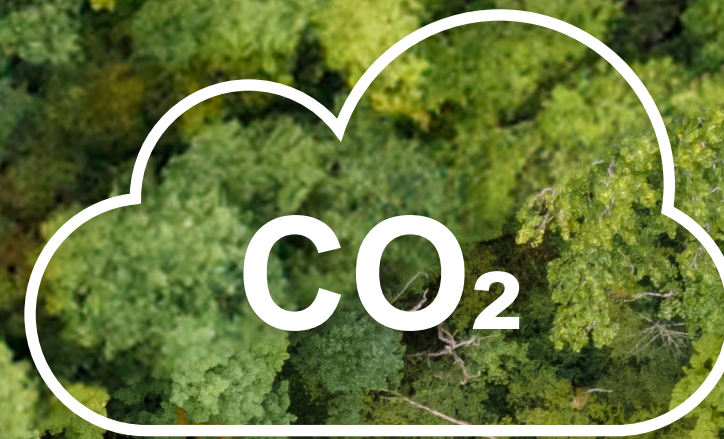


Arup guide to
EU Carbon Legislation

Jan 2024





Significant new EU legislation will affect your planning, design and investment decisions. Arup can guide you.

Clarifying EU carbon legislation

No energy infrastructure investment can ignore the recent wide-ranging EU carbon legislation due to their inevitable and compoundable impact. Project planners, designers and investors need to have these legislative items front of mind to ensure opportunities are optimised.

The impact of EU carbon legislation on carbon intensive industries

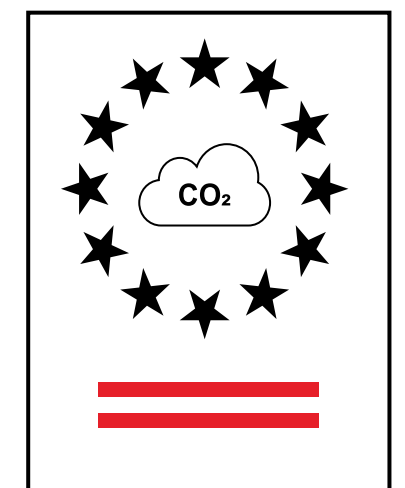
In 2023, the European Union (EU), the world's third largest economy, adopted a wide body of decarbonisation legislation under its Green Deal policy initiative that will disrupt infrastructure and energy sectors. This will spur significant investment in hydrogen and its derivatives, maritime and aviation fuels, alternative power for road transportation, green steel, zero-carbon chemicals and advanced manufacturing.

Long-term investment decisions will need to take into account this exponentially growing shift. The cost comparison per unit between fossil fuel based and renewable energy based solutions will look very different in 2030, and again in 2050. Any investment decision related to infrastructure and manufacturing cannot ignore this impact. Project planners, designers and investors need to have these legislative items front of mind to ensure opportunities are harvested and optimised.

The sheer amount of new legislation can be complex to navigate. This guide aims to provide clarity on the collective impact of the legislative items on carbon intensive industries and transport over the coming decades by:

