

Doutoramento em Alterações
Climáticas e Políticas de
Desenvolvimento Sustentável

SEMINAR ENERGY & CLIMATE CHANGE

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- Climate Policy
 - Carbon pricing schemes
 - EU Climate Policy (brief)
 - EU – Emissions Trading Scheme



Nations Unies
Conférence sur les Changements Climatiques 2015
COP21/CMP11
Paris, France

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HOW TO PROMOTE MITIGATION?

MARKET WILL GET IT ON ITS OWN PREMISES?

The tragedy of the commons is a situation in a shared-resource system where individual users, acting independently according to their own self-interest, behave contrary to the common good of all users by depleting or spoiling the shared resource through their collective action. The theory originated in an essay written in 1833 by the British economist William F. Lloyd.

Garrett Hardin (1968), "commons" is taken to mean any shared and unregulated resource such as atmosphere, oceans, rivers, fish stocks, roads and highways. Read Garrett's paper [here](#)

Kyoto Protocol (signed in 1997-> 2012)

1 tCO₂ = economic value in the market

- Major invention in international environmental diplomacy
- Emissions Trading
 - Cap-and-trade between industrialised countries
 - Traded unit Assigned Amount Units (AAU)
- Joint Implementation (JI)
 - Emission reduction projects in industrialised countries
 - Traded unit Emission Reduction Unit (ERU)
- Clean Development Mechanism (CDM)
 - Emission reduction projects in developing countries
 - Traded unit Certified Emission Reductions (CER)

[Kyoto Protocol / Paris Agreement] [Companies]

Mitigation targets / pledges
for a specific year

(% reduction face to a base year)

How to reduce
CO₂e
emissions?

- New Technology
- New Processes
- New Behaviour
- New Product

Same service with less
CO₂e emissions

New market rules

carbon = commodity

CO₂ emissions have a cost,

CO₂ reduction is the driver
for decision and investment

carbon
=
commodity

ECONOMIC
INSTRUMENTS

Compliance market

Public Policy
Rules

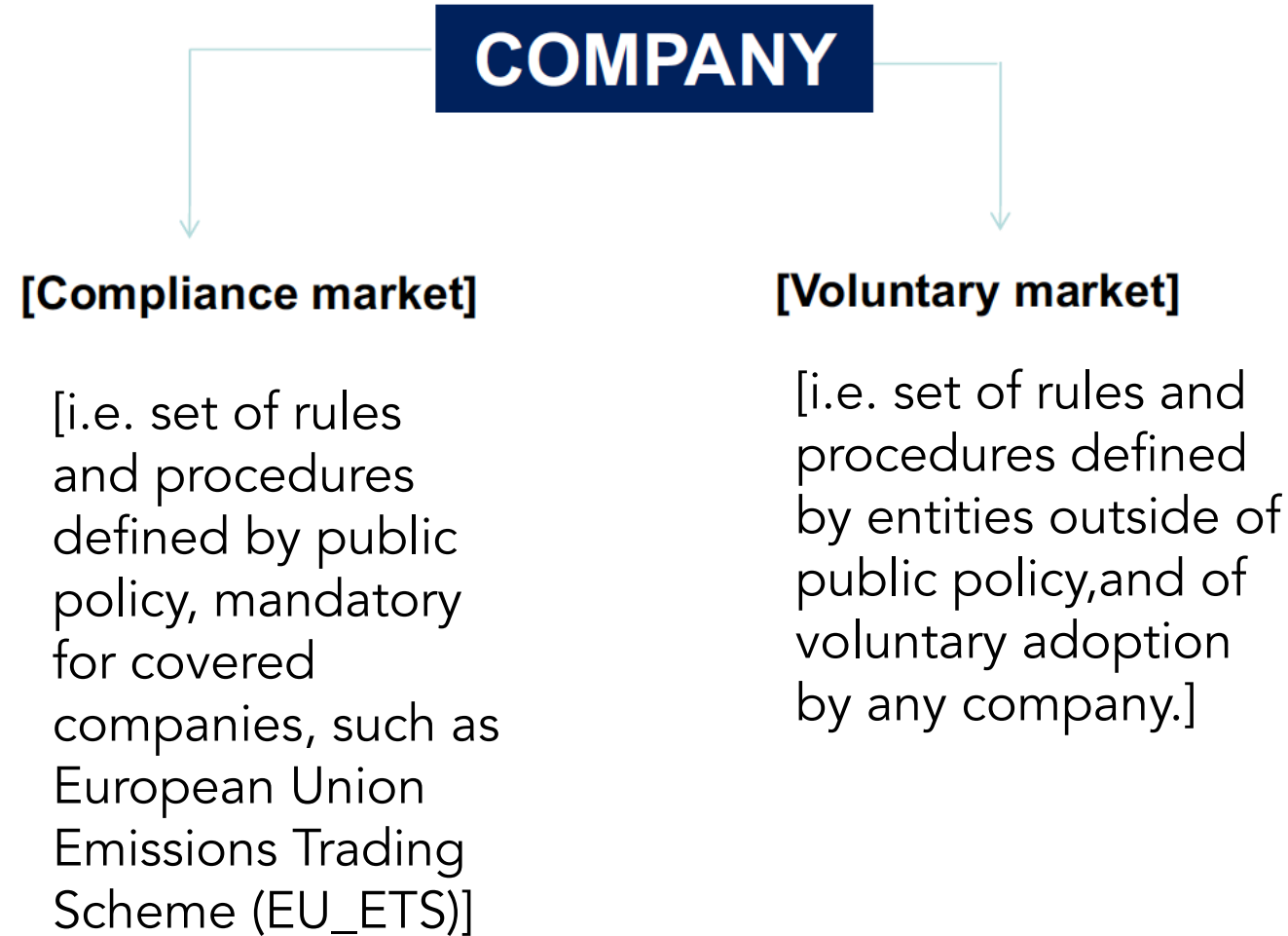
Voluntary market

Voluntary
Rules

COMPANIES

- New information and competences
- New organizational schemes
- New management variables

investment
operational costs
competitivity



achieve the balance between anthropogenic emissions by sources and removals by sinks in the second half of this century (neutral balance)

CARBON NEUTRALITY (NEUTRALIDADE CARBÓNICA)

GREENHOUSE GAS EMISSIONS + CO₂ SEQUESTRATION = 0

by 2050

Paris Agreement

CHALLENGE:

Huge difference to the pathway towards 2°C, based on current NDCs (Nationally Determined Contributions)

2020:

The COVID-19 crisis offers only a short-term reduction in global emissions and will not contribute significantly to emissions reductions by 2030 unless countries pursue an economic recovery that incorporates strong decarbonization.

Unconditional targets are considered voluntary and implementable without outside support.

Conditional on either financial support from a "high-ambition" bloc of countries, or conditional on supportive climate-related policies pursued by other countries.

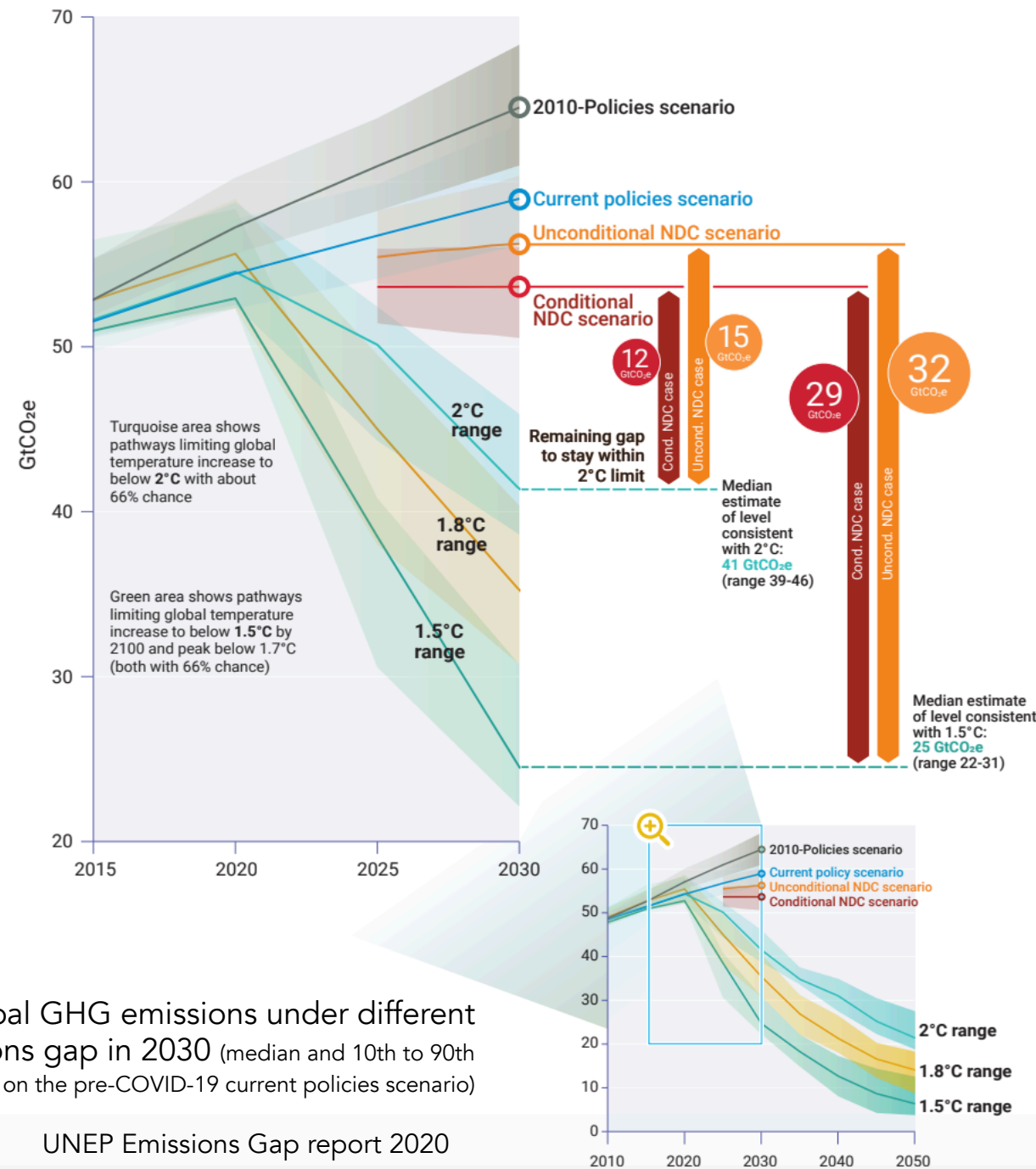
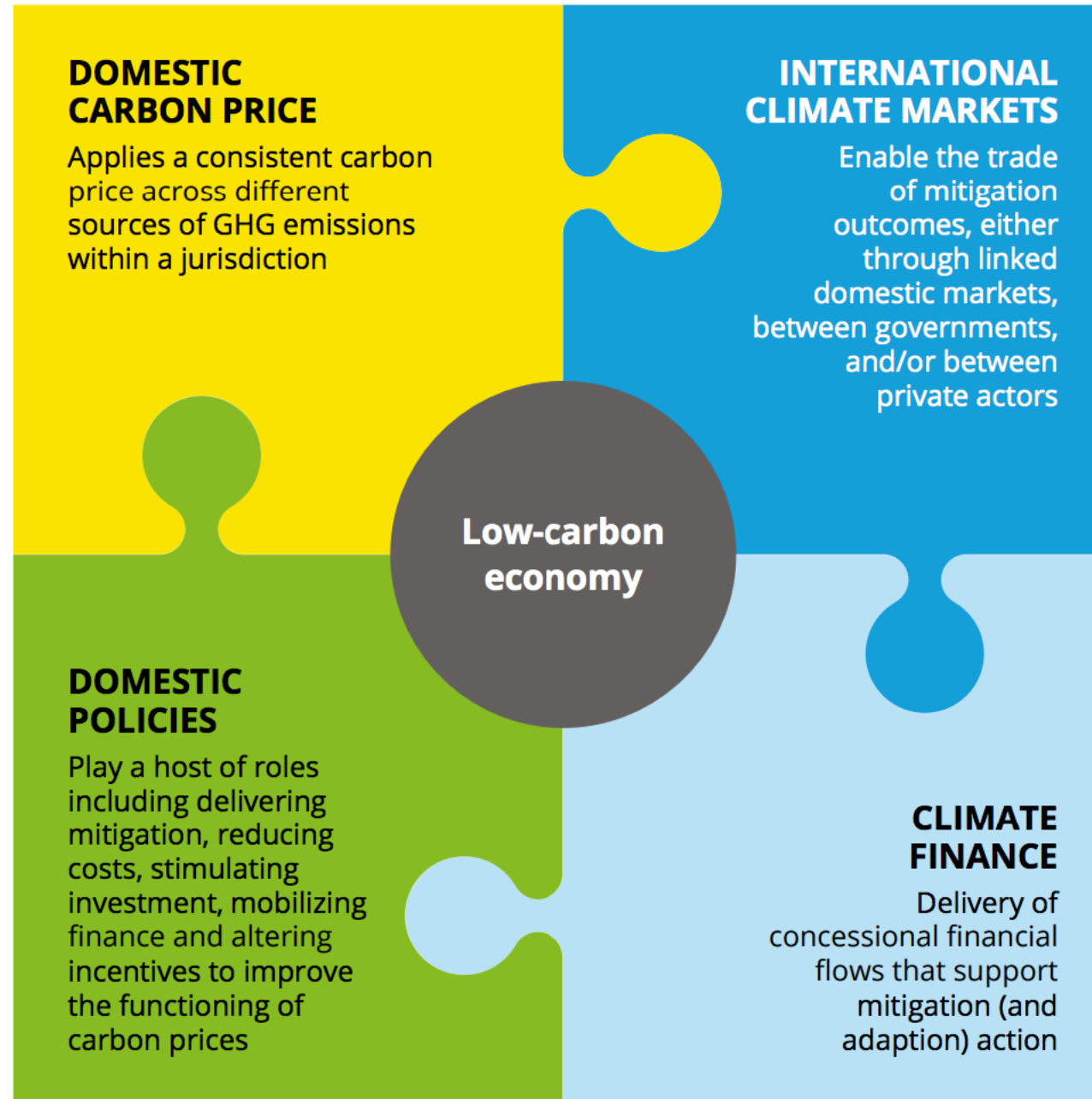


