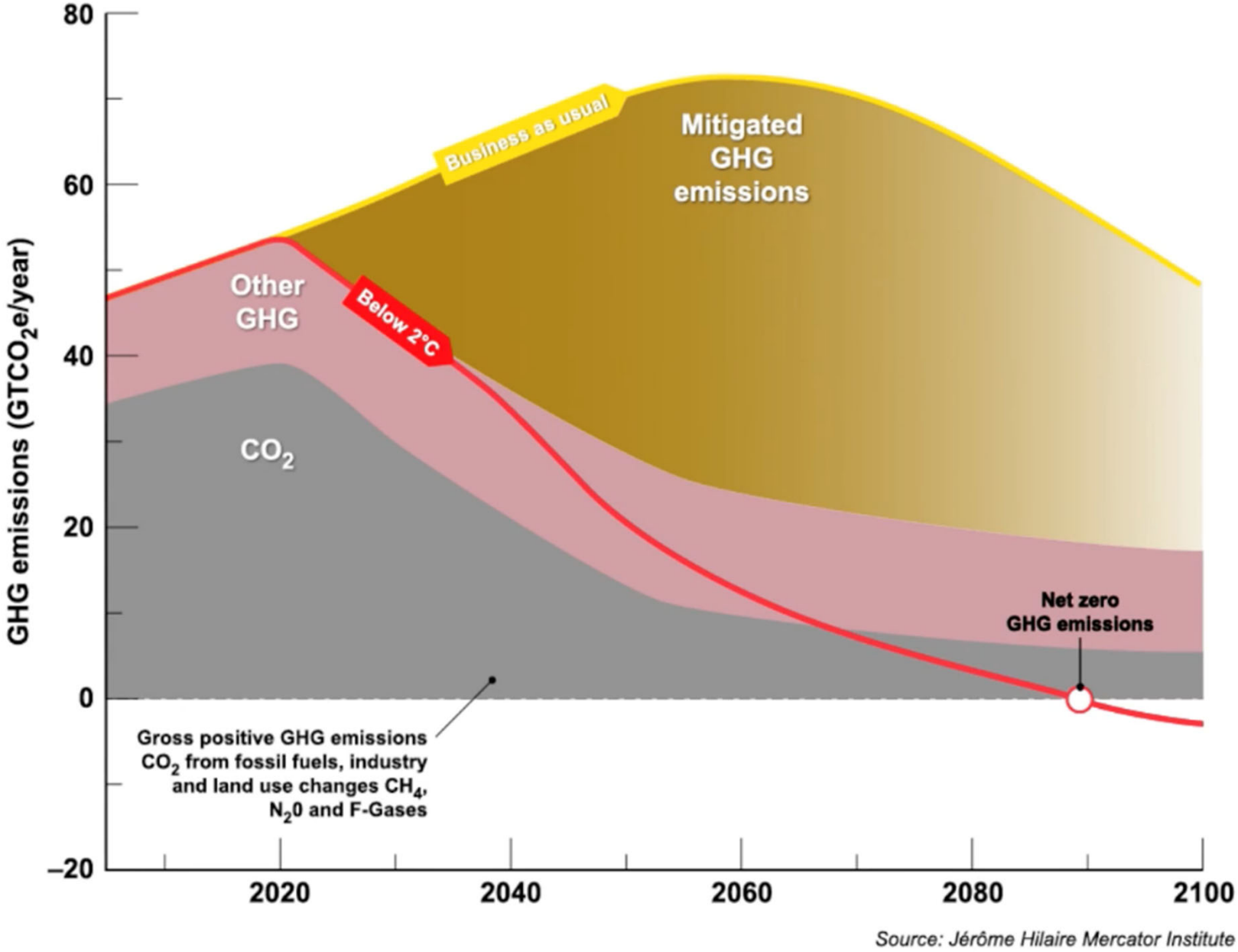
Source: Jérôme Hilaire Mercator Institute