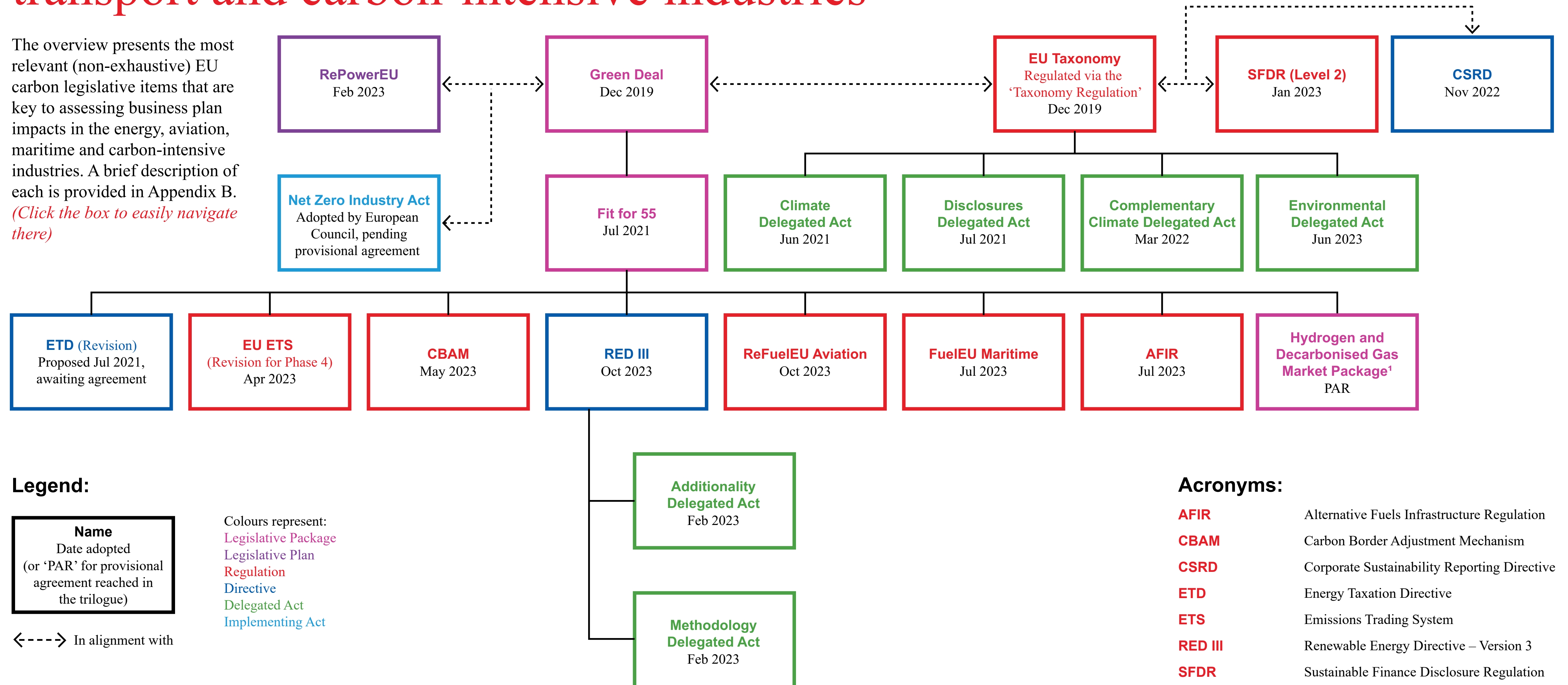
1. Providing an overview of the most relevant (non-exhaustive) pieces of legislation for energy, aviation, maritime and carbon-intensive industries,
2. Highlighting the legal categories and processes of EU legislation
3. Putting a spotlight on some key legislative items, with a focus on the recent changes to the Renewable Energy Directive (RED III) and its impact on other regulations, and
4. Setting out, in time, how these various EU legislative items interact.

The outcome will illustrate how fossil fuel based solutions are expected to increase cost and become less competitive while the economic competitiveness of low-carbon alternatives will increase through mandates, incentives, efficiencies and economies of scale.



EU carbon legislation relevant to the energy, transport and carbon-intensive industries

The overview presents the most relevant (non-exhaustive) EU carbon legislative items that are key to assessing business plan impacts in the energy, aviation, maritime and carbon-intensive industries. A brief description of each is provided in Appendix B. *(Click the box to easily navigate there)*



Legend:

Name
Date adopted
(or 'PAR' for provisional agreement reached in the trilogue)

Colours represent:
 Legislative Package
 Legislative Plan
 Regulation
 Directive
 Delegated Act
 Implementing Act

←----→ In alignment with

Acronyms:

AFIR Alternative Fuels Infrastructure Regulation
CBAM Carbon Border Adjustment Mechanism
CSRD Corporate Sustainability Reporting Directive
ETD Energy Taxation Directive
ETS Emissions Trading System
RED III Renewable Energy Directive – Version 3
SFDR Sustainable Finance Disclosure Regulation

