



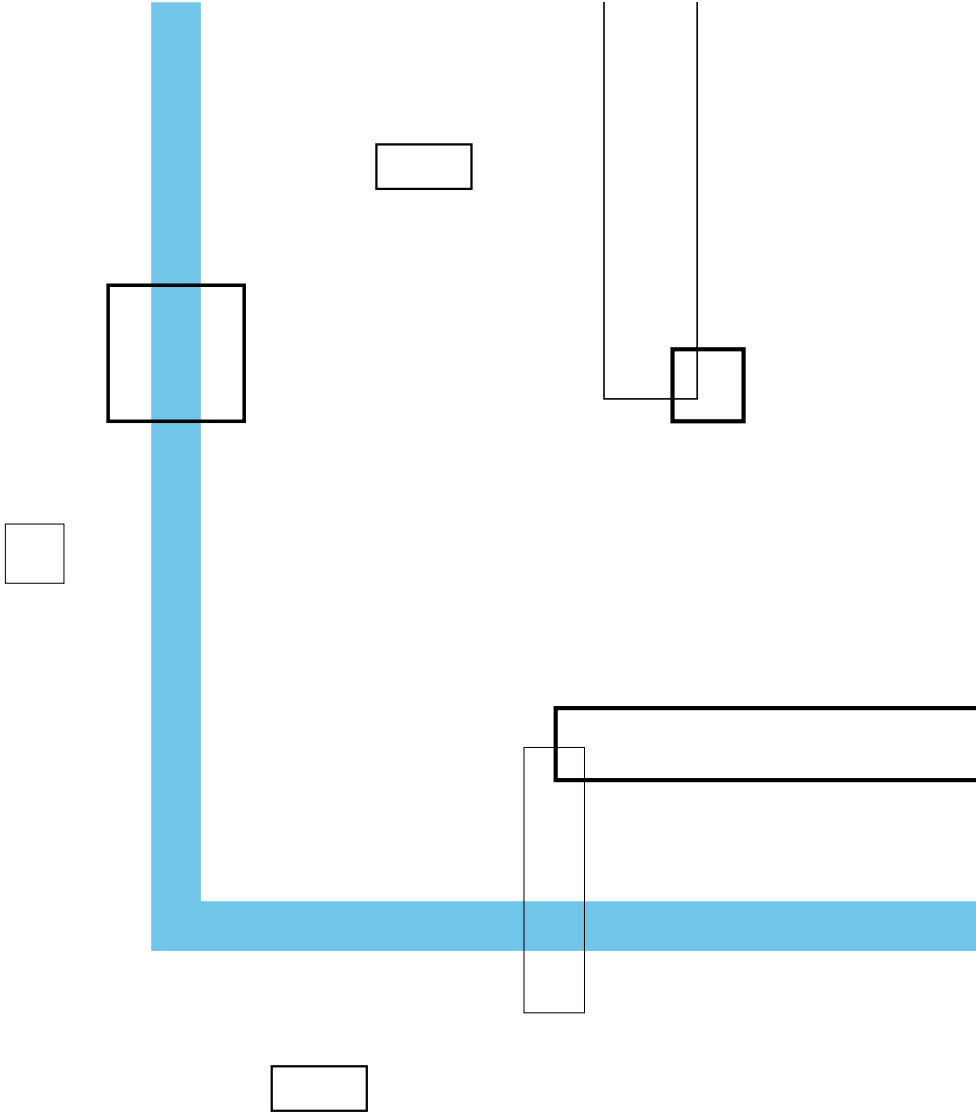
# Carbon Markets

EPRG Winter Seminar

December 8, 2023



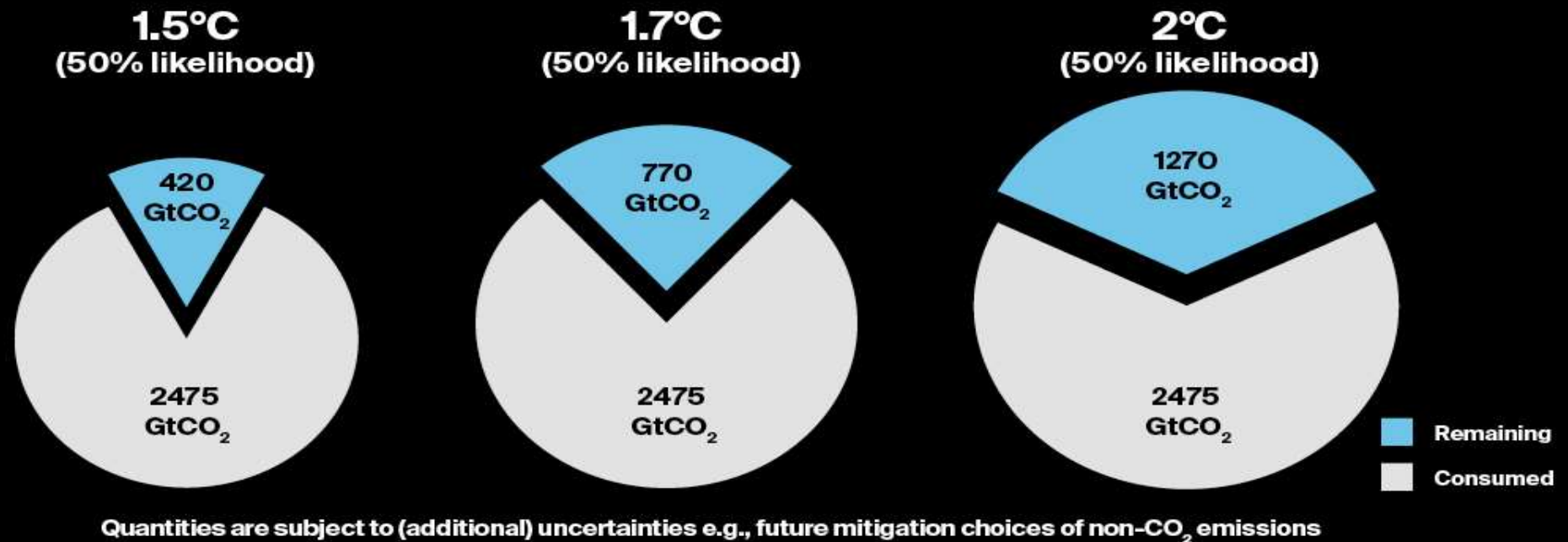
# The science and economics of net zero



# What is net zero?

Conserving the carbon budget

## The remaining carbon budget to limit global warming from 2022

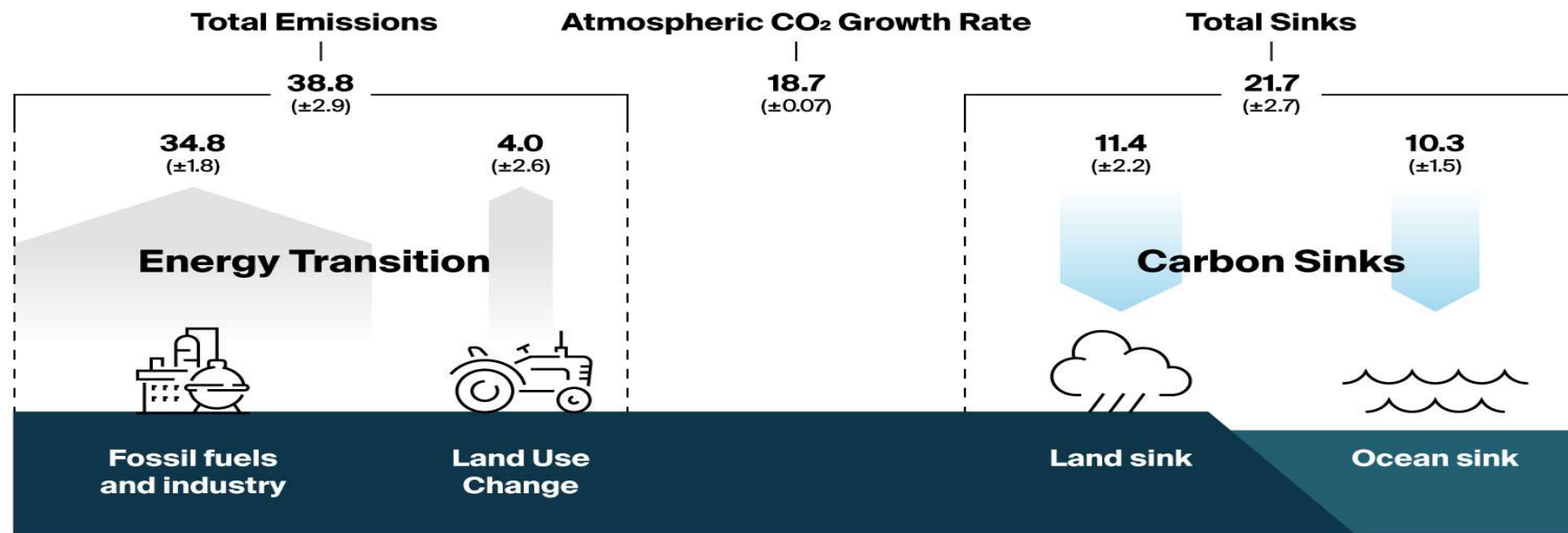