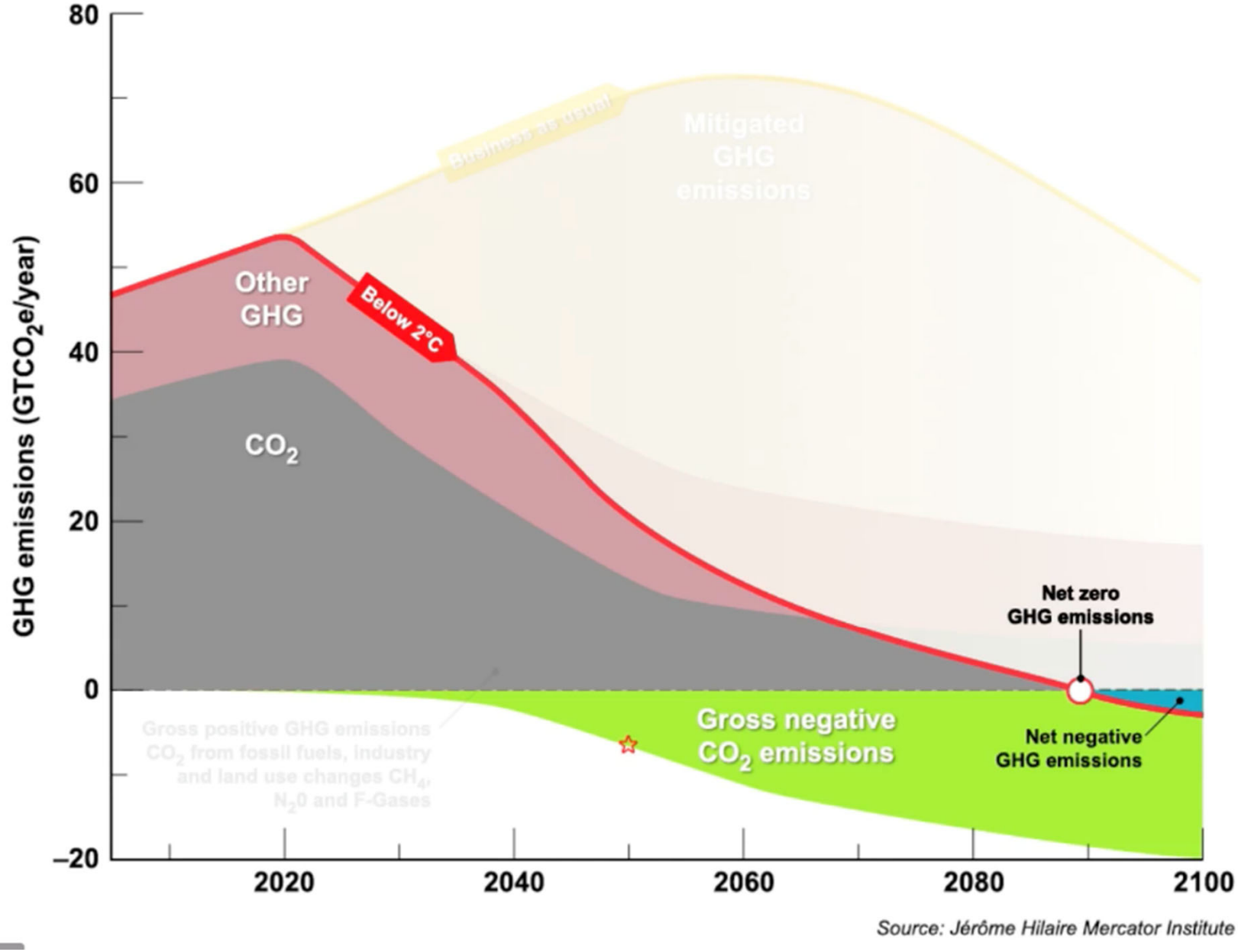
Source: Jérôme Hilaire Mercator Institute



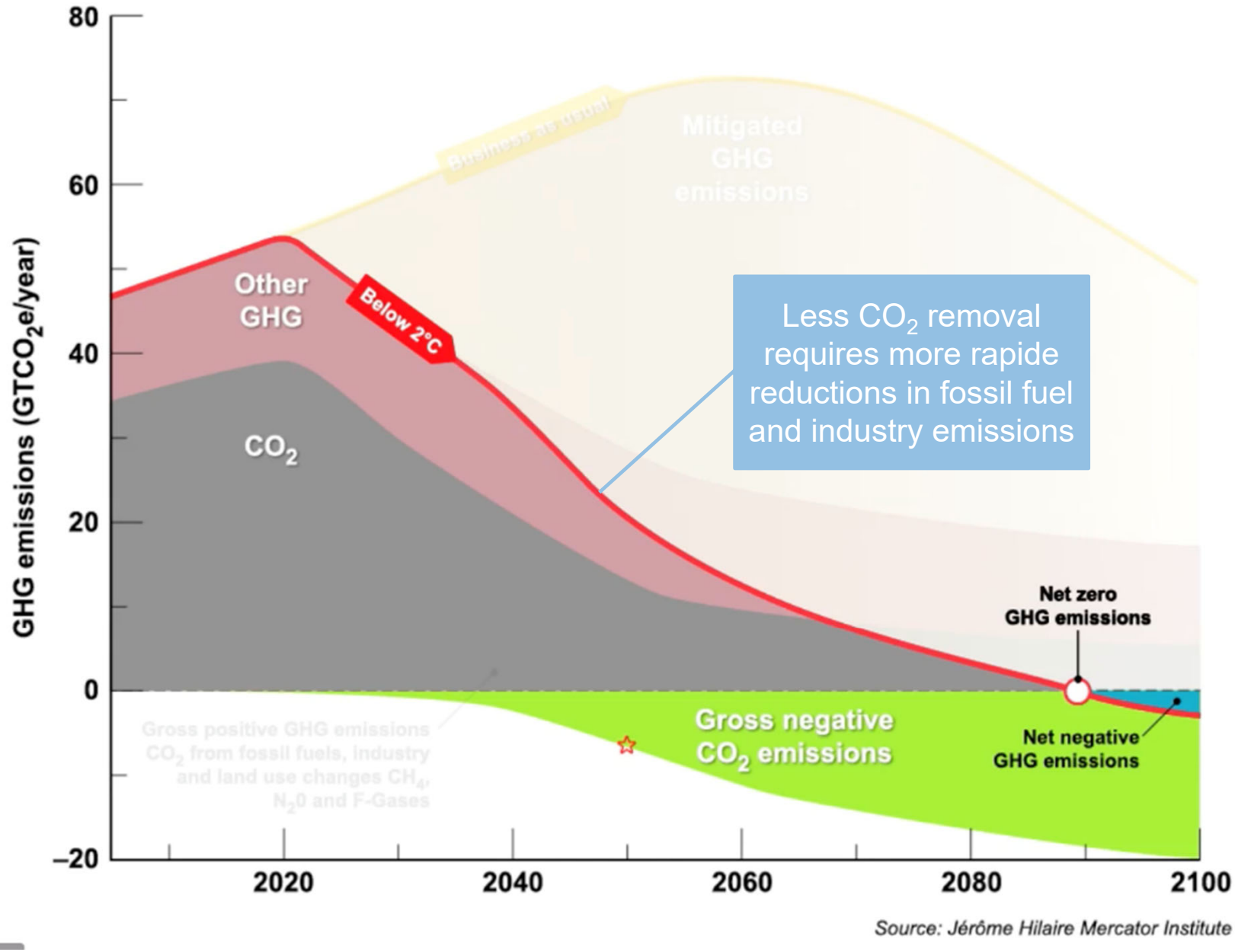
Source: Jérôme Hilaire Mercator Institute