Figure ES.5. Global GHG emissions under different scenarios and the emissions gap in 2030 (median and 10th to 90th percentile range; based on the pre-COVID-19 current policies scenario)

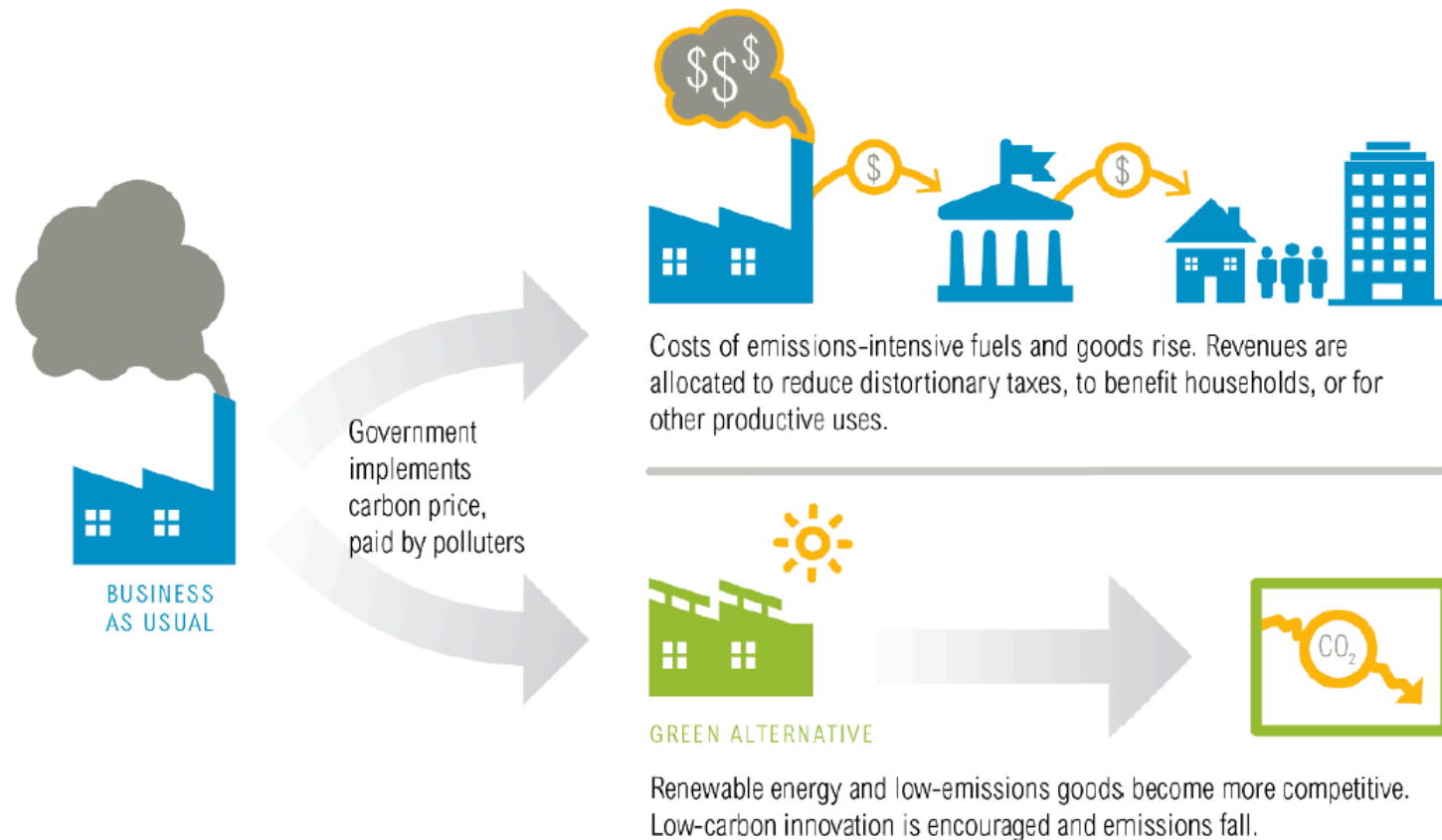
UNEP Emissions Gap report 2020

No end-of-pipe technology to reduce greenhouse gas emissions in industrial units or thermal power plants;

- How to induce mitigation in nations?
- How to make companies reducing their greenhouse gas emissions?
- How to press families and individuals reducing emissions?



WHAT HAPPEN IF WE PUT A PRICE IN THE CARBON?



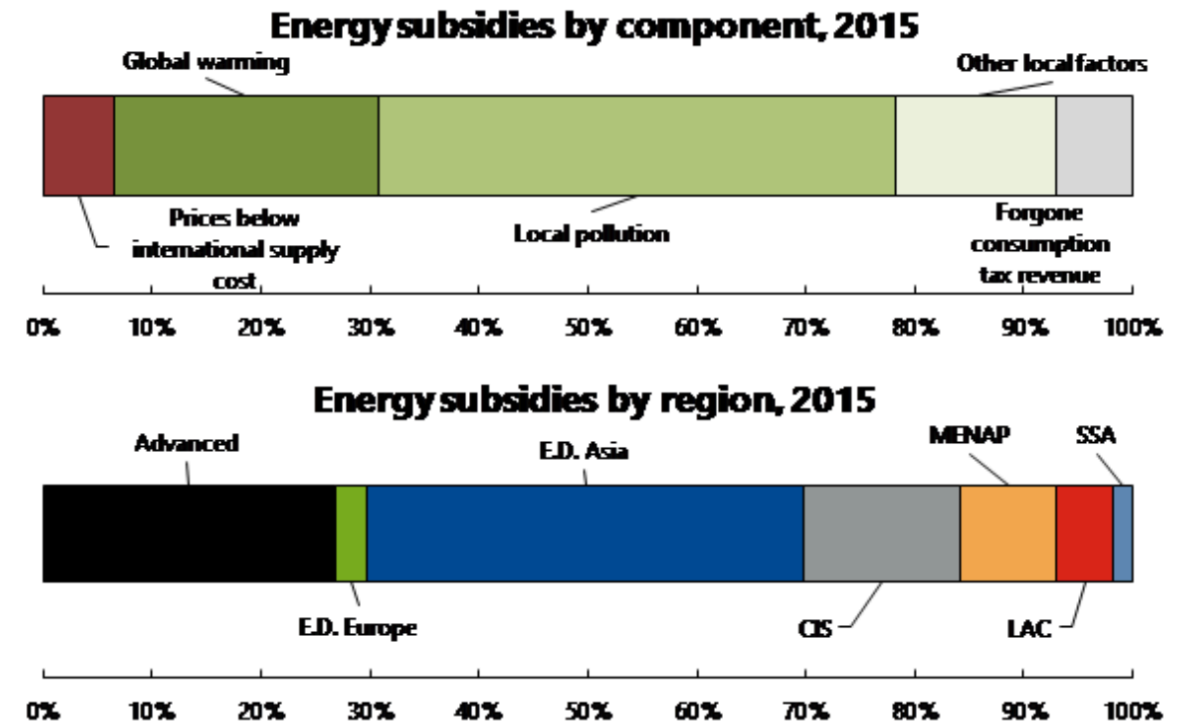
Post-tax energy subsidies were estimated at \$4.7 trillion (6.3 percent of global GDP) in 2015 and at \$5.2 trillion (6.5 percent of global GDP) in 2017.

In dollar terms, Emerging and Developing Asia accounts for about 40% of global post-tax subsidies with advanced economies accounting for about one quarter.

Getting Energy Prices Right, IMF ([video](#))

Post-tax consumer subsidies exist if consumer prices for energy are below supply costs plus the efficient levels of taxation. The efficient level of taxation includes two components. First, energy should be taxed the same way as any other consumer product. Second, some energy products contribute to local pollution, traffic congestion and accidents, and global warming—efficient taxation requires that the price of energy should reflect these adverse effects on society. In most countries, taxes on energy fall far short of the efficient levels.

Producer subsidies exist when producers receive either direct or indirect support that increases their profitability above what it otherwise would be. This support can take many forms, including receiving a price for the output above the supply cost, paying a price for inputs below supply costs, or receiving a direct transfer from the budget.



INTERNATIONAL MONETARY FUND



Read the report [here](#)

- Voluntary instrument (no rules from governments): voluntary carbon market (will be presented later)

- Compliance instruments (rules set by public policies):

Emissions Trading Schemes: instrument based on a cap (over a industrial unit) and trade (between two industrial units).

Carbon Tax: on producers, like coal power plants over the coal consumed, or on consumers, like over gasoline or diesel consumption;

PURPOSE: CHANGE BEHAVIOR AND DECISION!

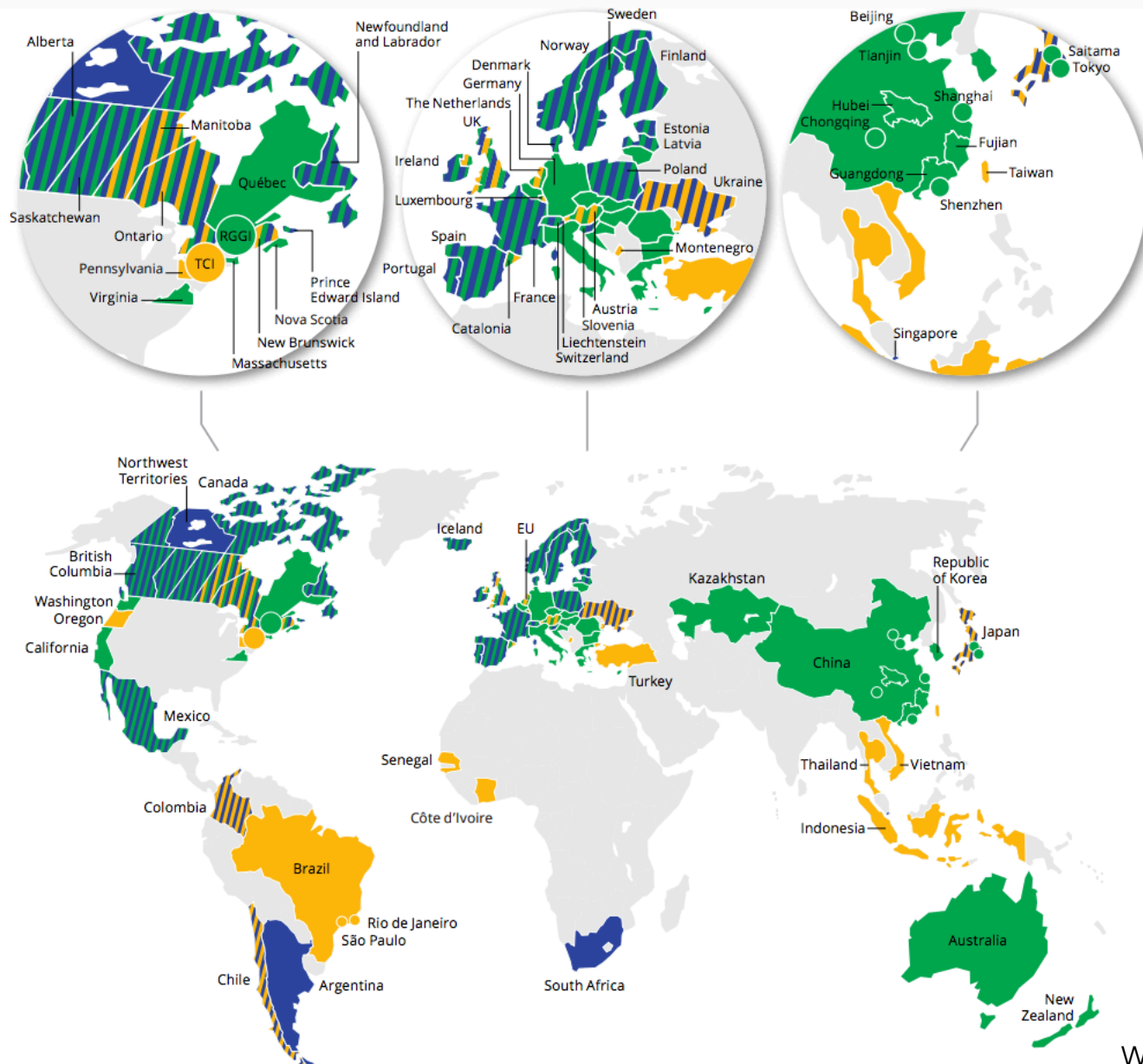


Figure ES.1 / Carbon pricing initiatives implemented, scheduled for implementation and under consideration (ETS and carbon tax).