Policies and regulations within the EU, with date of adoption indicated

Source: European Commission, Arup

¹ – Includes proposals to revise two regulations and a directive

Demystifying the categories of EU legislation

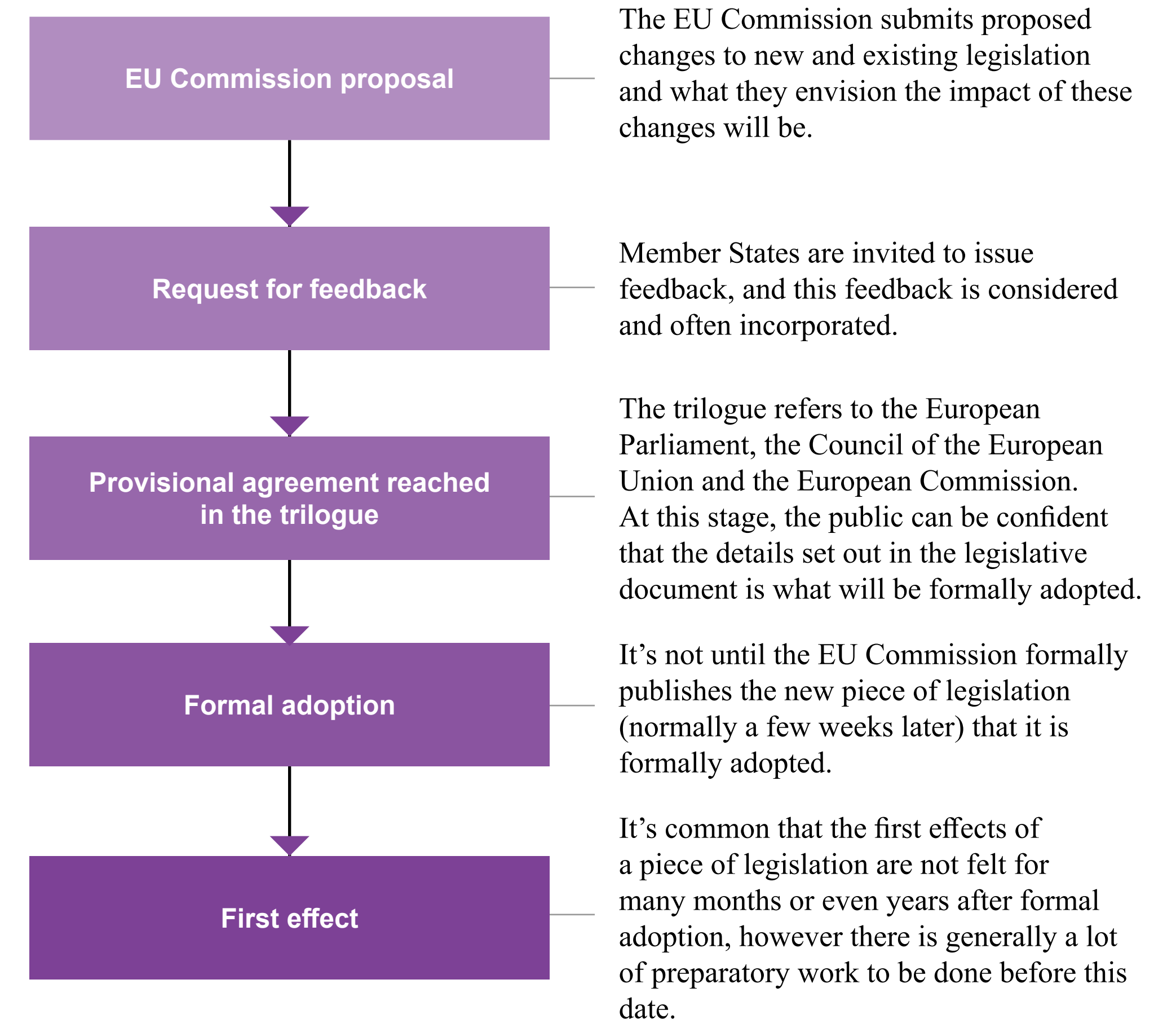
There are several types of legislation issued by the European Union, each with different reaches of regulatory power. Three of the primary forms are described below, along with an illustration of the timeline of the key steps in the proposal and implementation process.

Types of legislation and the approval process

Type of legislation	Description	Comments	Implementation
Directive	Sets out a goal that all EU countries must achieve. However, it is up to the individual countries to devise their own laws on how to reach these goals	Softer form of legislation	Member States have a deadline (normally 2 years) to transpose the directive into national law
Regulation	EU drafted law that must be applied immediately in their entirety across the EU Member States (and Norway to some extent)	Binding legislative act, does not require transposition into national laws	Immediately binding in their entirety to all EU countries
Delegated Act	A binding legislative act used as a supplement or to amend non-essential elements of other EU legislative acts, normally to provide rules or specifications for consistent application	Used for more science-based topics	The EU Commission adopts the delegated act and if Parliament and Council have no objections, it enters into force