Source: IPCC AR6 WGI; Friedlingstein et al 2021; Global Carbon Budget 2021

# What is net zero?

Global carbon budget | emissions and sinks

## Global carbon budget 2011-2020



### Emissions and Sinks

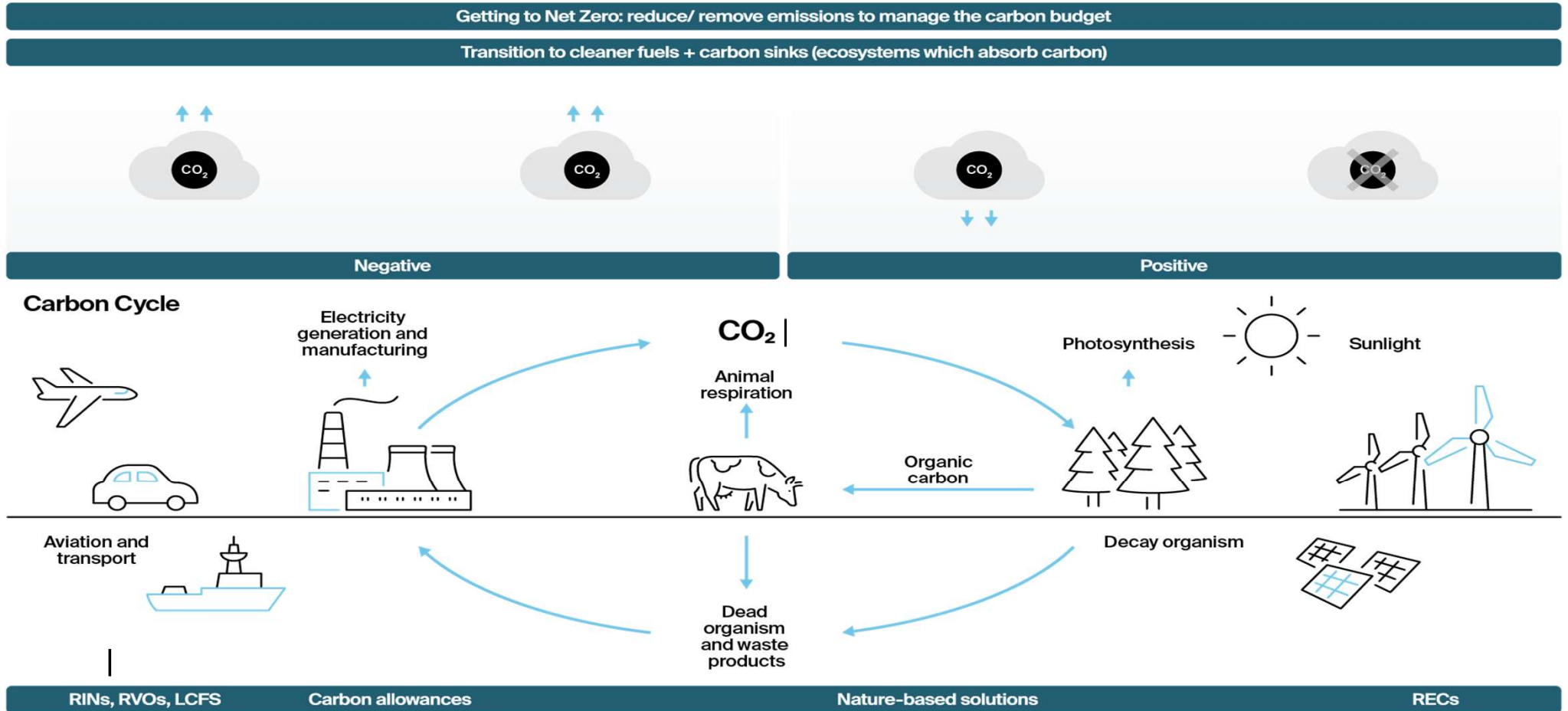
In billion-tons CO<sub>2</sub> per year (Pg CO<sub>2</sub> / yr), average 2011-2020