Source: Jérôme Hilaire Mercator Institute



Source: Jérôme Hilaire Mercator Institute


80
60
40
20
0
–20
GHG emissions (GTCO2e/year)
2020
2040
2060
2080
2100
Business as usual
Mitigated GHG emissions
Other GHG
Below 2°C
CO2
Less CO2 removal requires more rapide reductions in fossil fuel and industry emissions
Net zero GHG emissions
Gross negative CO2 emissions
Net negative GHG emissions
Gross positive GHG emissions CO2 from fossil fuels, industry and land use changes CH4, N20 and F-Gases
Source: Jérôme Hilaire Mercator Institute

MORE COMPANIES WANT TO BE “CARBON NEUTRAL”

Carbon neutrality or “net zero” :

Any CO_2 released into the atmosphere from human activity is balanced by an equivalent amount being removed.

AND BEYOND CARBON NEUTRALITY : CLIMATE POSITIVE

What does being climate positive mean for IKEA?

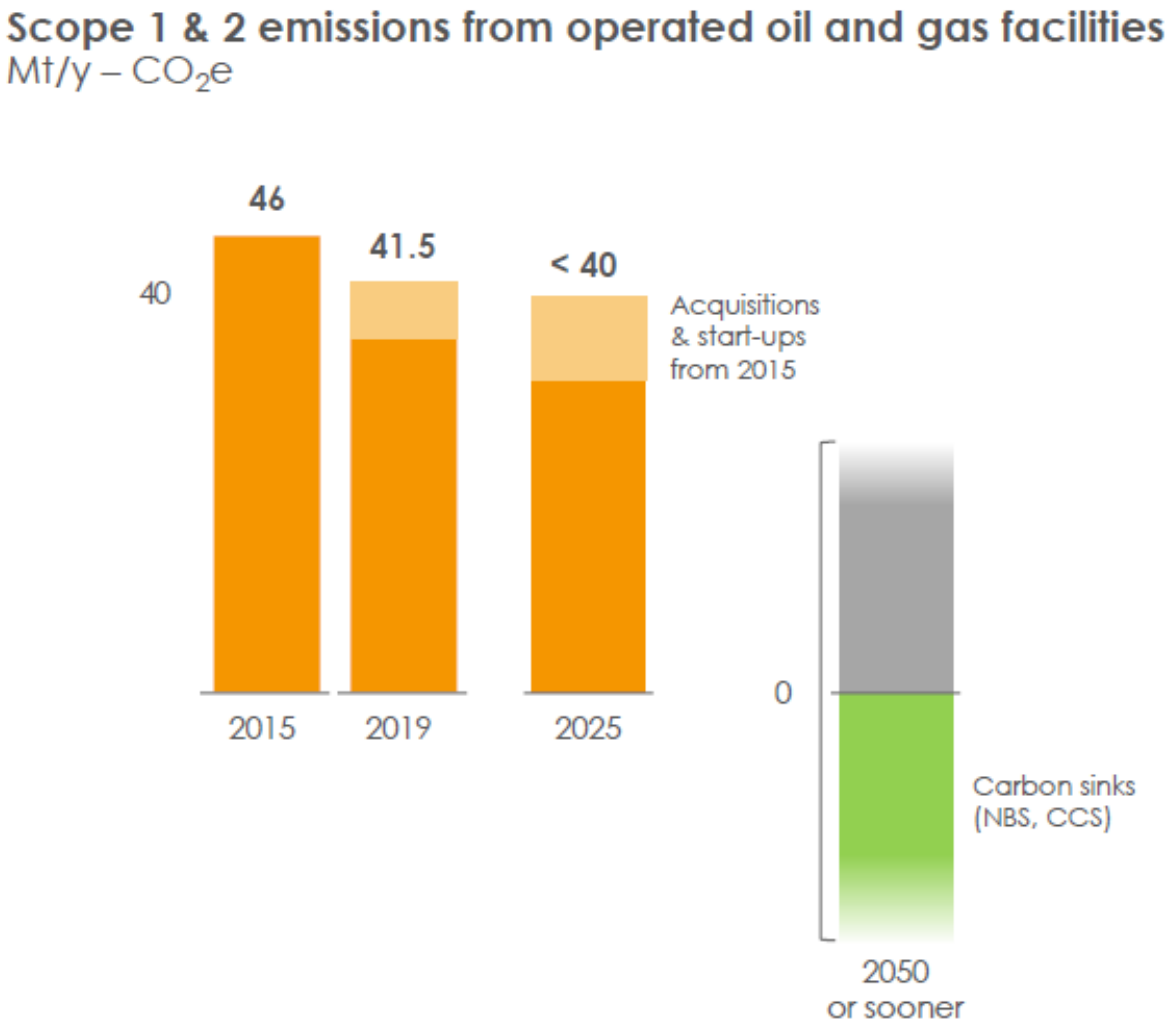
Becoming carbon negative or “Climate positive” requires a company, sector or country to remove more CO_2 from the atmosphere than it emits.