There are now 61 carbon pricing initiatives in place or scheduled for implementation, consisting of 31 ETSs and 30 carbon taxes.

ETS: Emissions Trading Scheme
Tax: CO2 tax

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

The large circles represent cooperation initiatives on carbon pricing between subnational jurisdictions. The small circles represent carbon pricing initiatives in cities.

Climate Policy: Carbon Pricing

2019: the carbon pricing story has expanded, with jurisdictions broadening their carbon pricing coverage to increase their climate ambition.

ETS and taxes cover 12 GtCO₂e or about 22% of global GHG emissions, This is an increase compared to 2018, (20%)

Figure ES.2 / Share of global emissions covered by carbon pricing initiatives (ETS and carbon tax)

World Bank, 2019

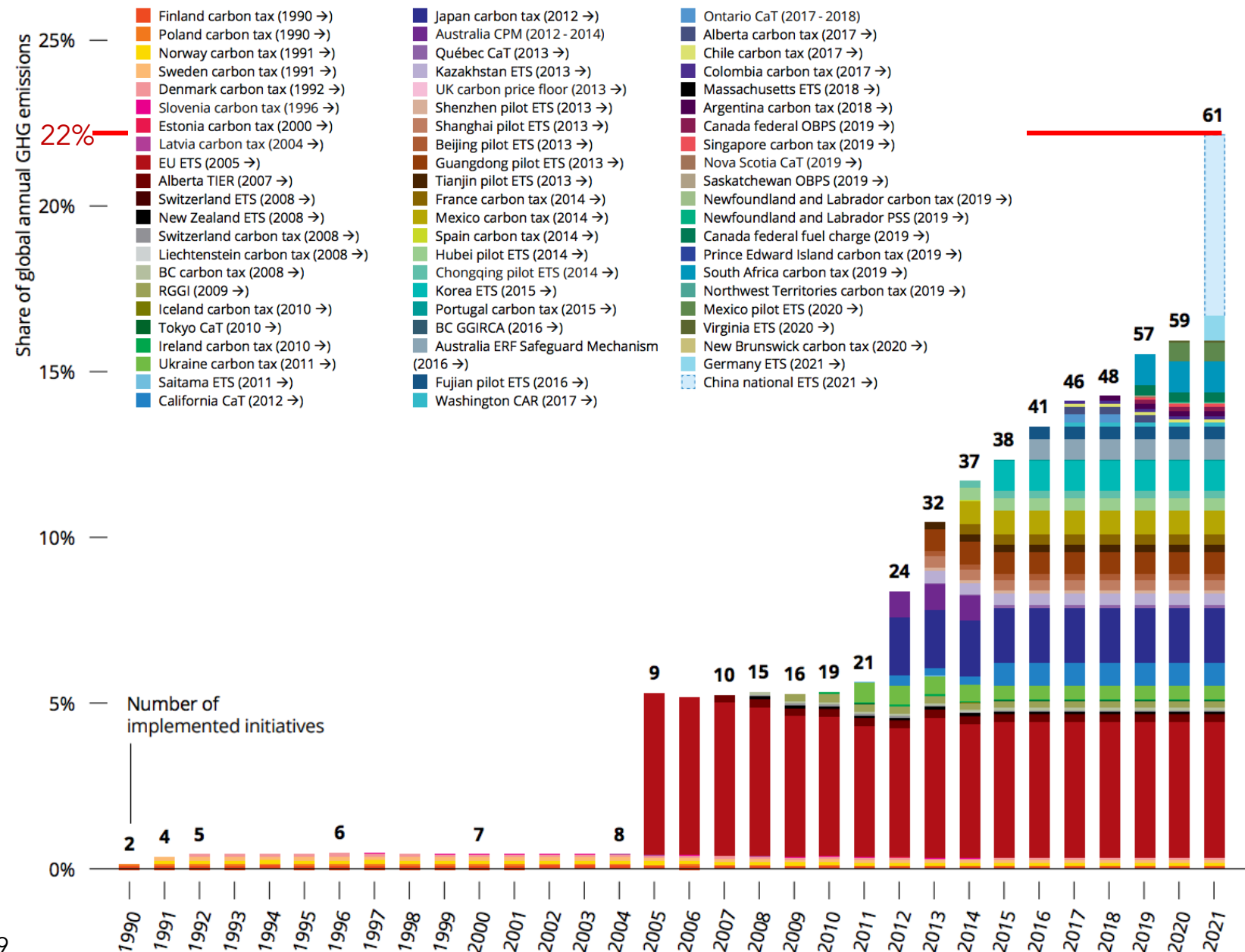
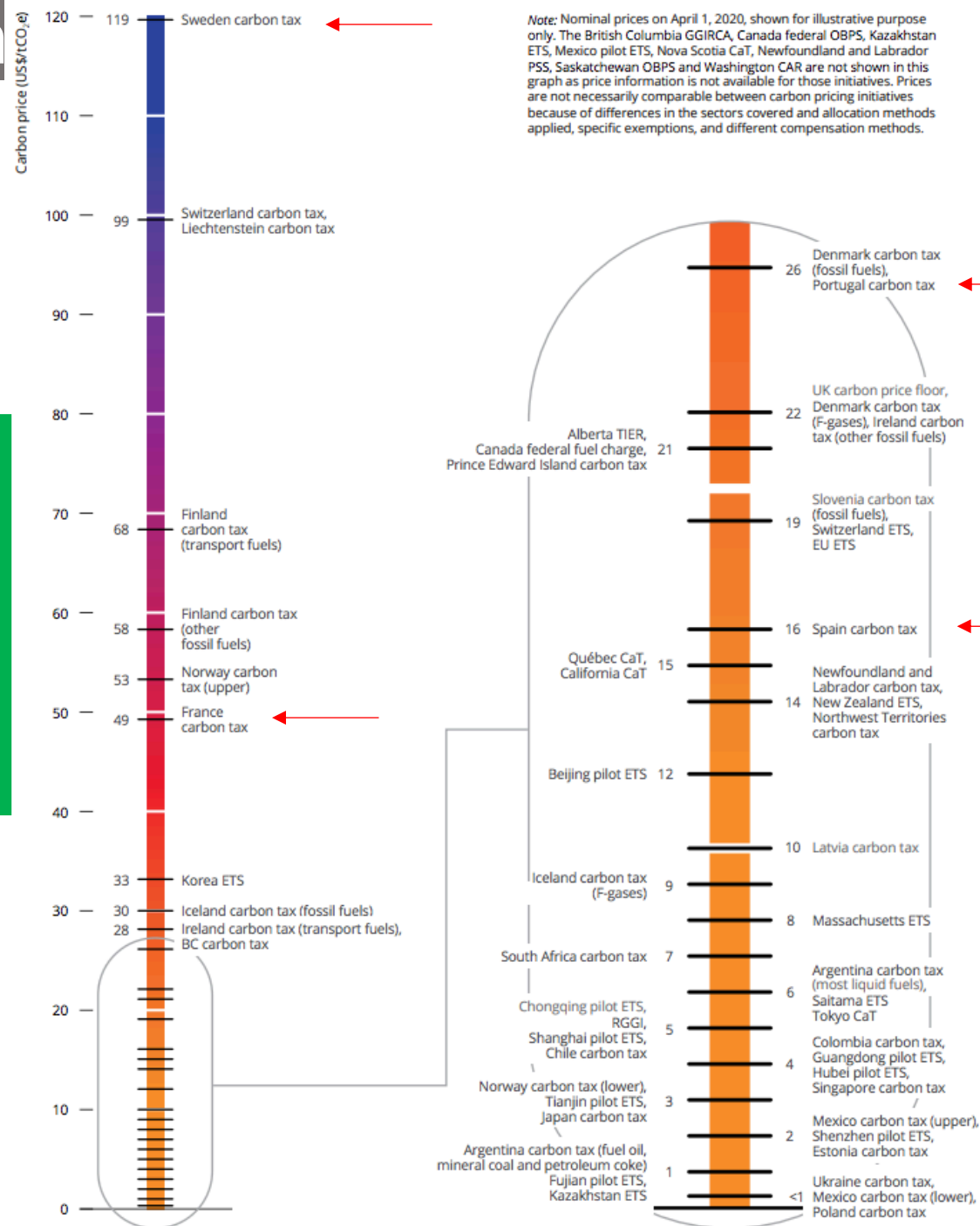


Figure ES.3 / Prices in implemented carbon pricing initiatives

Carbon Prices required to cost-effectively reduce emissions in line with the temperature goals of the Paris Agreement

Governments raised more than \$45 billion from carbon pricing in 2019. 2019 saw a slower yearly increase in revenues than 2018, largely as a consequence of the EU ETS price stabilization in 2019. Almost half of the revenues were dedicated to environmental or broader development projects, and more than 40 percent went to the general budget. The remaining share was dedicated to tax cuts and direct transfers.



PT 2021:
23,921 €/tCO₂

World Bank, 2019

European Climate Regulatory Framework :

- [2020 climate & energy package](#),
- [2030 climate & energy framework](#), updated to a more ambitious emissions reduction target (-55%)
- [2050 long-term strategy](#), based on [A Clean Planet for all- A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy](#).

[National long-term strategies](#), including national documents.

- [European green deal](#)



Dec 11, 2019

<https://www.youtube.com/watch?v=F2Z7rio5sow>

https://ec.europa.eu/clima/policies/strategies_en

2020

- 20% cut in **greenhouse gas** emissions (from 1990 levels)
- 20% of EU energy from **renewables**
- 20% improvement in **energy efficiency**

2030

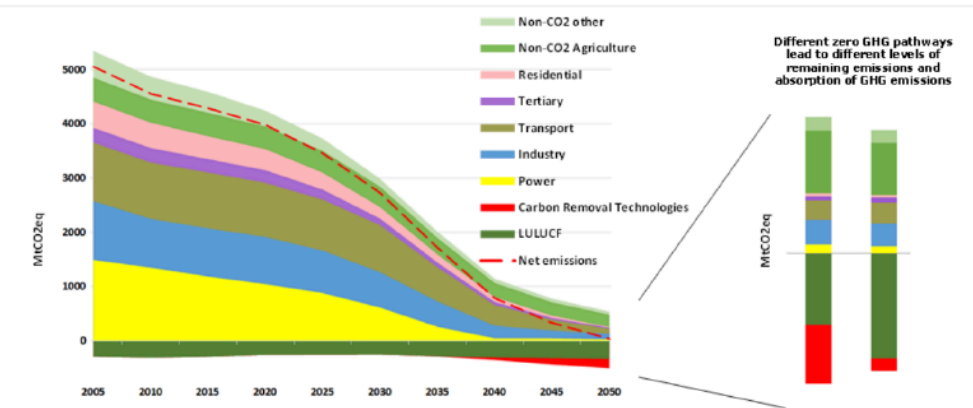
- **55%** cut in **greenhouse gas** emissions (from 1990 levels)
- 32% of EU energy from **renewables**
- 32,5% improvement in **energy efficiency**

2050

The European Parliament endorsed **the net-zero greenhouse gas emissions objective** in its resolution on climate change in Mar 2019 and resolution on the European Green Deal in Jan 2020.