Anthropogenic emissions      Sinks of anthropogenic emissions

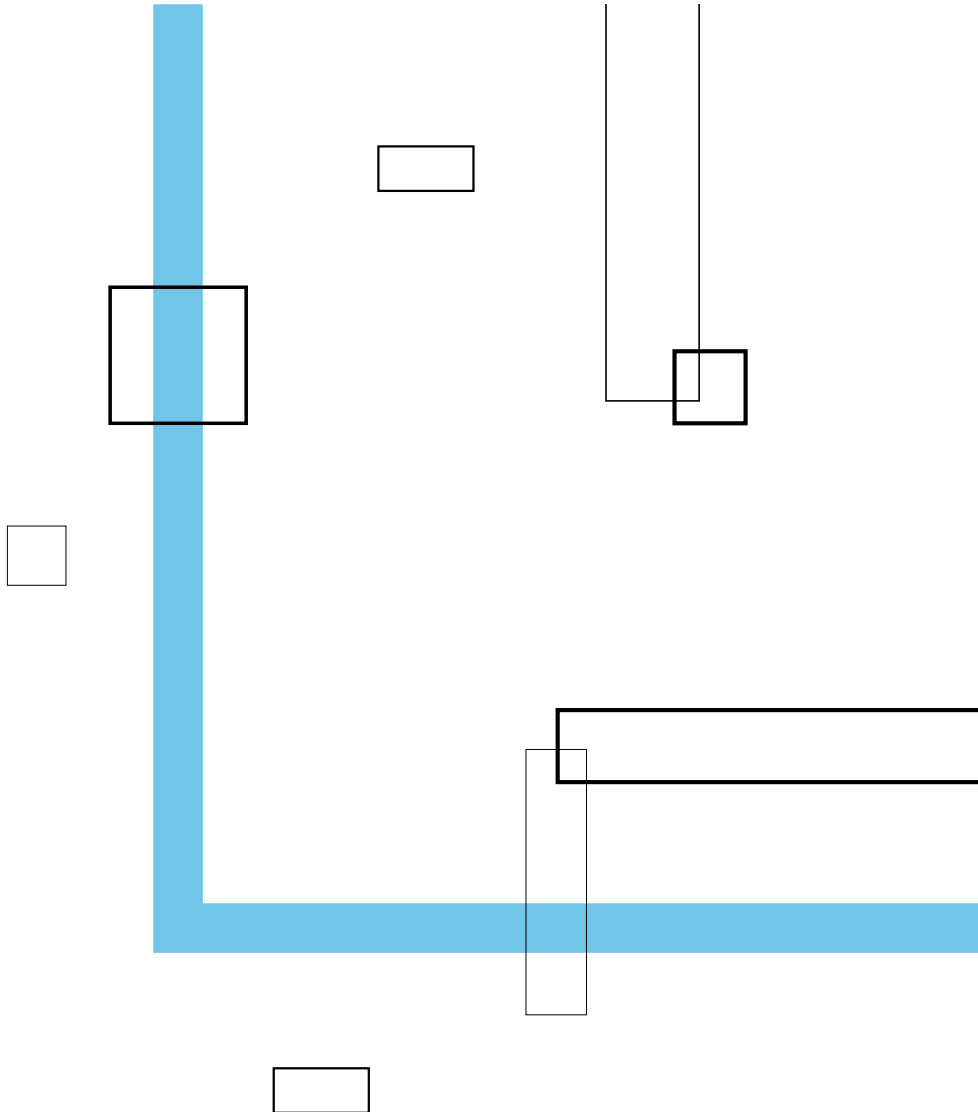
Source Global Carbon Project

# Environmental markets

Price signals to allocate capital across carbon cycle to conserve the carbon budget



# Carbon tonnes at risk

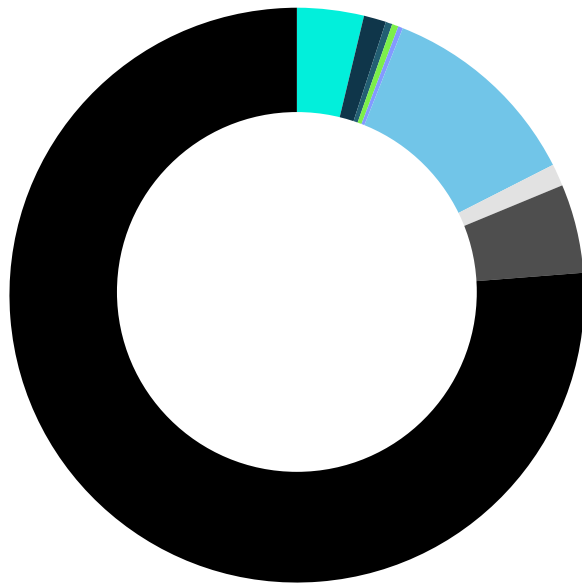




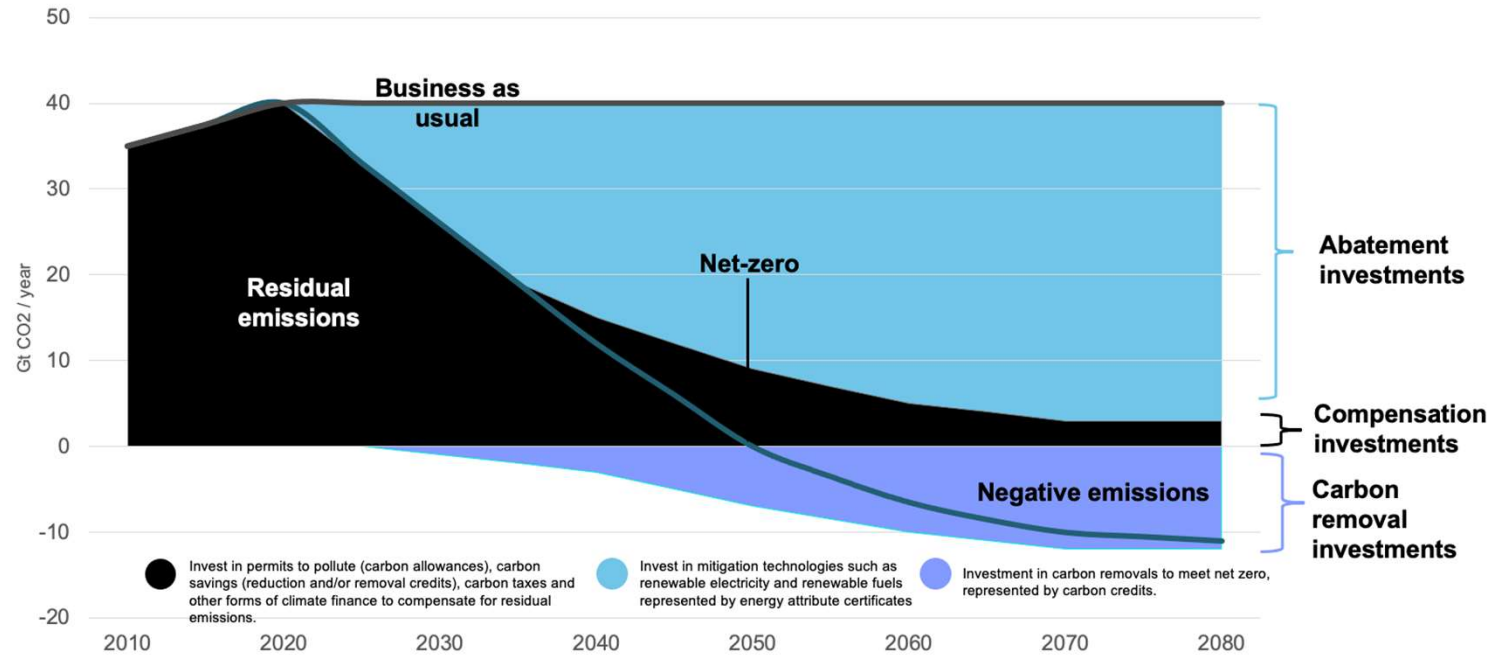
# Carbon pricing and carbon tonnes at risk