GETTING TO NET ZERO

TOTAL shares the ambition to get to Net Zero by 2050 together with society for its global business

1	Net Zero on Operations by 2050 or sooner (scope 1+2)
2	**Net Zero in Europe by 2050 or sooner** (scope 1+2+3)
3	**60% or more Net Carbon Intensity reduction by 2050** (scope 1+2+3): **less than 27.5 gCO2e/MJ**

NET ZERO BY 2050 OR SOONER ACROSS TOTAL'S WORLDWIDE OPERATIONS



Objective: 5 to 10 Mt/y sink capacity by 2030

TRANSFORMING TOTAL INTO A BROAD ENERGY COMPANY

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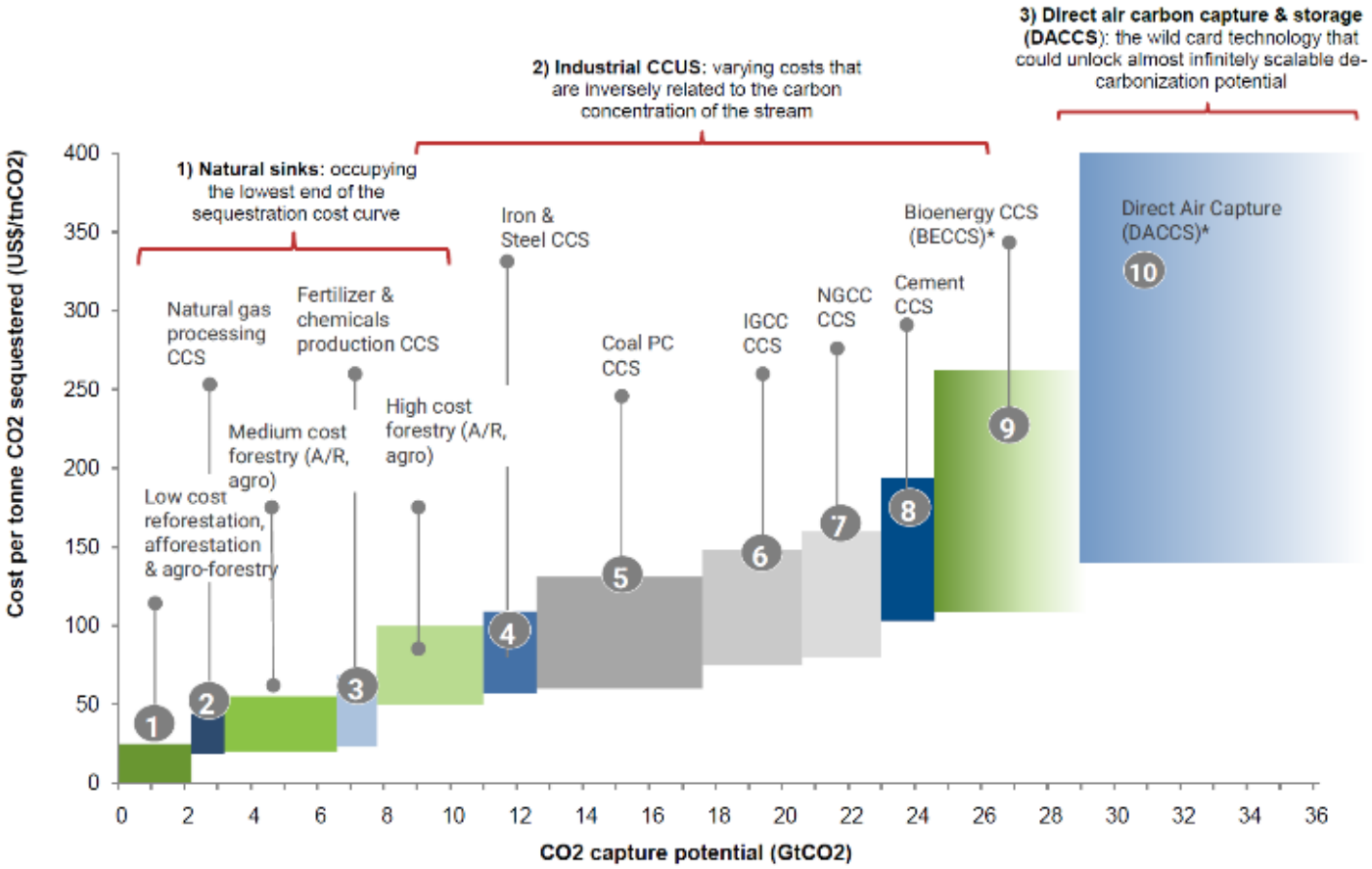
CARBON SEQUESTRATION