Types of EU Legislation

Source: Arup



Non-exhaustive list of key steps in the development and approval process

Source: Arup

Legislation Spotlight

RED III

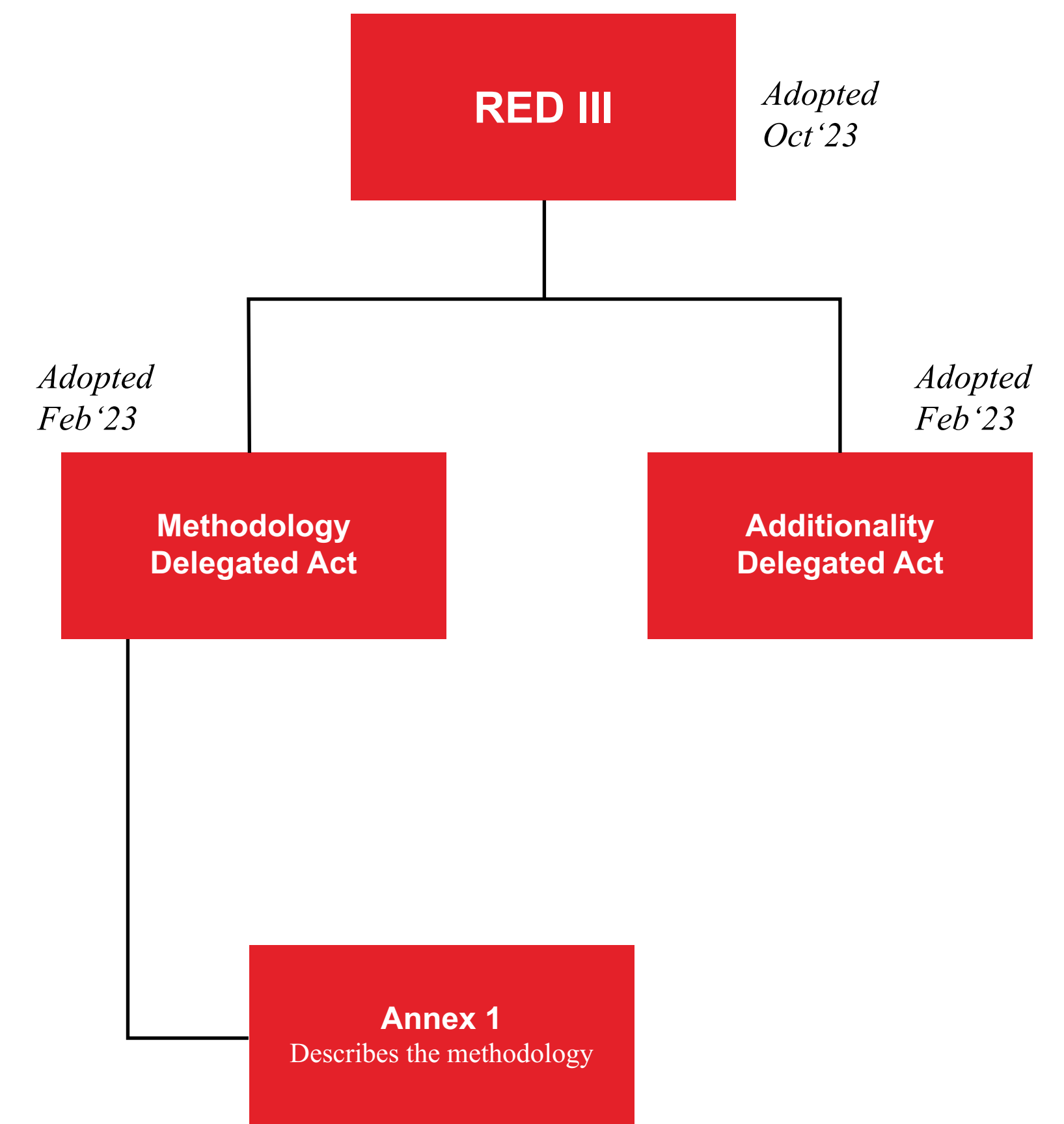


What's been revised? | RED III

The changes to the Renewable Energy Directive are anticipated to increase the deployment of renewable energy and increase use and production requirements for recycled carbon fuels and renewable fuels of non-biological origin, particularly renewable hydrogen.