EU long term strategy submitted to UNFCCC (2019) aligned to Paris Agreement goal

Figure 4: GHG emissions under the scenario of a global temperature increase of 1.5°C¹



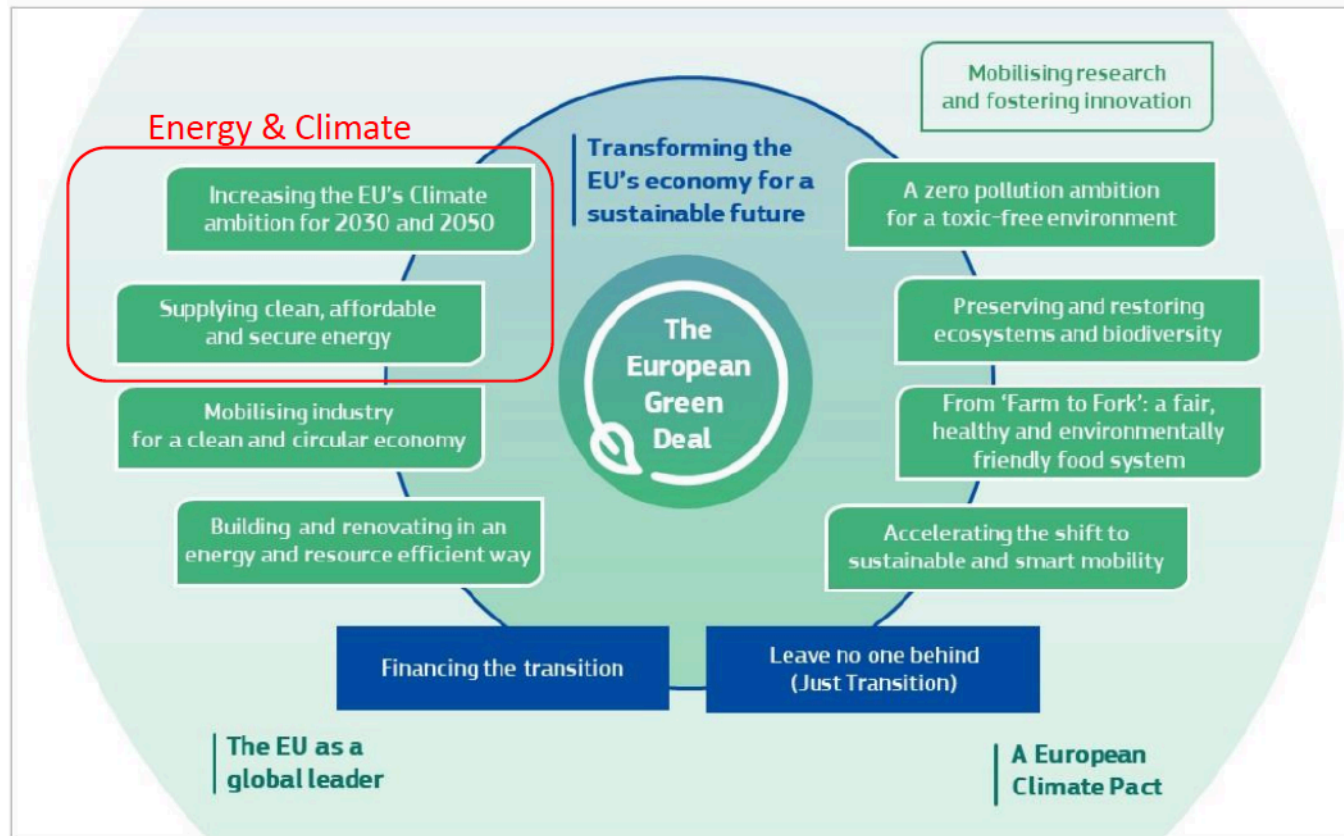


Figure 1: The European Green Deal

Between 1990 and 2018, EU reduced greenhouse gas emissions by 23%, while the economy grew by 61%. However, current policies will only reduce greenhouse gas emissions by 60% by 2050.

(...)

By summer 2020, the Commission will present an impact assessed plan to increase the EU's greenhouse gas emission reductions target for 2030 to at least 50% and towards 55% compared with 1990 levels in a responsible way.

“ **Climate change represents the greatest and widest-ranging market failure ever seen.** ”

Sir Nicholas Stern, Head of the UK Government Economic Service
and former World Bank Chief Economist, 2006

The Economics of Climate Change: The Stern Review (2006)

*Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to **losing at least 5% of global GDP each year**, now and forever.*

*If a wider range of risks and impacts is taken into account, the estimates of damage could **rise to 20% of GDP** or more. In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year.*

Read more [here](#)

GREENHOUSE GAS EMISSIONS ► NEGATIVE EXTERNALITY FROM ECONOMIC ACTIVITIES

External costs of carbon emissions: costs that society pays in other ways, such as damages and losses, for example agricultural due to droughts or floods, health costs due to heat waves, costs with damages and property losses due to floods, rural fires and rising sea levels.

SOCIAL COST OF CARBON ([William D. Nordhaus](#), 2017; [Ricke et al](#), 2018;

E&E NEWS
CLIMATE

Cost of Carbon Pollution Pegged at \$51 a Ton

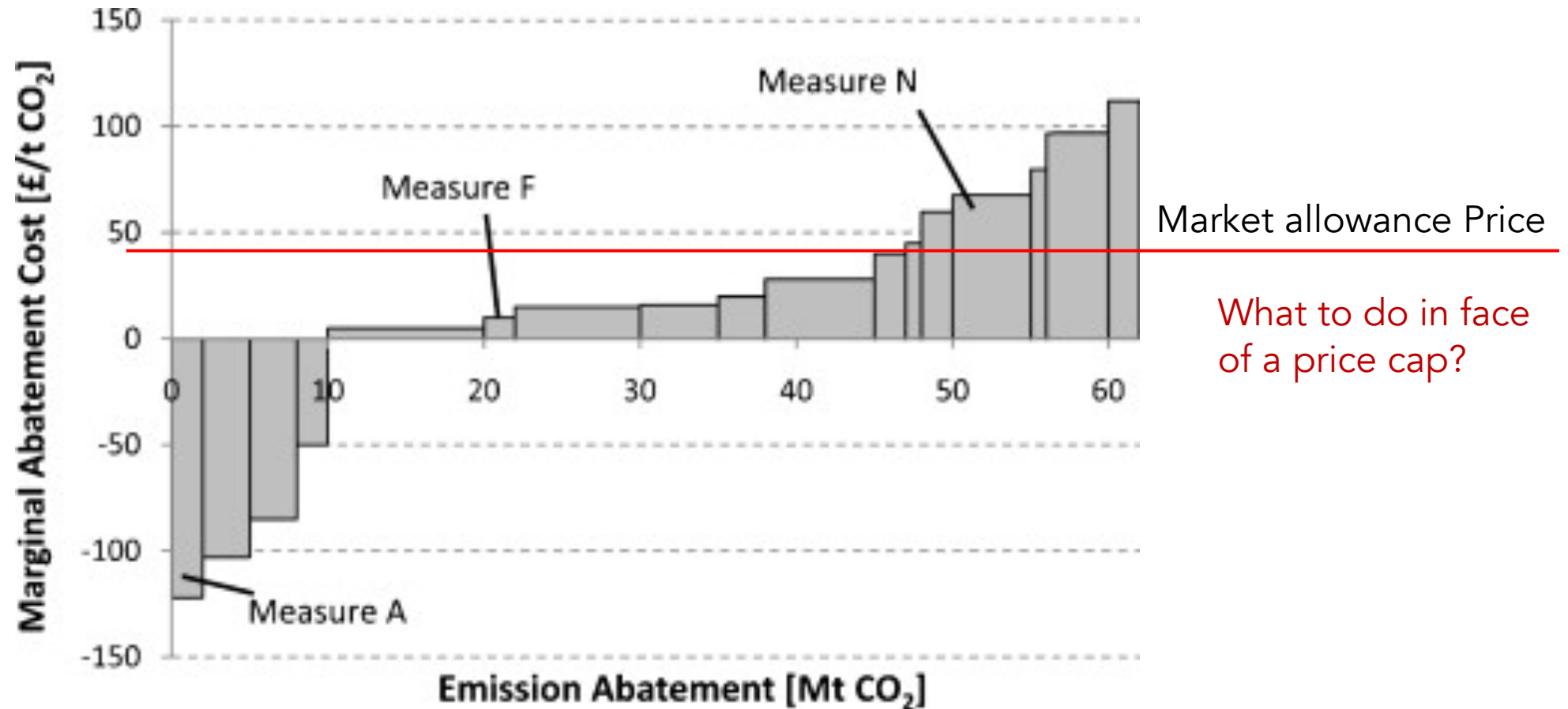
The Biden Administration raised the benchmark, and may do it again within a year

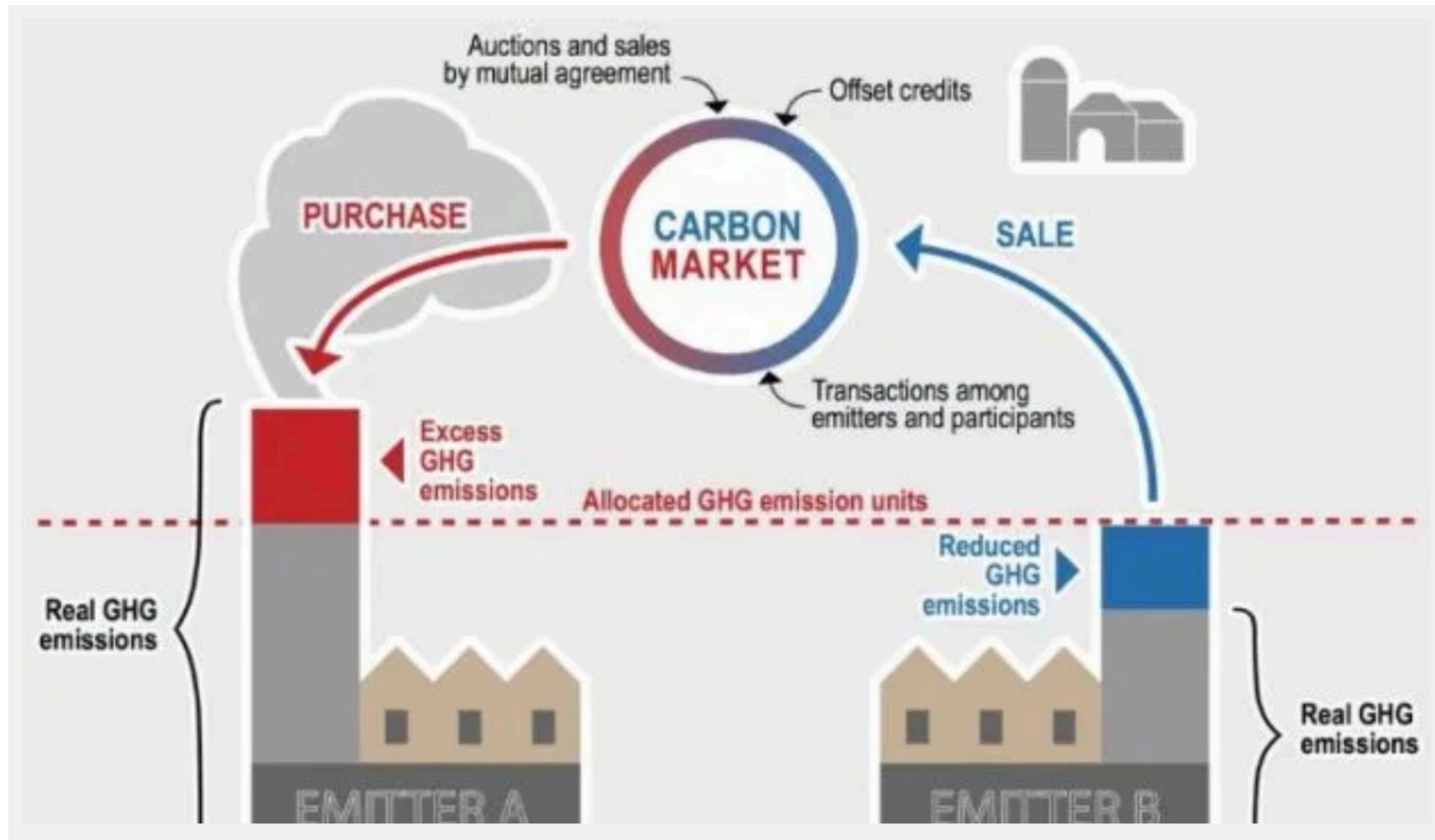
By Jean Chernick, E&E News on March 1, 2021

» There is a growing consensus that carbon pricing—charging for the carbon content of fossil fuels or their emissions—is the single most effective mitigation instrument. «

*Christine Lagarde, Managing Director of the International Monetary Fund and
Vitor Gaspar, Director of the International Monetary Fund's Fiscal Affairs Department*

A marginal abatement cost curve (MACC) is an estimate of the volume and costs of opportunities to reduce emissions in a given year.





What commodity is traded?

What is(are) the factor(s) that decide the purchase allowances vs. cut back the emissions?

Emissions trading, also known as 'cap and trade', is a cost-effective way of reducing greenhouse gas emissions.