Carbon sequestration cost curve and the GHG emissions abatement potential

The carbon sequestration curve is less steep vs. the conservation curve but has a higher range of uncertainty. Direct Air Carbon Capture (DACCS) is the technology with the most uncertainty and the greatest potential

Source : Global CCS Institute, Goldman Sachs Global Investment Research Carbonomics Q&A: Five key questions from investors, Feb 2020

ENERGY & COST - INDUSTRIAL CO_2 CAPTURE

Atmosphere
[CO2] ~ 0.04%

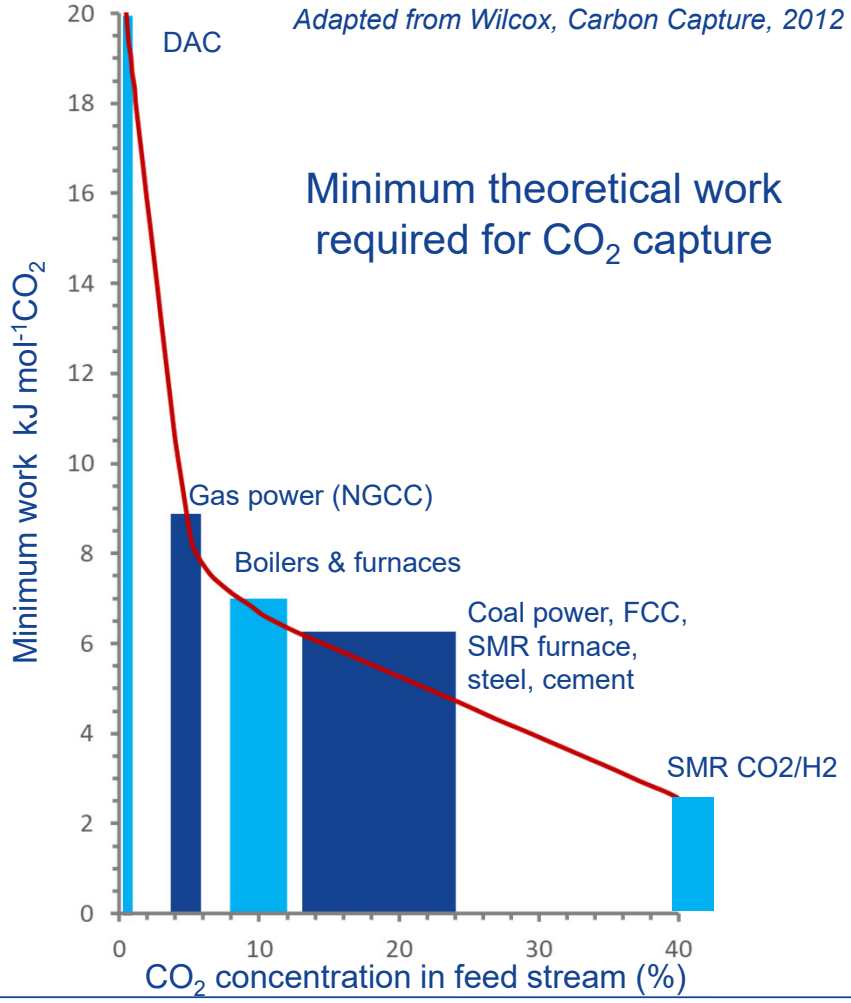
Higher energy needs for the regeneration = OPEX