## Annual emissions and net zero pathway

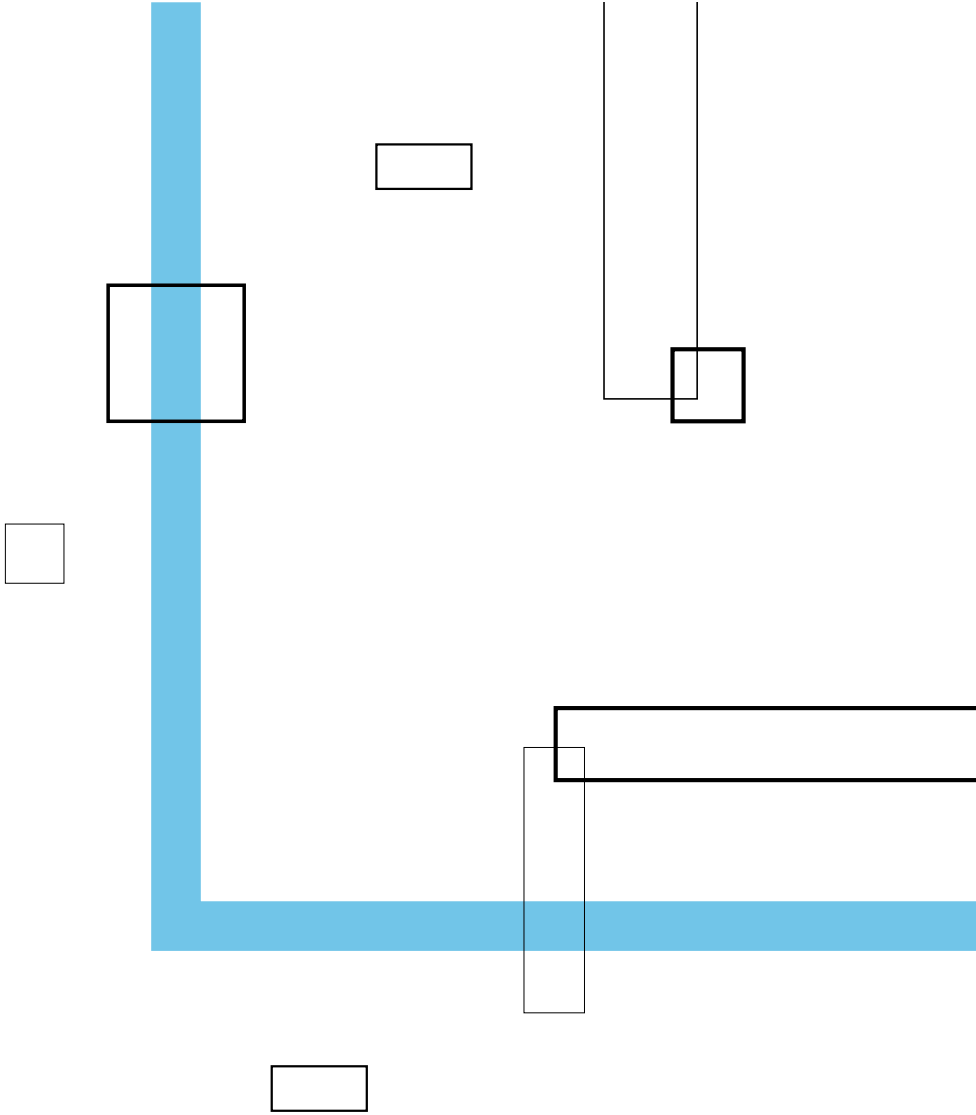
Annual anthropogenic CO2 emissions = 40 billion tonnes



- EUA
- CCA
- RGA
- UKA
- WA
- Other ETS
- Crediting mechanisms
- Tax
- Not priced directly



# Environmental markets today

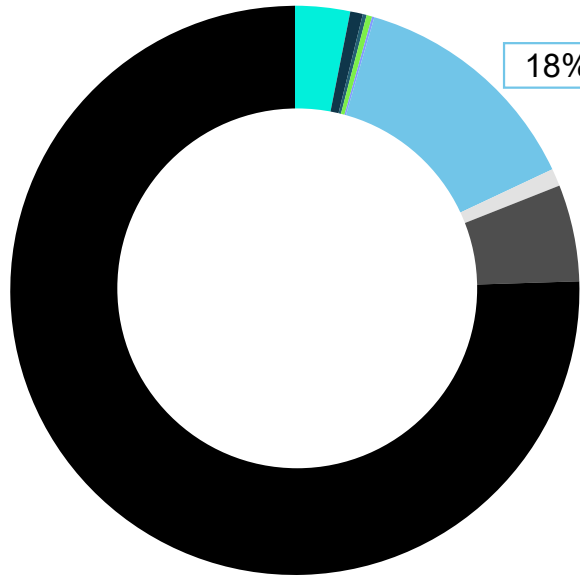




# Carbon tonnes at risk

Annual emissions, carbon tonnes at risk and trading volumes

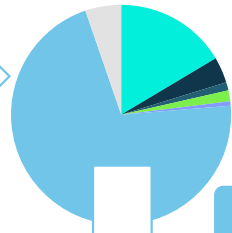
Annual anthropogenic CO<sub>2</sub>e emissions = 50 billion tonnes



- EUA
- CCA
- RGA
- UKA
- WA
- Other ETS
- Crediting mechanisms
- Tax
- Not priced directly

18% @ risk

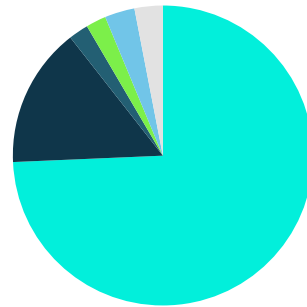
Cap and trade and crediting mechanisms issuance\*