To incentivise firms to reduce their emissions, a government sets a cap on the maximum level of emissions and creates permits, or allowances, for each unit of emissions allowed under the cap. Emitting firms must obtain and surrender a permit for each unit of their emissions. They can obtain permits from the government or through trading with other firms. The government may choose to give the permits away for free or to auction them.

Firms that expect not to have enough permits must either cut back on their emissions or buy permits from another firm. **For a given permit price, some firms will find it easier, or cheaper, to reduce emissions than others and will sell permits.**

At each moment, there is a unique price for all firms coordinating their activities and drives down emissions to the level allowed under the cap cost-effectively.

LSE, read more [here](#)

EU ETS: Key facts

- Operates in the 28 EU countries plus Iceland, Liechtenstein and Norway
- Limits greenhouse gas emissions from:
 - Approximately 11,000 energy intensive installations in power generation and manufacturing industry sectors
 - Operators of flights to and from EU Member States, Iceland, Liechtenstein and Norway (for the time being, only flights within these countries are covered)
- Covers around 45% of the EU's greenhouse gas emissions

Greenhouse gases and sectors covered

Carbon dioxide (CO₂) from:

- Power and heat generation
- Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals
- Civil aviation

Nitrous oxide (N₂O) from production of nitric, adipic and glyoxylic acids and glyoxal

Perfluorocarbons (PFCs) from aluminium production

Read more [here](#): The EU-ETS handbook (EU, 2015)

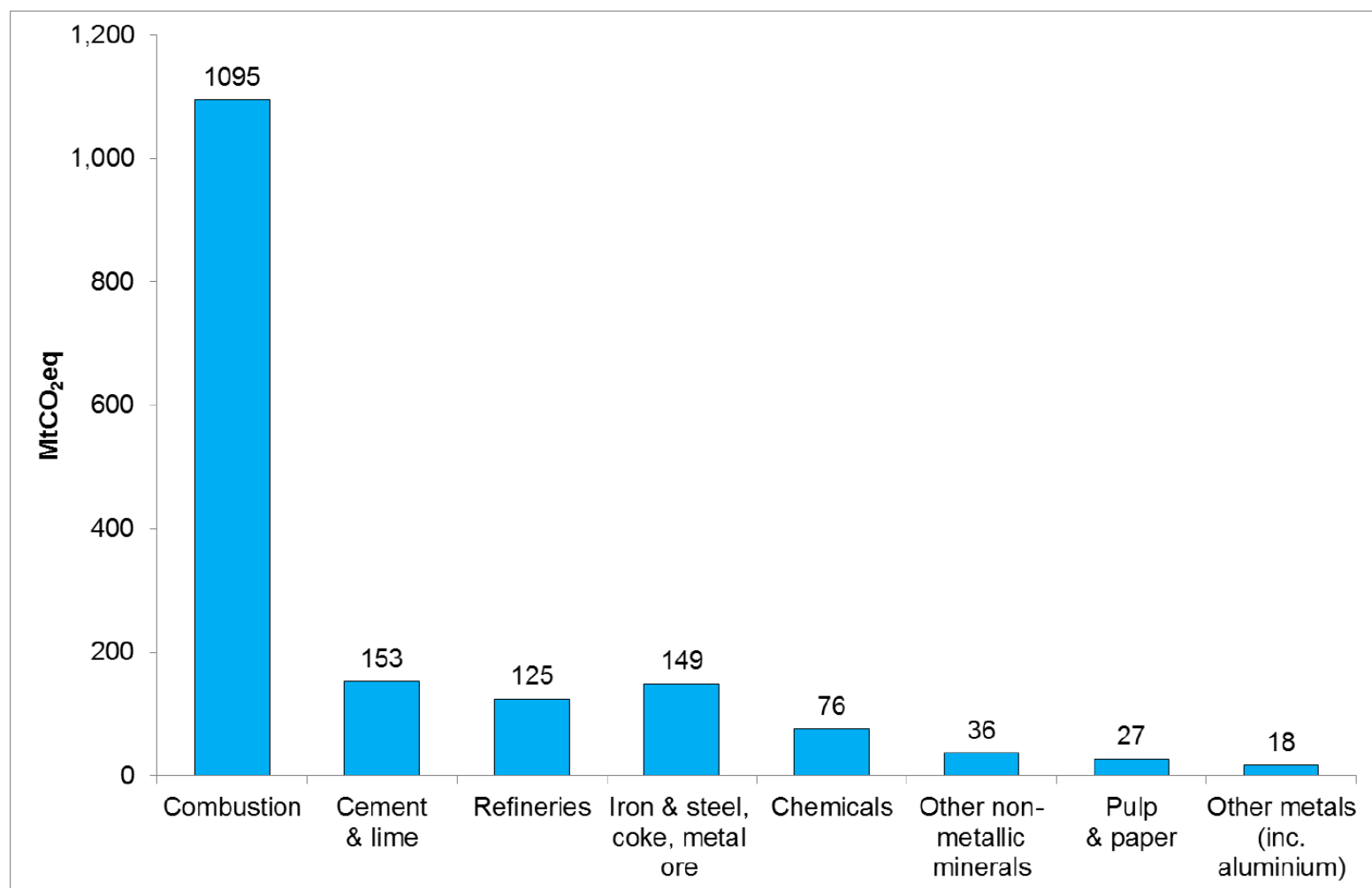


» **European Emission Allowance (EUA):** *permit* to emit 1 t CO₂e
1 EUA = 1 t CO₂

- » **Assign** an emissions **cap** and the respective EUA to the covered industrial installation,
- » Units operators: EUA_i ► **responsibility** to control/reduce GHG emissions,
- » **Trading** of EUA among any person or legal entity in the EU

What type of installations are covered?

Figure 1.1 EU ETS emissions by main activity type in 2018



- Any installation where the fuel (other than 97% or more of biomass) is burned in a combustion unit => 3MW for any purpose and which, when aggregated, exceeds 20 MW.
- All types of boilers, burners, turbines, heaters, ovens, calciners, ovens and, in particular, ovens, fryers, dryers, engines, fuel cells, chemical loop combustion units, rockets, thermal post-combustion units or catalytic.

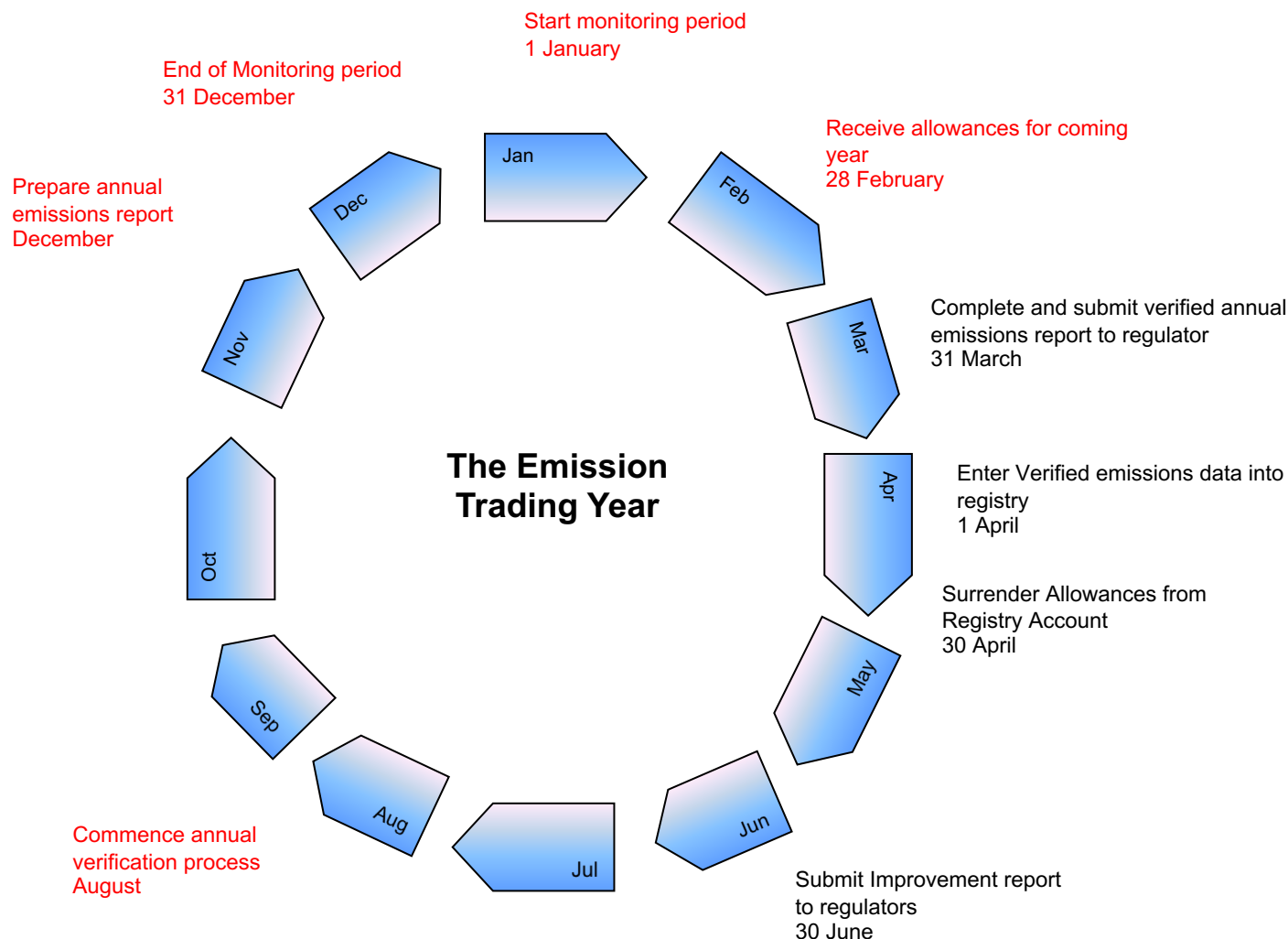
Examples

1	Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste)	CO2
2	Refining of mineral oil	CO2
3	Production of coke	CO2
4	Metal ore (including sulphide ore) roasting or sintering, including pelletisation	CO2
5	Production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour	CO2
6	Production or processing of ferrous metals (including ferro-alloys) where combustion units with a total rated thermal input exceeding 20 MW are operated. Processing includes, inter alia, rolling mills, re-heaters, annealing furnaces, smitheries, foundries, coating and pickling	CO2
7	Production of primary aluminium	CO2 & PFCs
8	Production of secondary aluminium where combustion units with a total rated thermal input exceeding 20 MW are operated	CO2
9	Production or processing of non-ferrous metals, including production of alloys, refining, foundry casting, etc., where combustion units with a total rated thermal input (including fuels used as reducing agents) exceeding 20 MW are operated	CO2
10	Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day	CO2
11	Production of lime or calcination of dolomite or magnesite in rotary kilns or in other furnaces with a production capacity exceeding 50 tonnes per day	CO2
12	Manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day	CO2
13	Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day	CO2
14	Manufacture of mineral wool insulation material using glass, rock or slag with a melting capacity exceeding 20 tonnes per day	CO2
15	Drying or calcination of gypsum or production of plaster boards and other gypsum products, where combustion units with a total rated thermal input exceeding 20 MW are operated	CO2
16	Production of pulp from timber or other fibrous materials	CO2
17	Production of paper or cardboard with a production capacity exceeding 20 tonnes per day	CO2
18	Production of carbon black involving the carbonisation of organic substances such as oils, tars, cracker and distillation residues, where combustion units with a total rated thermal input exceeding 20 MW are operated	CO2
19	Production of nitric acid	CO2 & N2O
20	Production of adipic acid	CO2 & N2O
21	Production of glyoxal and glyoxylic acid	CO2 & N2O
22	Production of ammonia	CO2
23	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 tonnes per day	CO2
24	Production of hydrogen (H ₂) and synthesis gas by reforming or partial oxidation with a production capacity exceeding 25 tonnes per day	CO2
25	Production of soda ash (Na ₂ CO ₃) and sodium bicarbonate (NaHCO ₃)	CO2
26	Capture of greenhouse gases from installations covered by this Directive for the purpose of transport and geological storage in a storage site permitted under Directive 2009/.../EC	CO2
27	Transport of greenhouse gases by pipelines for geological storage in a storage site permitted under Directive 2009/.../EC	CO2
28	Geological storage of greenhouse gases in a storage site permitted under Directive 2009/.../EC	CO2