Recent revisions to the Renewable Energy Directive

- The recent revisions to the Renewable Energy Directive (RED) introduced the following changes:
 - EU's binding renewable target for 2030 raised to a minimum of 42.5% with a goal of 45% (up from the previous 32% target). This almost doubles the existing share of renewable energy in the EU.
 - National authorities should take no longer than 12 months to approve new renewable energy installations, if located in so-called 'renewables go-to areas', and within 24 months in other areas, making permitting procedures easier and faster.
 - Member States should aim for at least 5% of newly installed renewable energy capacity to be innovative renewable energy technology.
 - Changes to sector-specific binding targets, summarised overleaf.
- The changes from RED II to RED III are significant for renewable fuels of non-biological origin (RFNBOs), including renewable hydrogen and hydrogen-based synthetic fuels. This is seen by (i) targets defined for the transport sector mandating a minimum share of low-carbon fuels by 2030 including a sub-target for RFNBOs specifically, and (ii) mandating a minimum portion of hydrogen produced in the EU to be renewable, essentially phasing out grey hydrogen.
- In addition to changes from RED II, 2023 saw the formal adoption of the Methodology and Additionality Delegated Acts, which define requirements to be adhered to in order for RFNBOs to be considered renewable and for recycled carbon fuels (RCFs) to meet regulatory standards. The two key requirements are:
 - Under RED III and the Methodology Delegated Act, both RCFs and RFNBOs will be required to have at least 70% greenhouse gas (GHG) emission savings, with the savings calculated according to the Methodology Delegated Act.
 - To ensure that renewable hydrogen production leads to an increase in overall use of renewable energy in the EU, the Additionality Act will require any renewable hydrogen production being first operational from 2028 to source their electricity from new renewable energy generation capacity (rather than detracting from renewable energy supply in the grid).



What are the revised targets? | RED III

RED III added and revised sector-specific obligatory targets from RED II. Notably, targets now apply to the buildings and industrial sectors, and promote greater production and use of renewable fuels of non-biological origin (RFNBOs) and recycled carbon fuels (RCF).


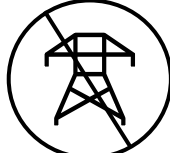

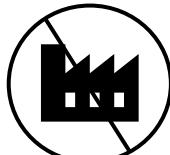
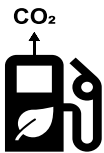
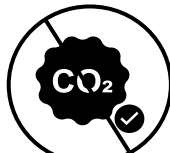
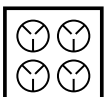
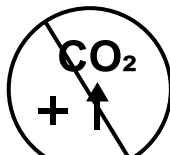

Industry	Category	2018 RED II – Sector-Specific Targets	2023 RED III – Sector-Specific Targets
Buildings	Buildings' energy source	N/A	49% share of renewable energy
Industry	Industries' energy source	N/A	Renewable energy use to increase by 1.6% annually
	Hydrogen in industry	N/A	42% of hydrogen should come from renewable fuels of non-biological origin (RFNBOs) by 2030, 60% by 2035, essentially to replace grey hydrogen
Transport	Renewable energy in transport	14% energy target (out of road and rail fuels)	14.5% GHG intensity reduction target <u>or</u> 29% renewable energy target (out of all energy supplied to transport)
	Advanced biofuels (Annex IX, part A)	3.5% (out of road and rail fuels, with multiplier)	5.5% of a combination of both fuel types, with a 1% RFNBO minimum (out of all energy supplied to transport)
	Renewable fuels of non-biological origin (RFNBOs)	No target	
	Waste oils (Annex IX, part B)	1.7% cap (out of all energy supplied to road and rail)	1.7% cap (out of all energy supplied to transport)
	Food- and feed-based biofuels	Cap at whichever is lower: 7% or 2020 consumption in each member state + 1% (out of road and rail fuels)	Cap at whichever is lower: 7% or 2020 consumption in each member state + 1% (out of all transport energy consumption)
	Multipliers	<ul style="list-style-type: none"> • 2x for advanced biofuels and waste oils • 4x for renewable electricity used in vehicles • 1.5x for renewable electricity in rail • 1.2x for aviation and maritime fuels, except food- and feed-based biofuels" 	Towards the overall 29% renewable energy target and all applicable sub-targets for either an energy target or GHG target: <ul style="list-style-type: none"> • 2x for advanced biofuels, RFNBOs, and waste oils • 4x for renewable electricity in vehicles • 1.5x for renewable electricity in rail • 1.2x for advanced biofuels and 1.5x for RFNBOs in aviation and maritime sectors
Fossil comparator	<ul style="list-style-type: none"> • 94 gCO_{2e}/MJ for all transport energy 	<ul style="list-style-type: none"> • 183 g CO_{2e}/MJ for electricity used in vehicles • 94 g CO_{2e}/MJ for all other energy used in transport 	
Heating & cooling	Heating and cooling energy source	<ul style="list-style-type: none"> • 1.1% annual increase (indicative target that is not binding) 	<ul style="list-style-type: none"> • Binding targets: Renewable energy usage should increase 0.8% annually until 2026 and 1.1% annually from then until 2030

What's it all about? | Methodology Delegated Act

The Methodology Delegated Act defines what sources of carbon are eligible for use in RFNBO and RCF production, aiming to ensure the fuels are produced sustainably, to encourage carbon-intensive industries to decarbonise and to avoid double counting.