9

2X

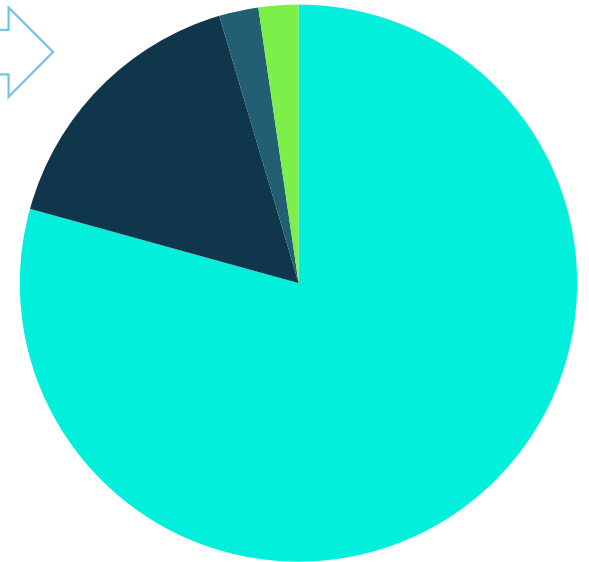
Cap and trade and crediting mechanisms trading volumes



17

8X

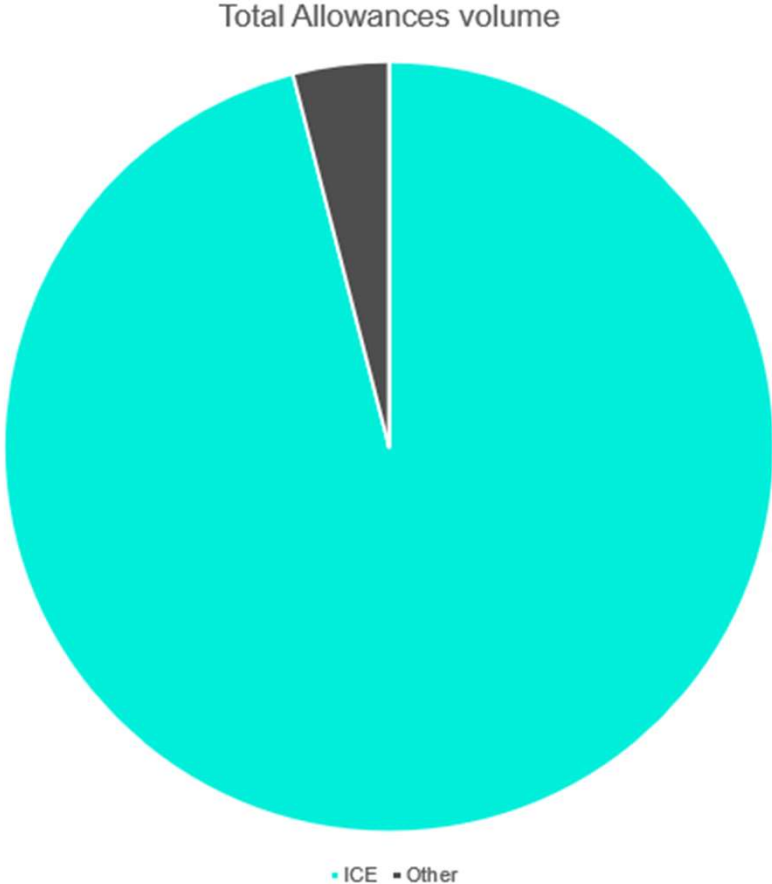
Cap and trade trading volumes of 4 (5) main futures markets



16

# Compensation investments

Cap and trade and carbon crediting mechanisms



# ICE is home to the world's largest environmental markets

## Connect to a global environmental portfolio to price climate risk



**>115 billion tonnes of allowances** equivalent to 3x world's annual CO<sub>2</sub> footprint



**>5 billion RINs** equal to 118 million barrels of renewable fuels



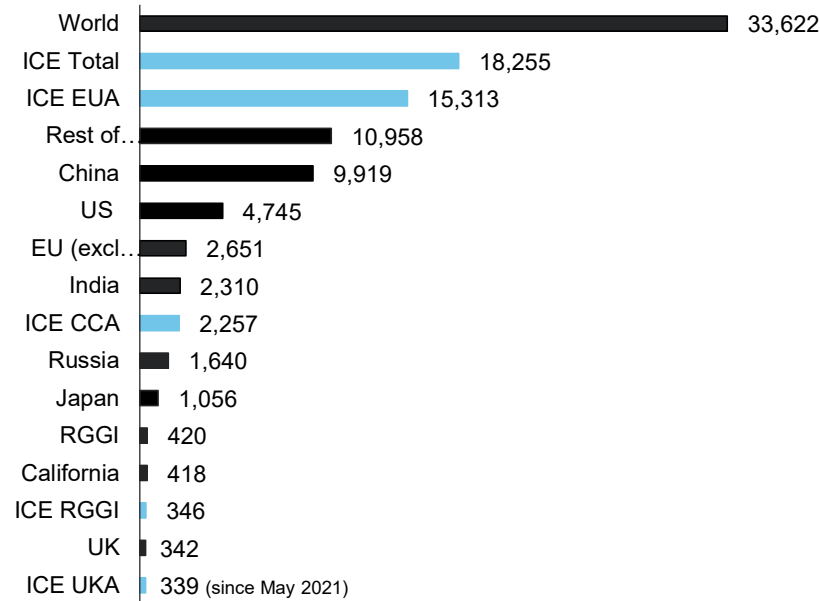
**>350 million RECs** equal to the annual per capita energy consumption of nearly million people



**>6 billion tonnes of carbon credits** corresponding to the Co<sub>2</sub> absorption of 6 billion trees



**>50% of world's annual emissions footprint** equivalent traded on ICE



2019 emissions per county/region in MtCO<sub>2</sub> (sources: IEA, California ARB, RGGI)  
Emissions traded on ICE in 2021 in MtCO<sub>2</sub> (source: ICE)



**\$75B open interest** of environmental futures and options risk managed at ICE



**\$1T notional value** of environmental futures and options traded per annum since 2021

# ICE host to the world's largest energy & environmental markets

Connect to a global environmental portfolio to price climate risk

## Negative Externalities >

- EU Carbon Allowance (EUA) >
- UK Carbon Allowance (UKA) >
- California Carbon Allowance (CCA) >
- RGGI Carbon Allowance (RGA) >
- Washington State Carbon Allowances (WCA) >
- Global Carbon Index Future (CO2) >
- Carbon Allowance Auctions >

## Positive Externalities >

### Carbon Credits

- California Carbon Credit (CCO) >
- CORSIA Carbon Credits (CP1) >
- Nature Based Carbon Credits (NBT) >
- Carbon Credit Auctions >

### Energy Attribute Certificates

- Renewable Energy Certificate (REC) >
- Low Carbon Fuel Standard (LCFS) >
- Renewable Identification Number (RIN) >
- Renewable Volume Obligation (RVO) >