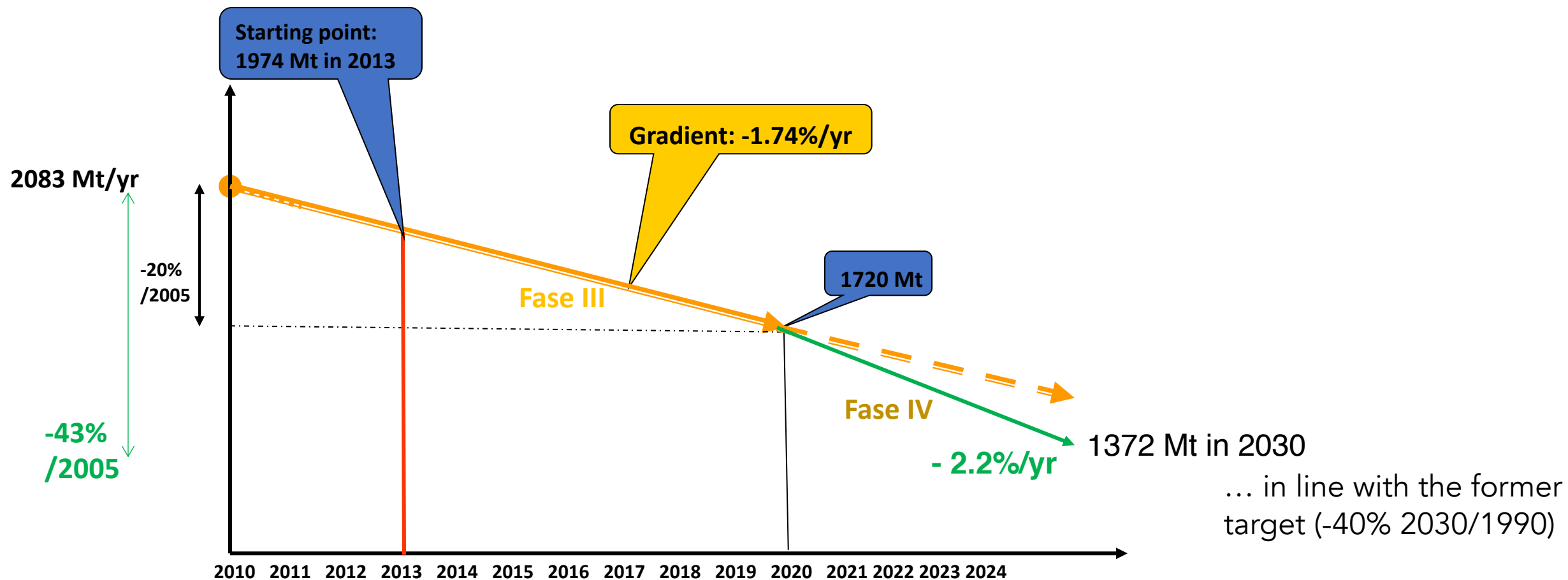
How EU-ETS functions? the compliance annual cycle

Industry installations are registered in the national Emission Allowance Registry Platform, integrated within the EU registry

For the Portuguese case, Agência Portuguesa do Ambiente is the competent authority.



How to assign an emissions' cap for the EU?



➤ Linear factor to be reviewed by 2025

Should the installations pay for the EUAs or should receive them for free?

- Harmonized methodologies for the definition of standardized emissions, for each industrial sector: “**benchmarking**” based on the 10% most efficient installations in each sector at EU level.
- Installations (excluding electricity generation) receive 80% of **free licenses** in 2013:
 - Phase IV: 30% until 2026, decreasing linearly to 0% in 2030 (i.e. all licenses are acquired by auction)
- The case of **Electricity** (no free allocation! Why?)

How many free EUA an installation receive? The benchmark approach

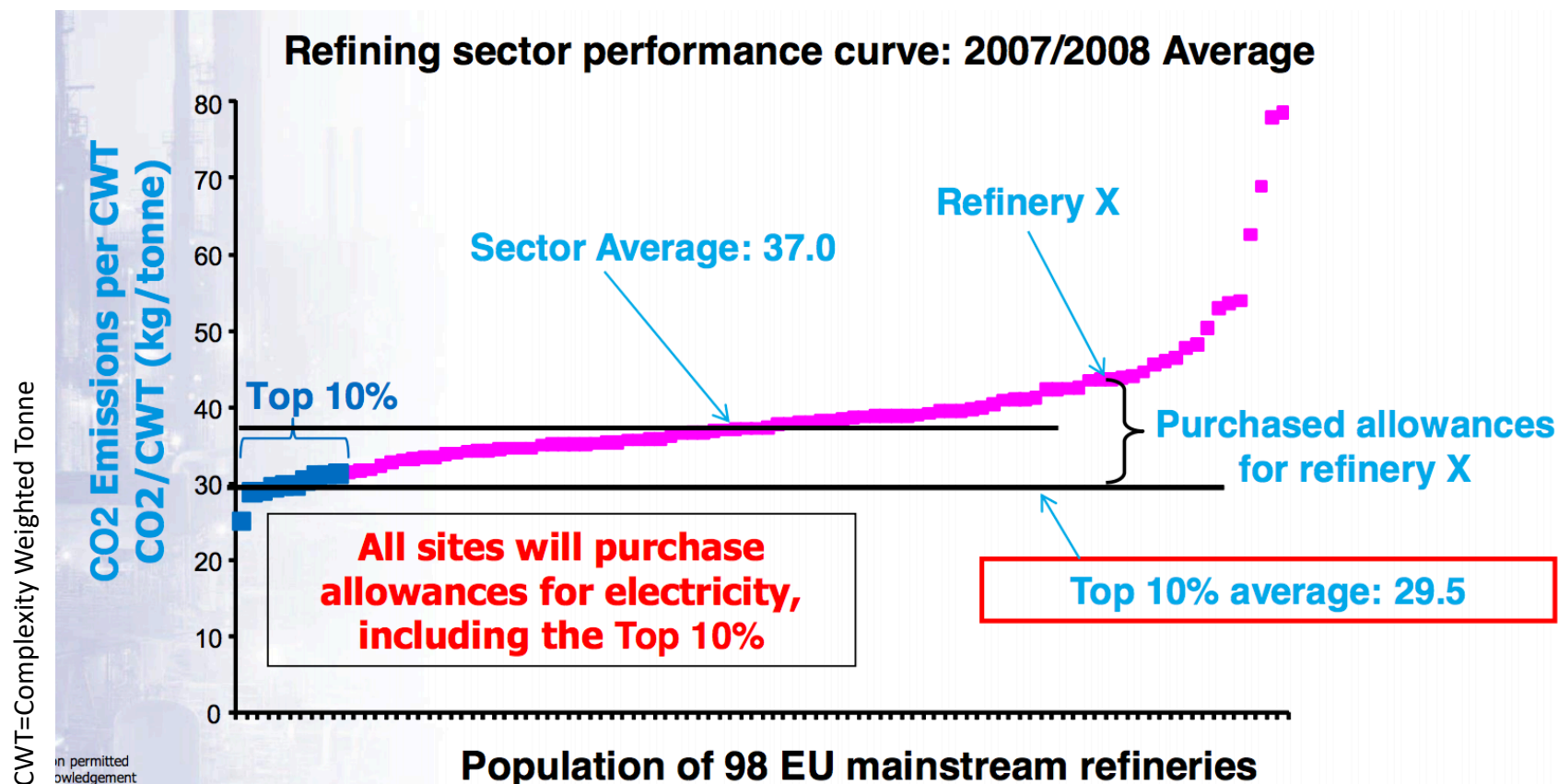
Harmonized methodologies for the definition of standardized emissions, for each industrial sector:
“benchmarking” based on the 10% of most efficient installations in each sector at EU level.

Refining Sector

Based on CO₂
intensity (kg/t)

Ranking from
the best to the
worst

Cut at 10%!
After this
threshold, the
installation must
buy the EUA.



Should the installations pay for the EUAs or should receive them for free?

Preventing 'carbon leakage'

'Carbon leakage' refers to the situation that may occur if, for reasons of costs related to climate policies, businesses transfer production to other countries which have **laxer constraints** on greenhouse gas emissions. This could lead to an increase in their total emissions. The risk of carbon leakage may be higher in certain energy-intensive industries.

The sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage are placed on an official list. The current list includes around 170 sectors and subsectors, covering a very high share of industrial emissions.

The list is established for five years, on the basis of clearly defined criteria and after extensive consultation with stakeholders. The current list applies for the years 2015-2019.

Sectors at risk of **carbon leakage** receive 100% free licenses, beyond the benchmark: the cost of participation in CELE in relation to the sector's GVA at EU level is over 5%;

AND

- the sum of exports and imports to and from non-EU countries and the total EU market (domestic volume + imports) is over 10%

OR

- individually, each criterion exceeds 30%.

What are the sectors in risk of carbon leakage?

Free allocation of EUAs

[COMMISSION DELEGATED DECISION \(EU\) 2019/708 of 15 February 2019](#)

ANNEX

Sectors and subsectors which, pursuant to Article 10b of Directive 2003/87/EC, are deemed to be at risk of carbon leakage

1. Based on the criteria set out in Article 10b(1) of Directive 2003/87/EC

NACE Code	Description
0510	Mining of hard coal
0610	Extraction of crude petroleum
0710	Mining of iron ores
0729	Mining of other non-ferrous metal ores
0891	Mining of chemical and fertiliser minerals
0899	Other mining and quarrying n.e.c.
1041	Manufacture of oils and fats
1062	Manufacture of starches and starch products
1081	Manufacture of sugar
1106	Manufacture of malt
1310	Preparation and spinning of textile fibres
1395	Manufacture of non-wovens and articles made from non-wovens, except apparel
1411	Manufacture of leather clothes
1621	Manufacture of veneer sheets and wood-based panels
1711	Manufacture of pulp

... continue

Where the installations buy the necessary EUA?

PRIMARY MARKET: AUCTIONS OF ISSUANCE LICENSES

The European Commission has appointed [EEX](#) - European Energy Exchange- as the common platform for auctions. Only the United Kingdom and Germany has own platforms. Two auctions a week.

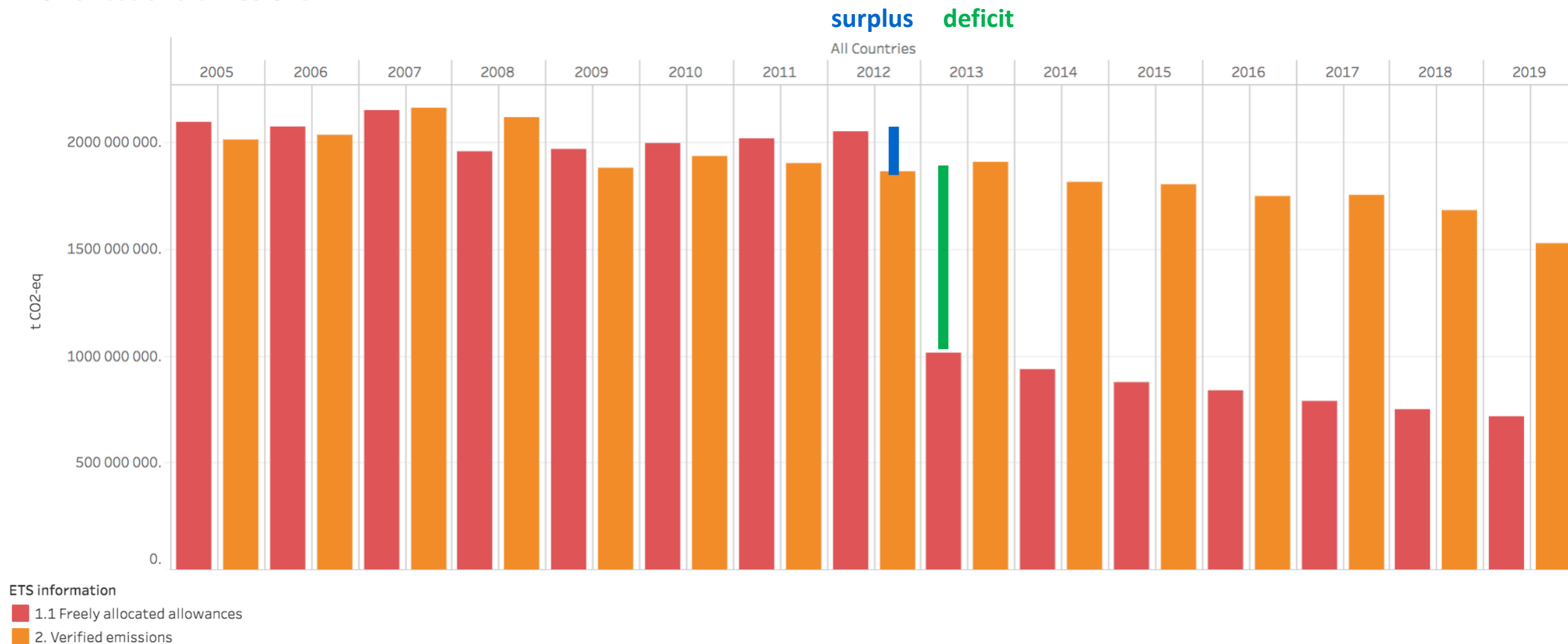
SECONDARY MARKET:

A EU-ETS operator can also access the secondary carbon market to purchase EU licenses:

- negotiate directly with other companies within the EU-ETS
- buy or sell through intermediaries, e.g. banks and specialized services
- use the services of a broker
- join one of several stock exchanges that include carbon allowances products

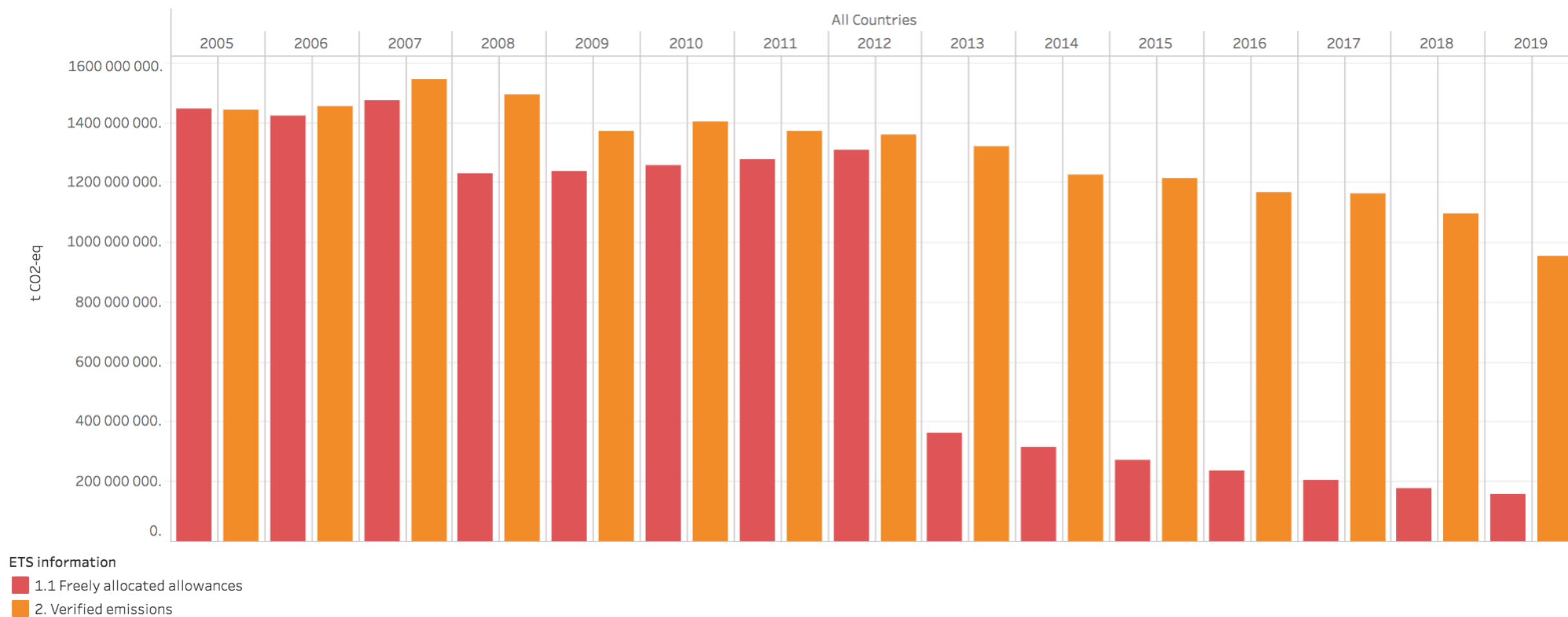
Allowances and emissions

All installations/ all Member States

<https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1#tab-based-on-data>

Combustion installations/ all Member States

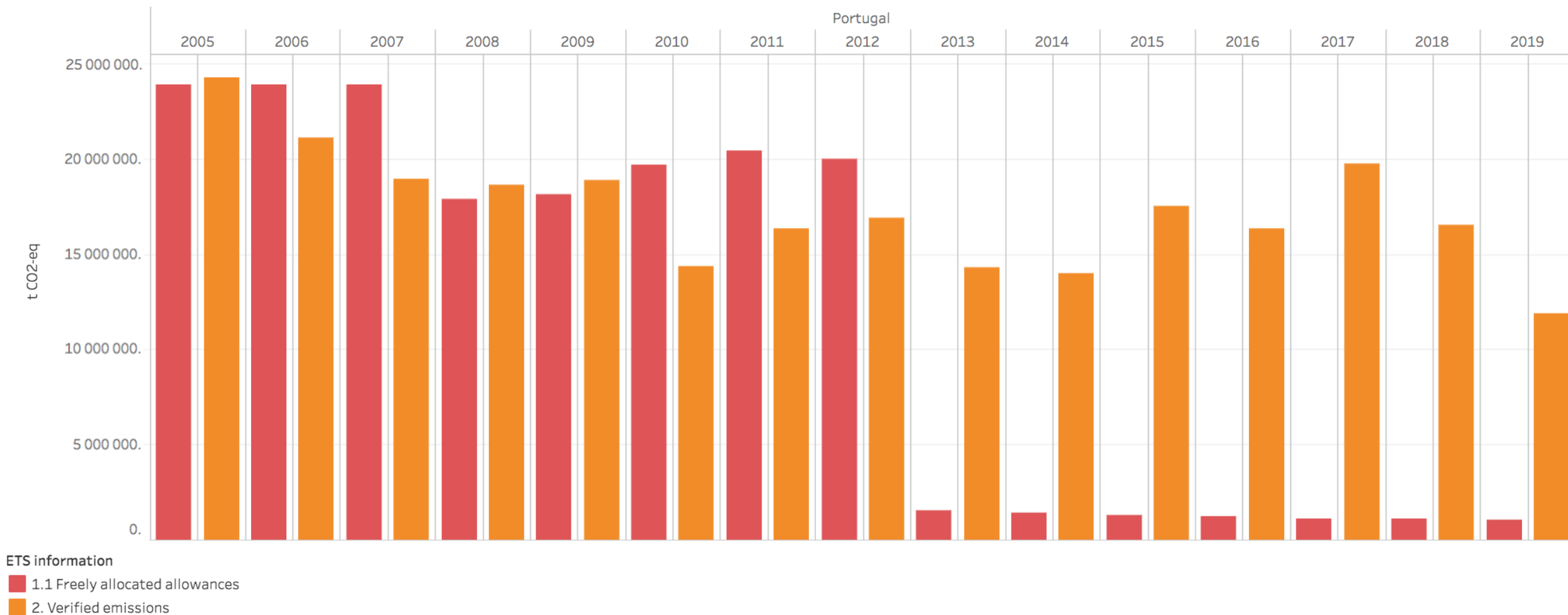
Allowances and emissions



<https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1#tab-based-on-data>

Combustion installations/ Portugal

Allowances and emissions



<https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1#tab-based-on-data>

What has been the evolution of the EUA price?

(EUA: European Unit Allowances)

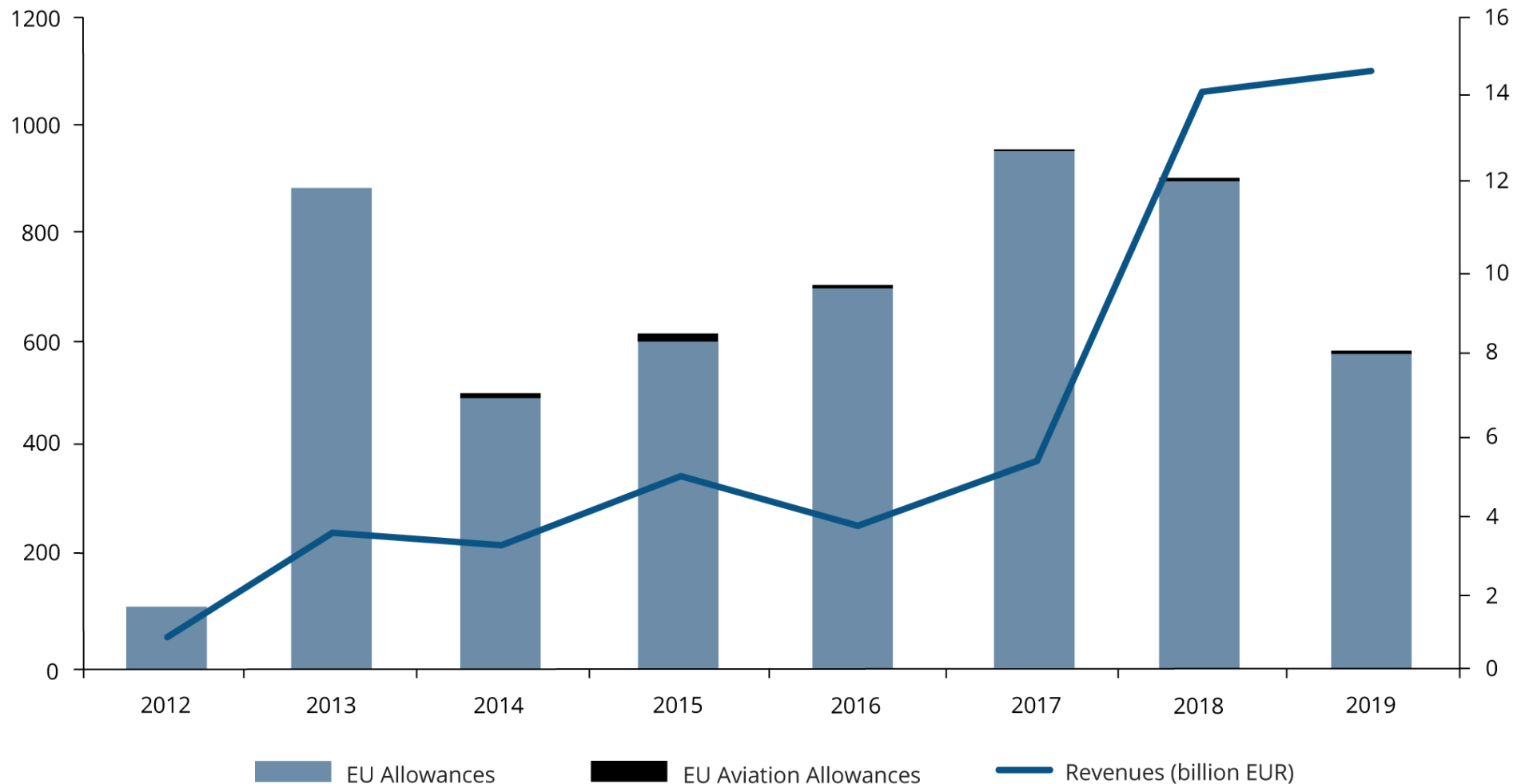


<https://ember-climate.org/data/carbon-price-viewer/>

EU-ETS auctioning amounts and revenues for the third trading period (2013-2019)