5 to 10 GJ/t CO_2 for DAC @ 0.04% CO_2

2 to 3 GJ/t CO_2 for an NGCC @ 4% CO_2

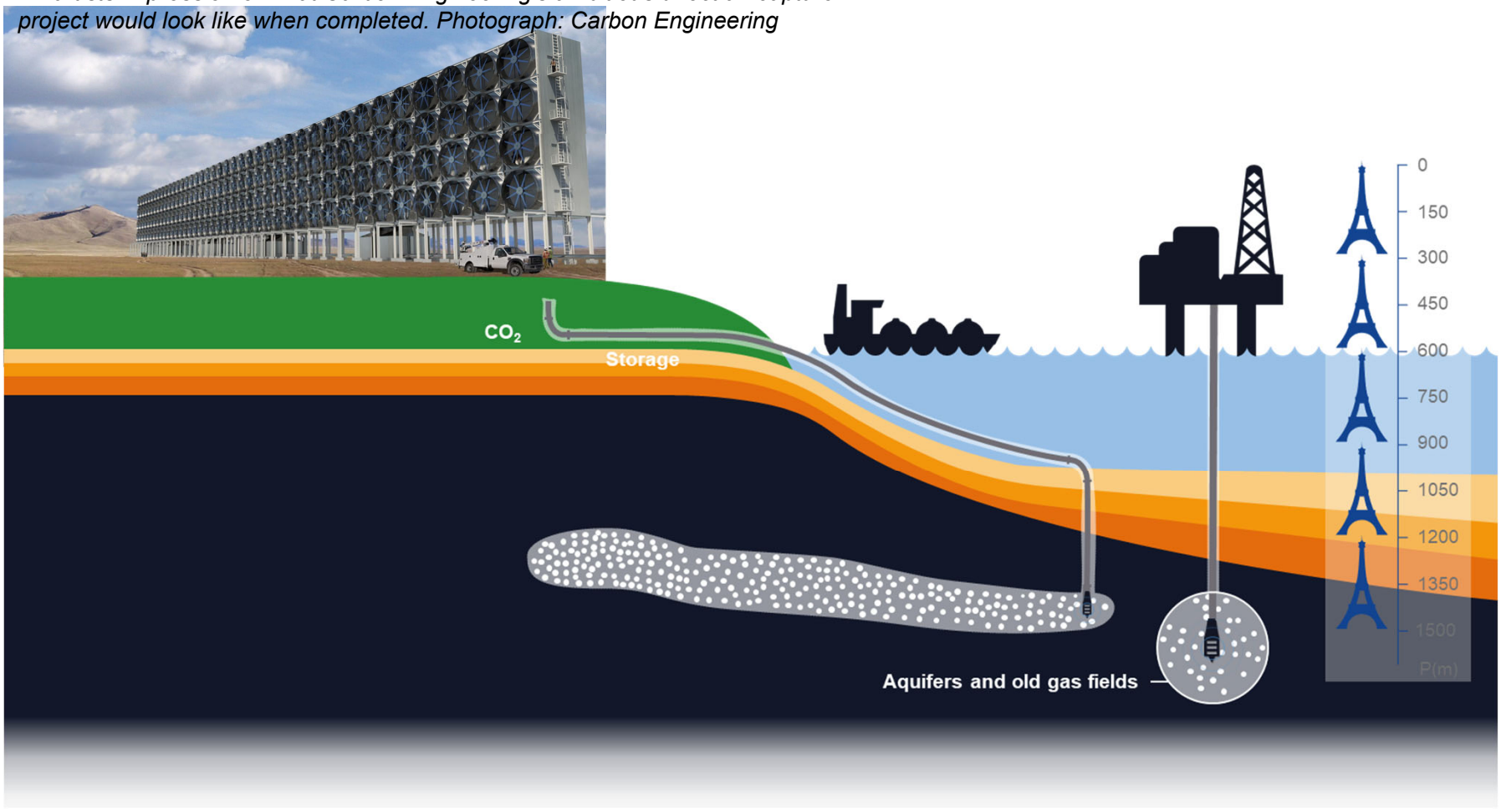
Greater contactor surface = CAPEX

X100 for DAC compared to capture on NGCC



DIRECT AIR CAPTURE + CARBON STORAGE (DACS)

An artists impression of what Carbon Engineering's ambitious direct air capture project would look like when completed. Photograph: Carbon Engineering