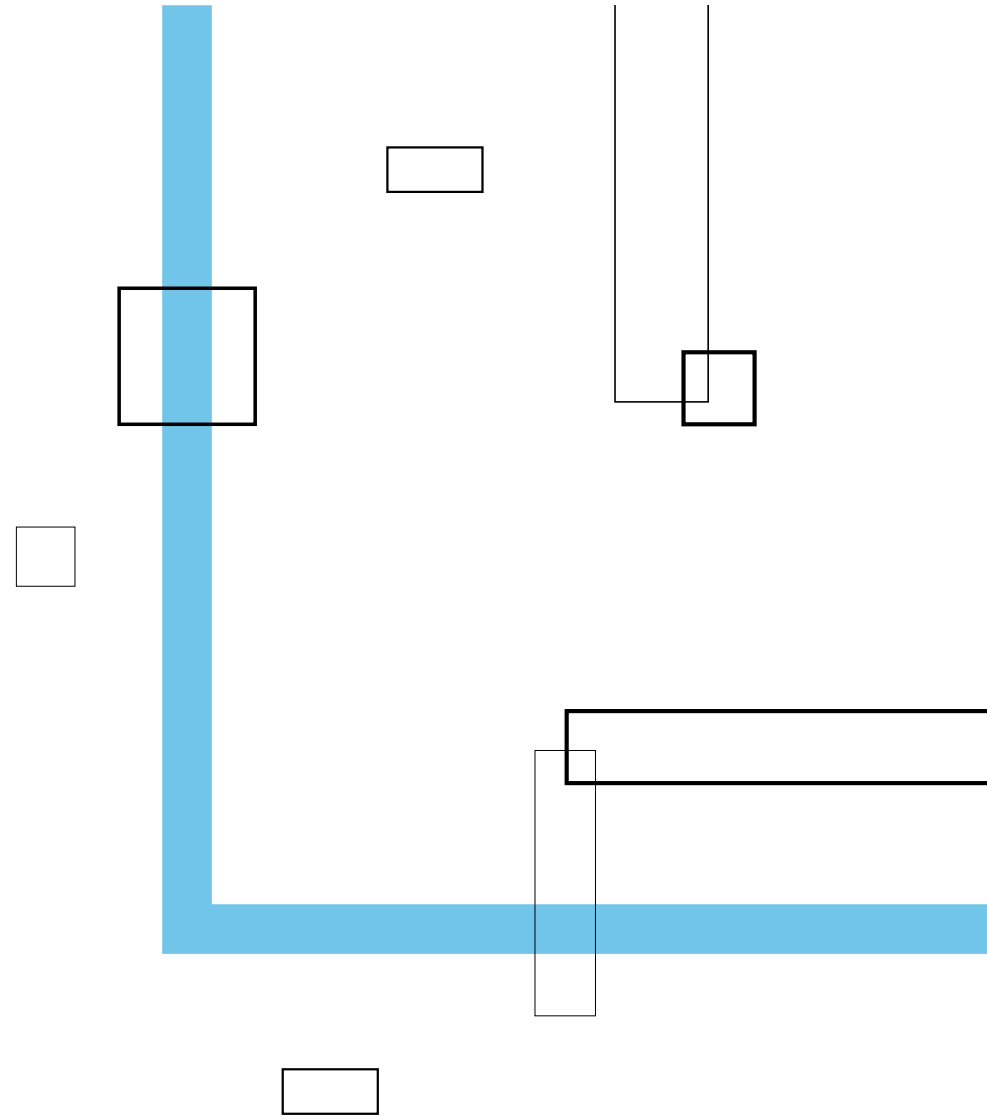
## Renewable Fuels >

- FAME >
- UCOME >
- RME >
- HVO >
- Ethanol >



**World's first Paris Agreement aligned carbon credit futures contract**  
CORSIA Phase 1 launched 9 October 2023

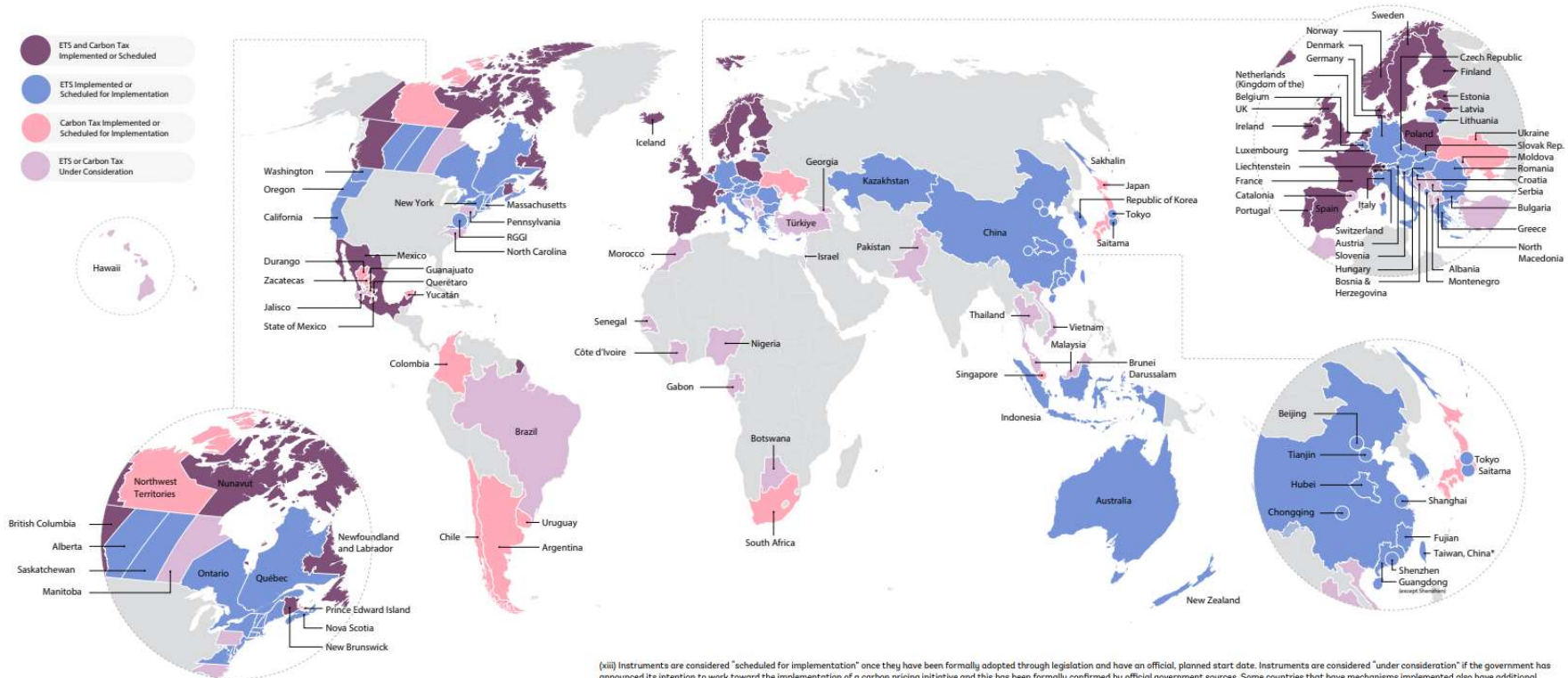
# Appendix



# Carbon pricing map

## ETS and carbon taxes

FIGURE 5  
MAP OF CARBON TAXES AND ETSs<sup>(xiii)</sup>



(xiii) Instruments are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date. Instruments are considered "under consideration" if the government has announced its intention to work toward the implementation of a carbon pricing initiative and this has been formally confirmed by official government sources. Some countries that have mechanisms implemented also have additional instruments under consideration. For subnational jurisdictions only the subnational instrument is reflected.