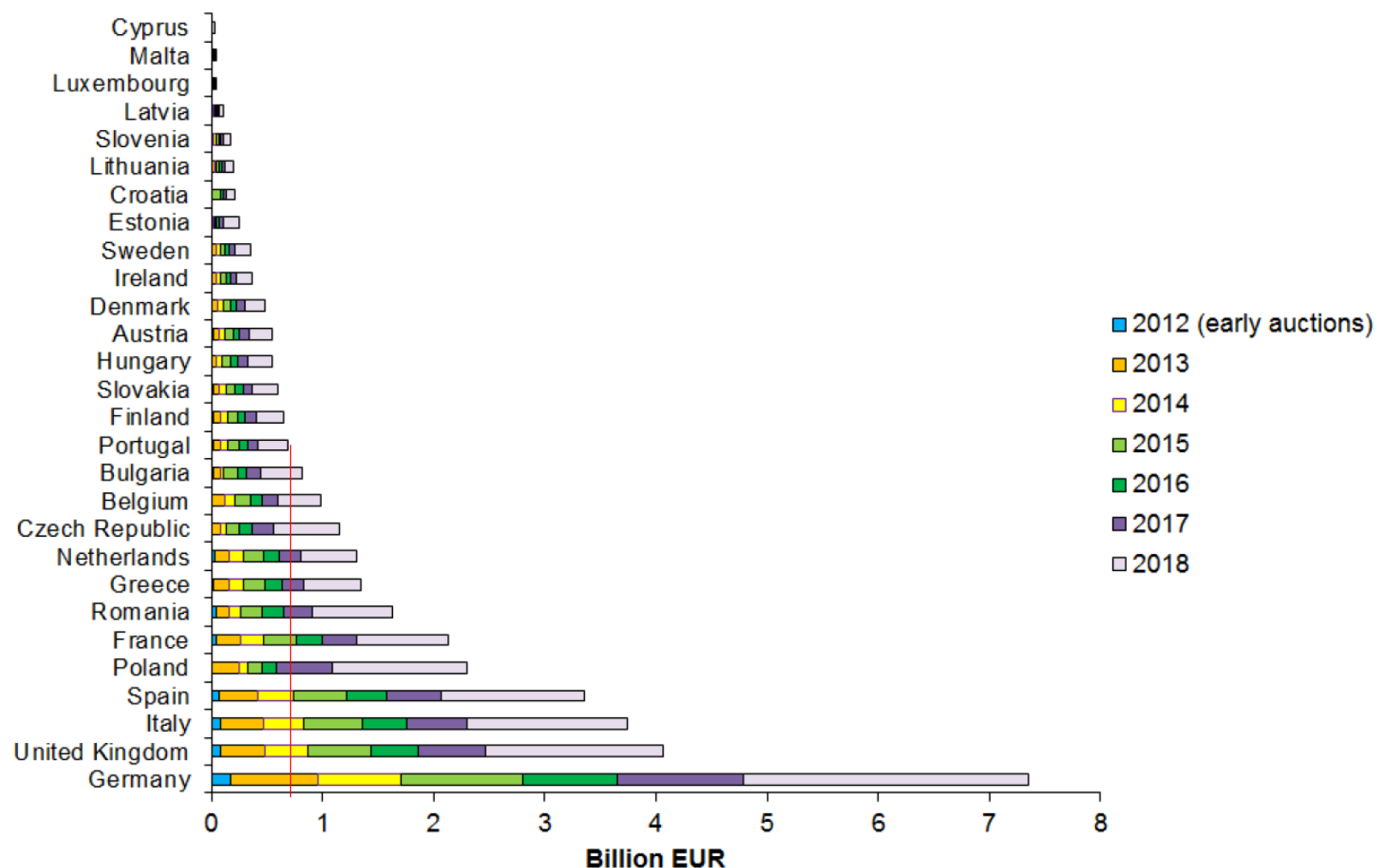
Million allowances sold

Billion EUR

European Environment Agency, <https://www.eea.europa.eu/data-and-maps/figures/figure-3-eu-ets-auctioning>

How much are the revenues from the auctions?

Figure 2.7 EUA auction revenues in the third trading period, by EU Member State, 2012-2018



Note: 2012 (early auctions) refer to amounts that pertain to the year 2013, but had been auctioned a year earlier.

Source: EEX (2019); ICE (2019).

How the revenues are spent? The case of Portugal

Decreto-Lei n.º 12/2020: Establishes the legal regime applicable to greenhouse gas emission allowance and trading, transposing Directive (EU) 2018/410

Artº 23: Emissions Allowances Auction

(...9

3 - The revenues generated by the auctions of the emission licenses attributed to Portugal constitute revenues for the Environmental Fund and must be used in the following proportion:

- a) **60% of the auction revenues** from allowances should be used to promote **renewable energies by offsetting part of the total extra cost of production in the special regime** from renewable energy sources each year, up to a limit of 100% this extra cost, including the extra cost of producing renewable cogeneration in its renewable fraction;
- b) Revenues not used for the purposes provided for in the preceding paragraph are used, in their entirety, for the purposes established in article 3 of Decree-Law no. 42-A / 2016, of 12 August [settles the **Environmental Fund and its goals**], without prejudice to the provisions of in the following paragraph;
- c) **6% of the revenue** not used for the purposes provided for in paragraph a) is the revenue of the Competent National Authority within the scope of the EU-ETS, to be transferred to it by the tenth working day of the month of February of each year, under the terms established by ordinance, to be used to cover **expenses resulting from the operation of the ETS**, as well as, in particular, in the development of its tasks in the field of climate change.

Despacho n.º 1897/2021

QUADRO 1

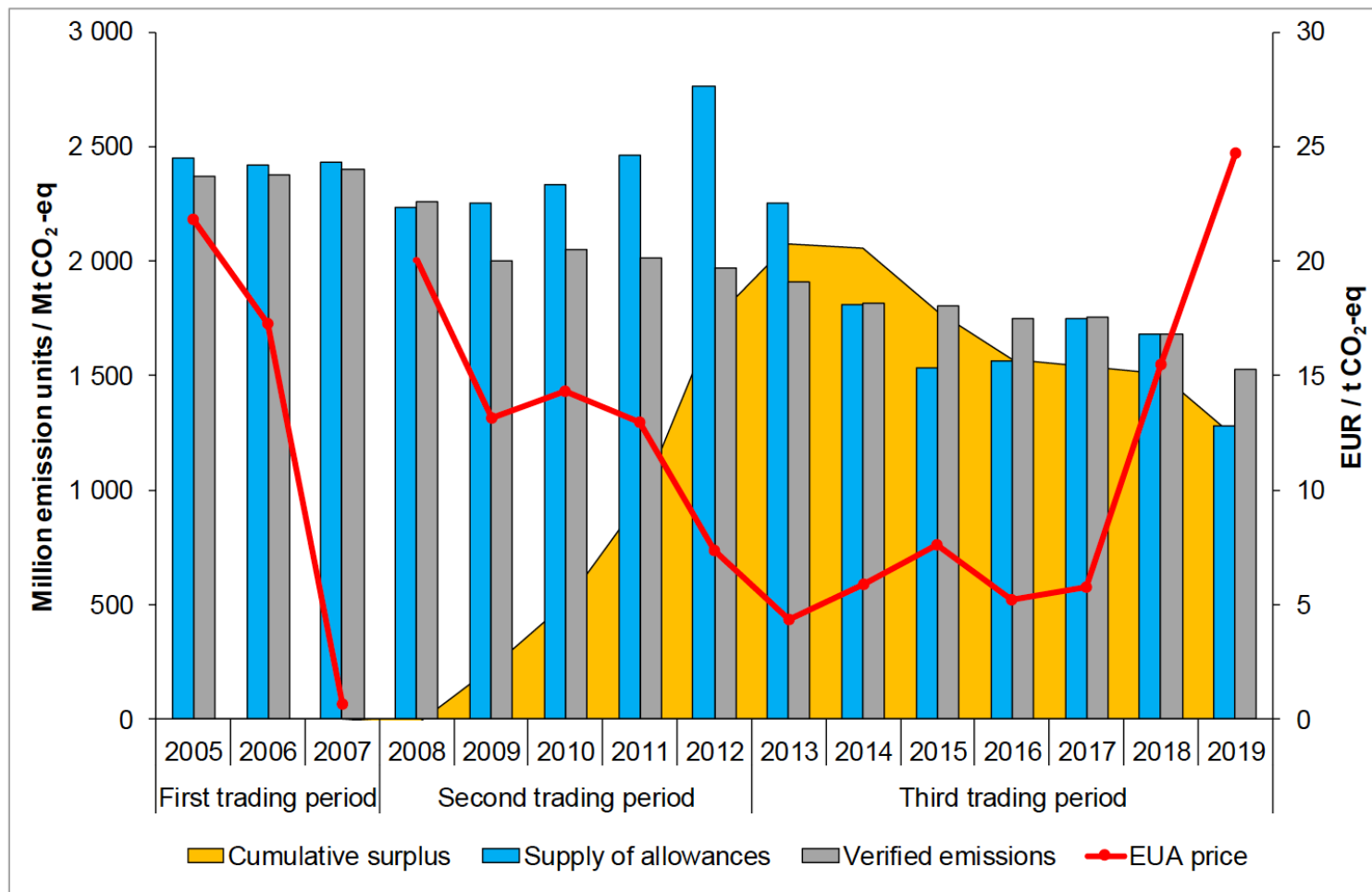
Receitas previstas para o Fundo Ambiental em 2021

Descrição	Valor (€)
Leilões CELE	255 150 000
Licenças de aviação	3 207 600
ISP gasóleo de aquecimento	32 000 000
Eliminação de subsídios prejudiciais ao ambiente (ISP)	9 820 000
Taxa de carbono (Financiamento do PART)	138 600 000
Saldo de gerência (Complemento ao financiamento do PART em 2021)	60 000 000
Saldo de gerência (Financiamento dos projetos previstos no âmbito do PEES)	26 000 000
Taxa recursos hídricos (TRH)	20 000 000
Taxa gestão resíduos (TGR)	15 000 000
Taxa de carbono sobre as viagens aéreas, marítimas e fluviais	10 000 000
Contraordenações ambientais	600 000
Taxas diversas, juros e outras transferências	650 000
<i>Total</i>	571 027 600

Revenues from EU-ETS in 2020

Revenues for Portugal 2021, until 13.04.2021: 105 M€ (Explore more [here](#))Auction Volume tCO₂ traded in 2020: 676,0 MtCO₂ (Emission Spot Primary Market Auction Report 2020)

How effective has been the EU-ETS in reducing CO₂ emissions?



Since the start of the EU ETS in 2005, emission from stationary installations have decreased by about 35%.

The surplus of emissions allowances that accumulated in the EU ETS between 2009 and 2013 (lower prices) has been reduced over the course of the third trading period by the backloading measure (900 million allowances in total) were not allocated) and the introduction of the Market Stability Reserve (MSR).

Note: The cumulative surplus represents the difference between allowances allocated for free, auctioned or sold plus international credits surrendered or exchanged from 2008 to date minus the cumulative emissions. It also accounts for net demand from aviation during the same time period.

Sources: Point Carbon. (2012); FFA (2020b); FFX (2020); ICF (2020)

Explore more [here](#)

The EU emissions trading system (EU ETS) is a cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. It is the world's first major carbon market and remains the biggest one.

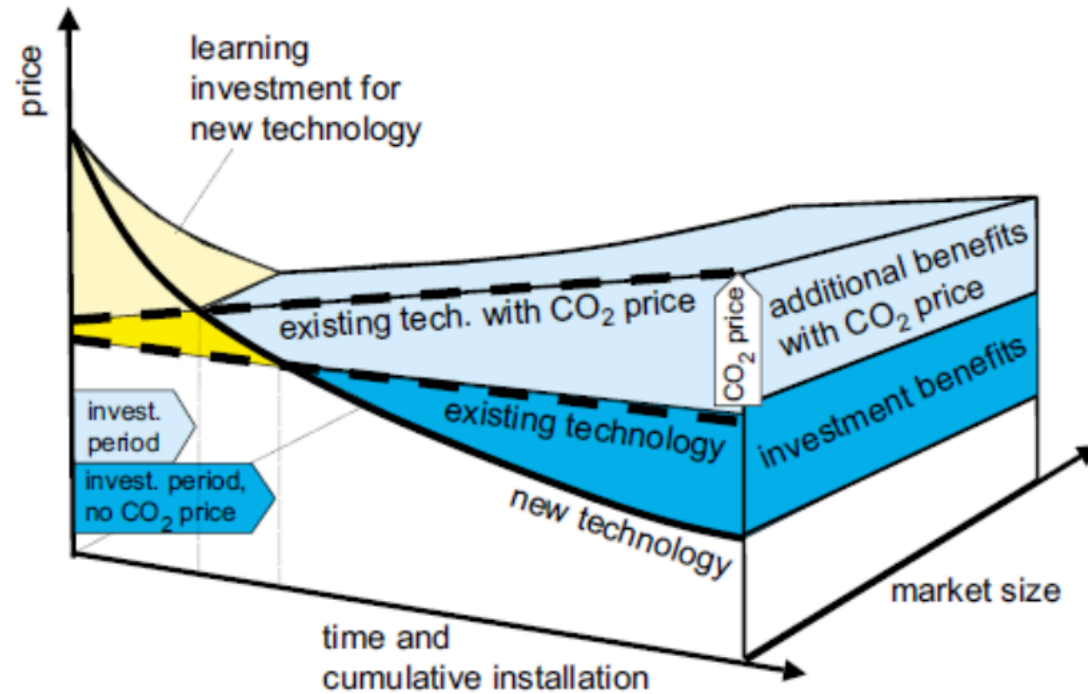
Environmental certainty – A fixed declining cap gives environmental certainty, i.e. with a set Linear Reduction Factor (LRF) we know a certain level of reductions in emissions will take place over a fixed time period.

Flexibility – Companies can meet their emissions reduction commitments in a number of different ways.

Cost effective – allows targets to be met at least cost.

What are the flaws?

What is the impact of a CO₂ price on the competitiveness of new technologies, when compared to existing ones?




Fonte: IPCC, 2007 (adaptado de Neuhoﬀ, 2004)

TRUE OR FALSE?

- a) The cost of new technologies tends to approximate existing technologies as the scale of their production increases.
- b) The existence of a price for CO₂ induces a delay in the competitiveness of new technologies compared to existing ones, i.e. new technologies tend to have a price convergent with existing ones in a more time-consuming period than if there is no price for the CO₂.
- c) In an economy where CO₂ has a price, existing technologies lose competitiveness more quickly than in the absence of that price.

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Cultivate curiosity
Investigate by yourself beyond the course
Push yourself to innovate beyond the state of the art
Work to become independent and critical