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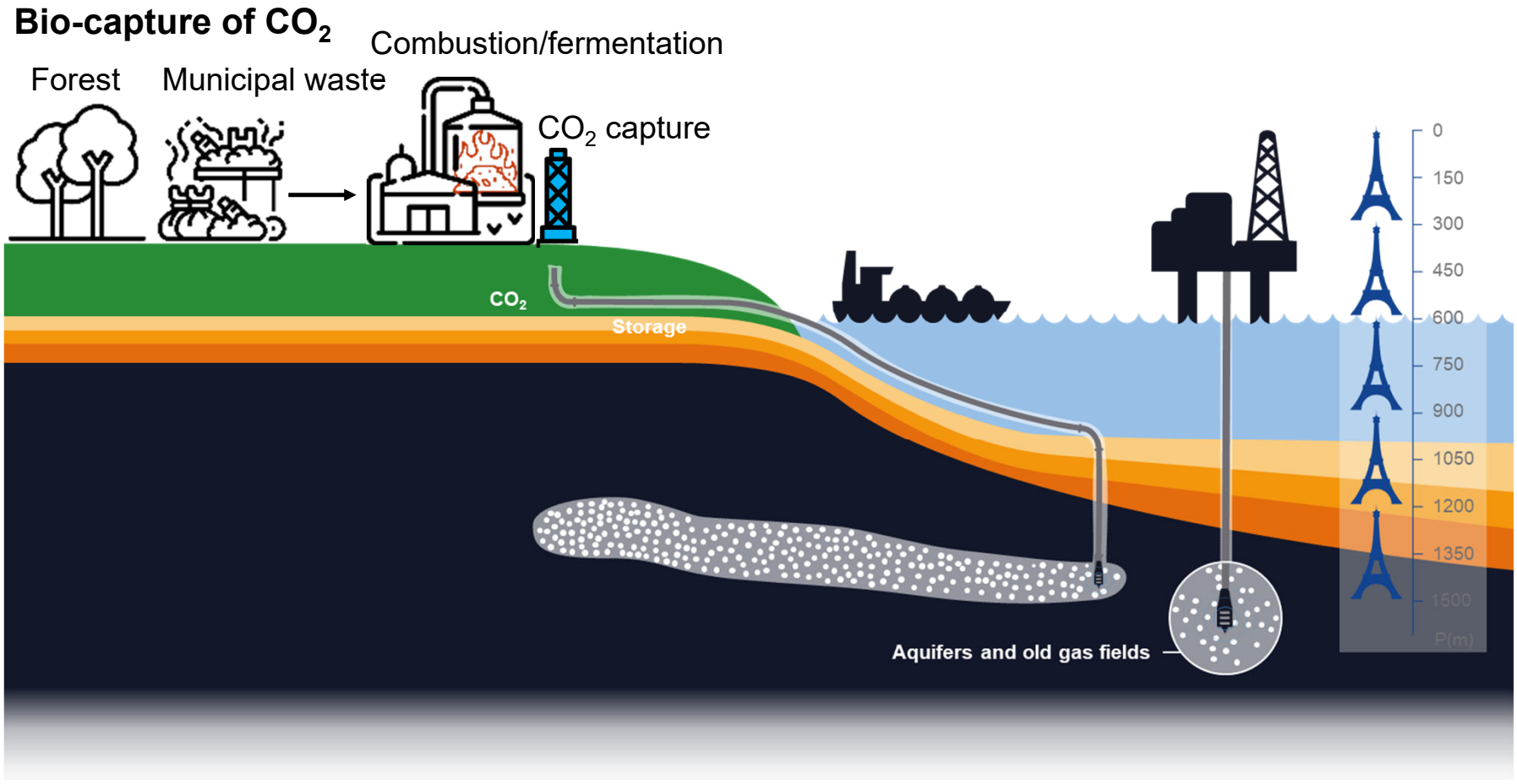
BIOENERGY + CARBON STORAGE (BECCS)