# Regulated carbon markets

ICE hosts the three largest and most liquid carbon markets in the world

	North America		Europe	UK
Name	Western Climate Initiative (WCI) <sup>1</sup>	Regional Greenhouse Gas Initiative (RGGI) <sup>2</sup>	European Emissions Trading System (EU ETS) <sup>3</sup>	UK Emissions Trading System (EU ETS) <sup>4</sup>
Members	California and Quebec have a linked cap and trade program British Columbia, Nova Scotia	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont. Virginia joined in 2021	All European countries plus Iceland, Liechtenstein and Norway (Switzerland is linked)	UK (4 Governments)
Start date	2013	2008	2005	2021
Size of cap	375 million allowances in 2021	71 million allowances in 2021	1,776 million allowances in 2021	155 million allowances in 2021
% emissions covered	85%	20%	45%	35%
Industries covered	Power sector, industry, distributed natural gas and fuels	Power sector	Power, industry, EU aviation	Power, industry, UK aviation
Supply / price management	Floor price (increase 5% + inflation) Allowance Price Containment Reserve (APCR) Price containment (ceiling after 2020)	Cost Containment Reserve (CCR) Emissions Containment Reserve (ECR) starts 2021	Market Stability Reserve (MSR)	Floor price £22 Cost containment mechanism
Notional value ICE (2020)	30 billion USD (+42.9%) 47 billion USD 2021 projection (+56%)	1.5 billion USD (+0) 1.8 billion USD 2021 projection (+25%)	308 billion EUR (+14.5%) 696 billion EUR 2021 projection (+125%)	GBP [-] 22 billion GBP 2021 projection
Churn (volume/cap*) 2020 [2019] *adjusted for MSR	<b>4.67 [3.61]</b>	<b>4.1 [4.5]</b>	<b>8.45 [7.85]</b>	<b>N/A [-]</b>

1. Also referred to as California Cap and Trade. For more information see [California cap & trade homepage](#)

2. For more information see [RGGI cap & trade homepage](#)

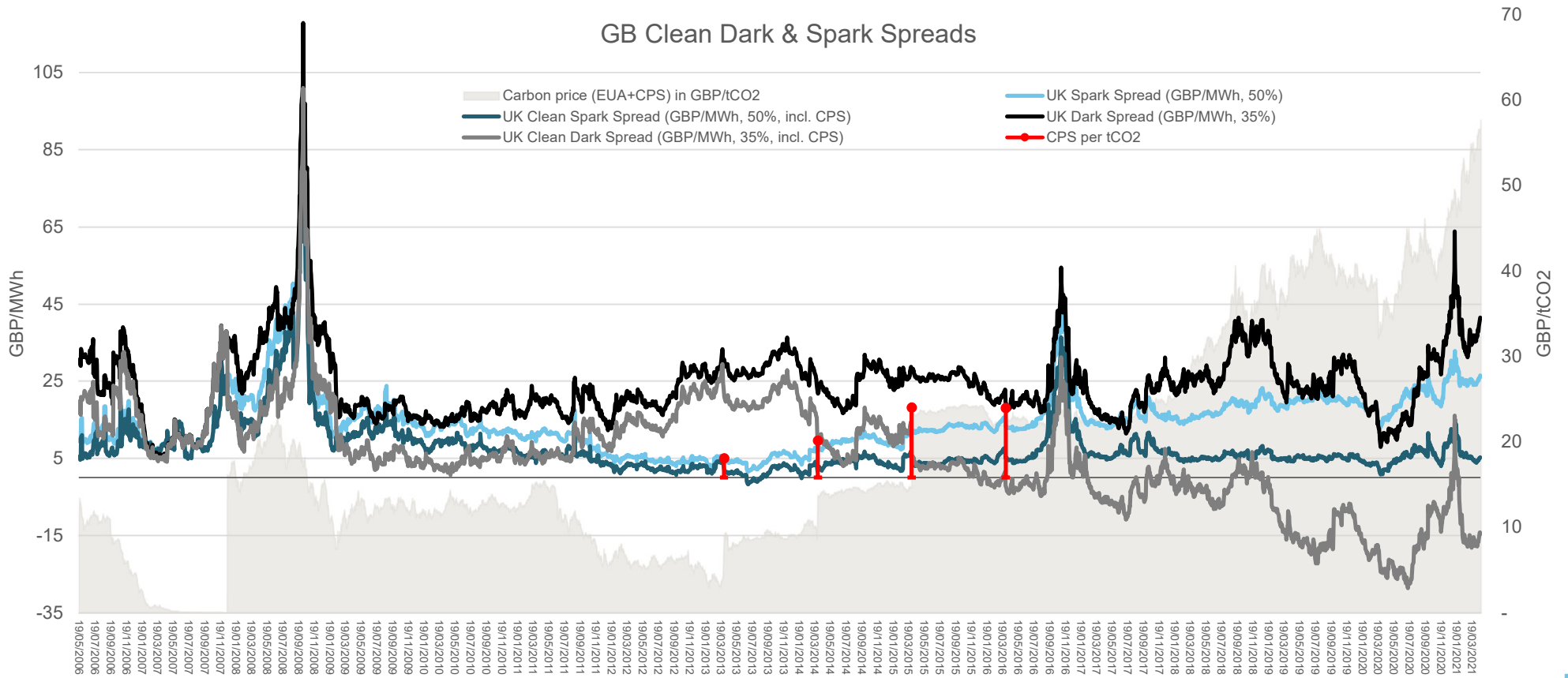
3. For more information see [European ETS Handbook](#)