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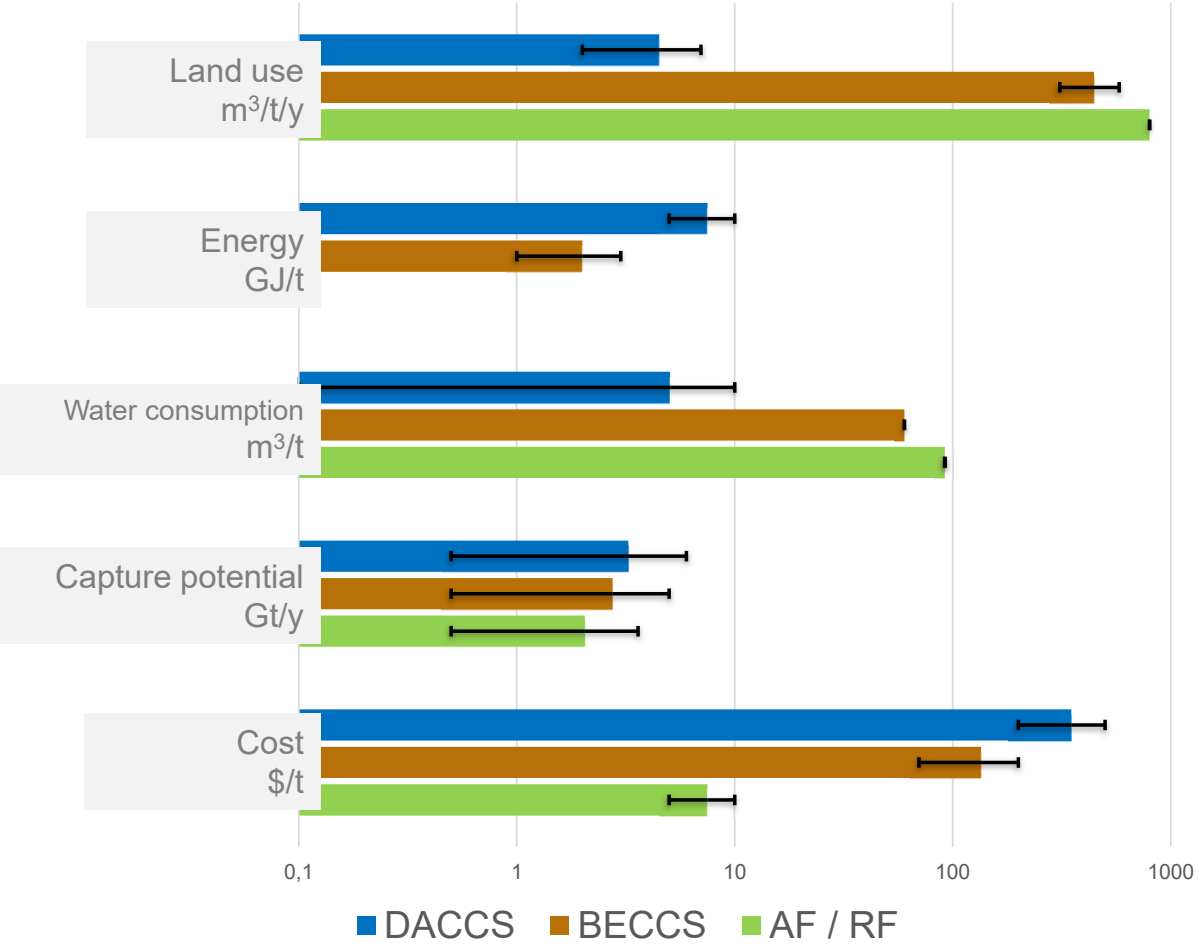
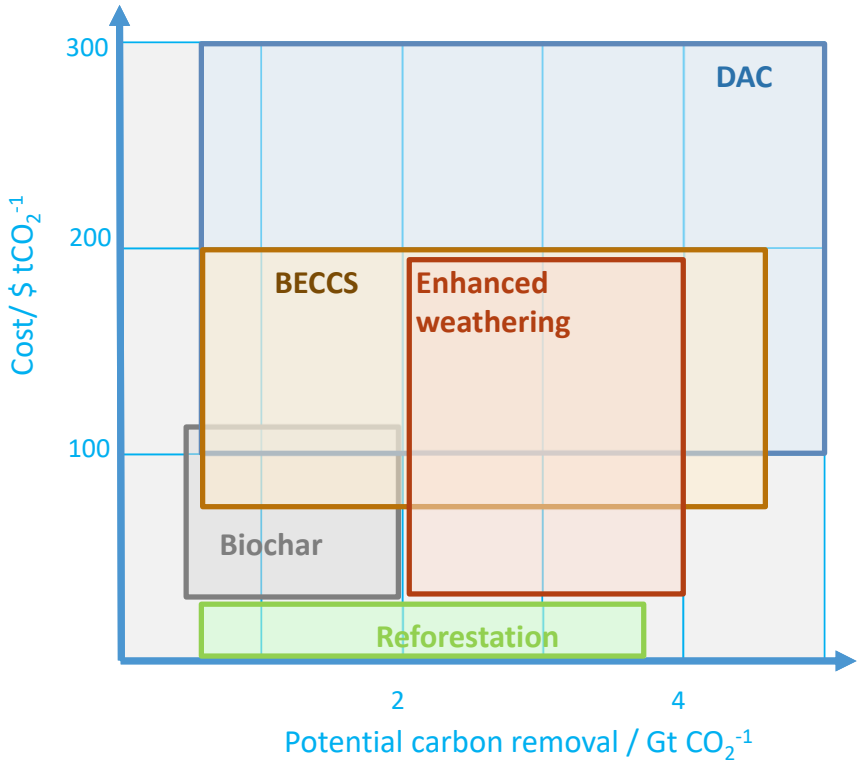
NEGATIVE EMISSION TECHNOLOGIES SUSTAINABILITY





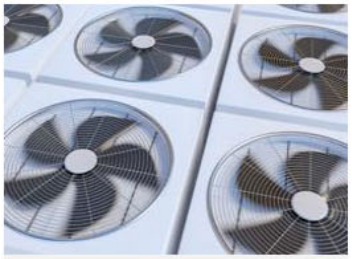
Negative emissions—Part 1: Research landscape and synthesis, J.C. Minx et al., Env. Res. Lett., 2018

Carbon Management and negative CO_2 emissions technologies towards a low carbon future

In 2019, IFP School launched the CarMa chair, a new research chair dedicated to carbon management and negative CO_2 emissions technologies. The chair is supported by TOTAL in association with Fondation Tuck.

Themes

Natural sinks:
Afforestation, Reforestation & Ocean («coastal blue carbon»)



DACCS:
Direct Air Carbon Capture and Sequestration technologies

BECCS:
Bio-Energy coupled with Carbon Capture and Storage

Engineered carbon sequestration:
in soils or under chemical rock weathering

CarMa

Carbon Management
IFP School Chair