4. For more information see [Participating in UK ETS](#)



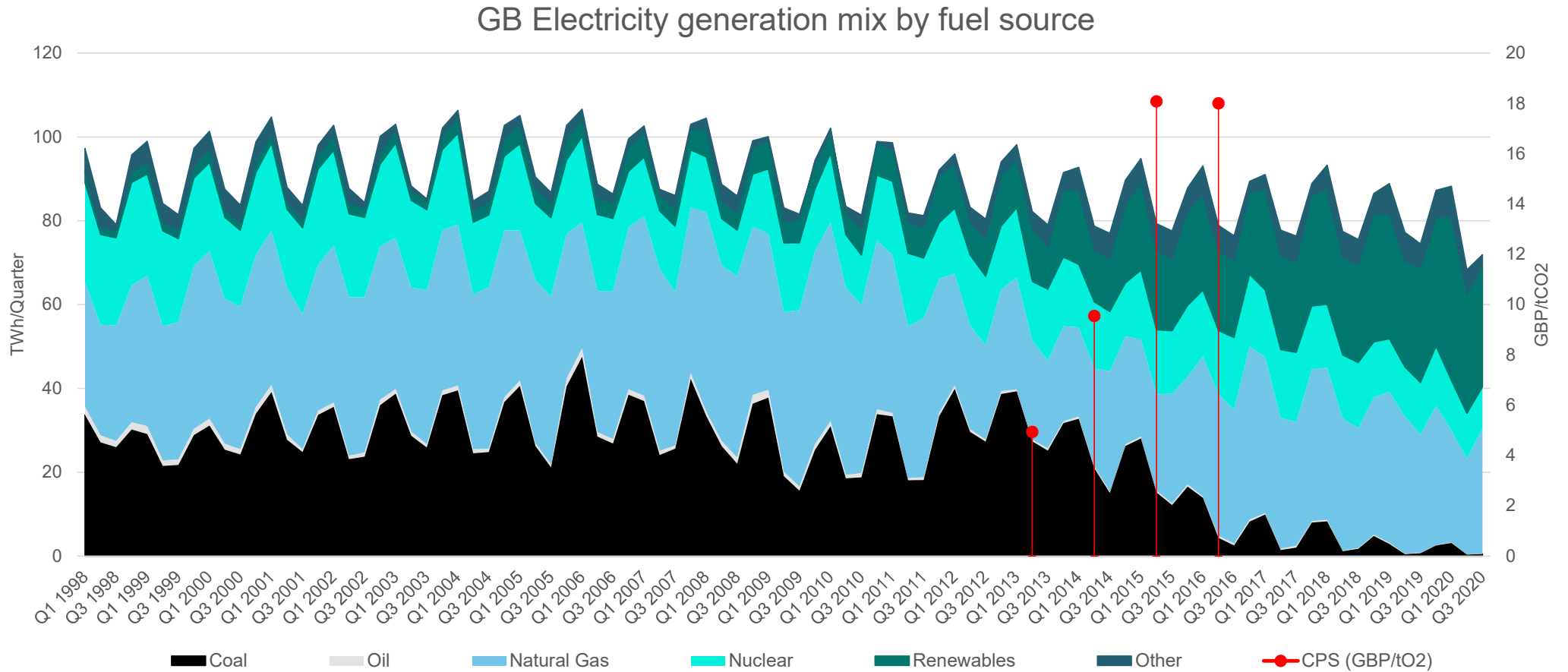
# Carbonomics: UK Case Study

When the price of carbon is taken into account, it is less profitable to produce electricity from both coal and natural gas



# Carbonomics: UK Case Study Outcome

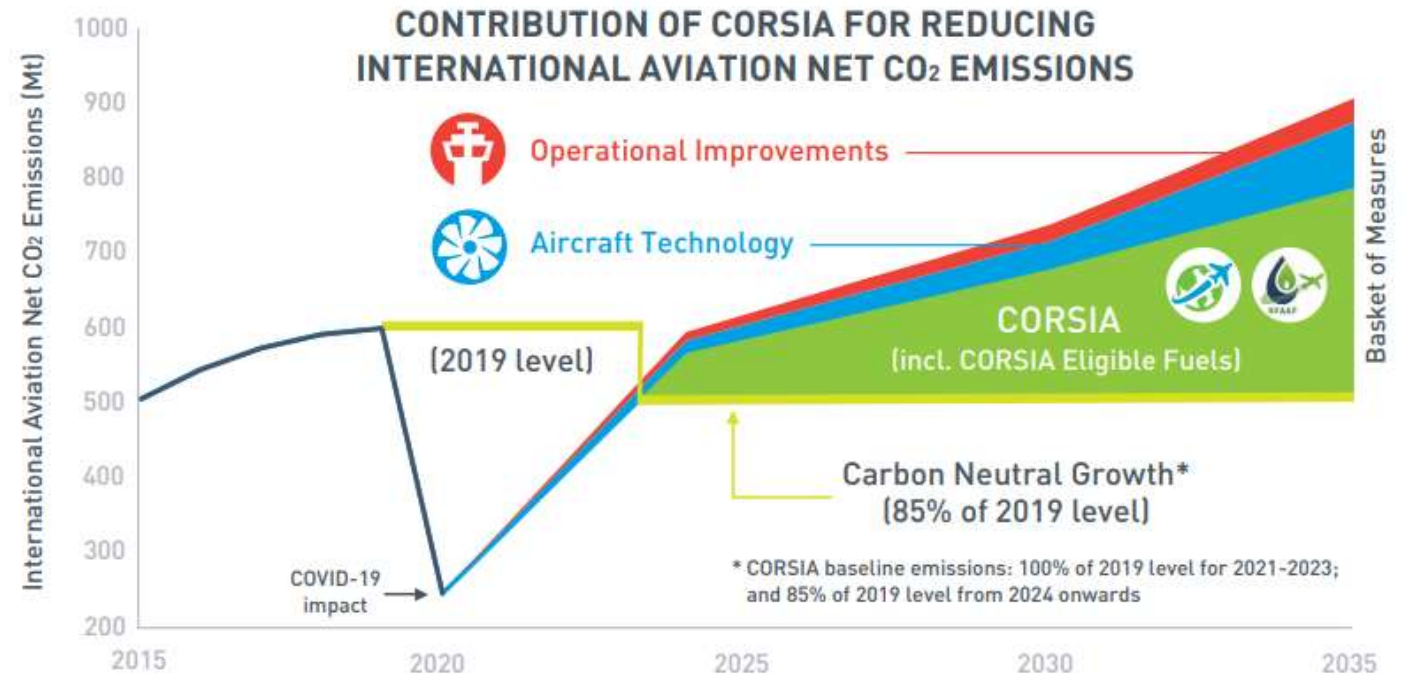
Coal is removed from merit order of electricity generation



Source: [Ofgem \(2021\), 'Electricity generation mix by quarter and fuel source \(GB\)', April](#)

# Carbon Offsetting And Reduction Scheme For International Aviation (CORSIA)

- First global market-based measure
- Part of basket of measures to offset emissions that cannot be reduced by operational improvements or Aircraft technology.
- Pilot Phase 21-23 (Voluntary – 88 states)
- First Phase 24-26 (Voluntary – 125 states)
- Second Phase 27-35 split in 3 years compliance periods (27-29; 30-32, 33-35) – all states (with exclusions)
- Baseline: 85% of 2019 level from 2024 onwards
- Member states ensure compliance.



## SUSTAINABLE DEVELOPMENT GOALS

ICAO's environmental work contributes to 14 out of the 17 United Nations SDGs