Key objectives of the Methodology Delegated Act

- The Methodology Delegated Act specifies the following:
 - Minimum threshold of GHG emission savings:
 - The total life-cycle emissions from the use of RFNBOs and RCFs must give a reduction of at least 70% to that of the fossil fuel comparator of 94 gCO_{2e}/MJ.
 - This equates to life-cycle emissions of less than 28.2 gCO_{2e}/MJ.
 - Valid sources of carbon for the production of RFNBOs and RCFs, summarised opposite.
 - Standard methodology for calculating the GHG emission reductions of RFNBOs and RCFs, set out in Annex I.
- Items (1) and (3) from the list above create stricter requirements and accountability for low-carbon fuels, and these requirements carry on to other regulations such as ReFuelEU Aviation.
- Item (2) ensures that the carbon used in the production of RFNBOs and RCFs does not detract from the overall ambition to lower GHG emissions. Low-carbon fuel producers who are currently using carbon captured from electricity production or other industrial activities will need to find an alternative source of carbon from 2036 and 2041 respectively, as these will become ineligible sources of carbon. The intention of this rule is to discourage the continuation of carbon-intensive industrial processes, instead encouraging the decarbonisation of these facilities.

Valid Carbon Sources	Currently/Eventually Invalid Carbon Sources
 Captured CO ₂ from an ETS-obligated facility that already paid for the ETS allowance (not indefinitely, see to the right)	 From 2036 onwards, CO ₂ captured from industrial activities for electricity production specifically
 Captured CO ₂ from combustion of RED-compliant biofuels, RCFs or RFNBOs (that did not receive credits for carbon capture and replacement)	 From 2041 onwards, CO ₂ captured from any industrial activities in Dir. 2003/87/EC such as cement, oil or steel production
 Captured CO ₂ from geological sources (where CO ₂ was released naturally)	 CO ₂ captured that has received emission credits under other provisions of the law (to avoid double counting)
 Direct air capture of CO ₂	 CO ₂ captured from a fuel that is deliberately burned for producing the CO ₂
 Biogenic CO ₂ from sustainable biomass: the captured CO ₂ stems from the production or the combustion of biofuels, bioliquids or biomass fuels complying with the sustainability and greenhouse gas saving criteria	

Carbon sources valid for RFNBO and RCF production as indicated by the Methodology Delegated Act

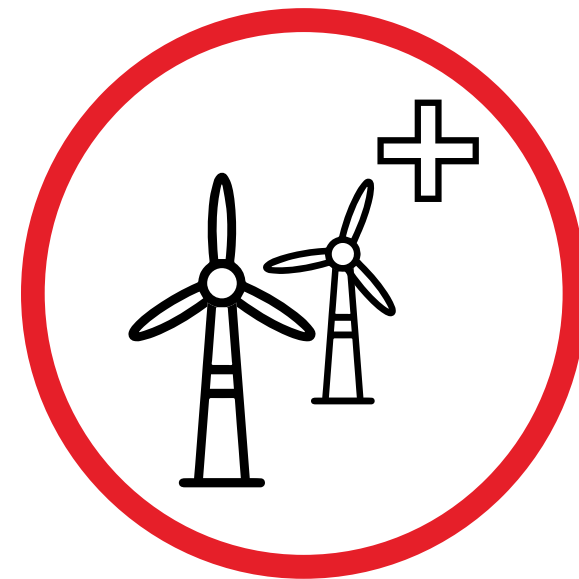
Source: European Commission, Arup

What's it all about? | The Additionality Delegated Act

The additionality, temporal correlation and geographical correlation requirements are described in the Additionality Delegated Act, to ensure RFNBO production doesn't take over existing renewable energy from the grid.

Three requirements of the Additionality Delegated Act

The Additionality Delegated Act describes three requirements that need to be met for RFNBO production using electricity via a grid connection, in order for the electricity to be considered fully renewable. Exemptions to one or more of these requirements exist in certain scenarios, described on the following slide.



Additionality fulfilled if producer has concluded PPA(s) with renewable energy source (RES) plant that:

- Was commissioned or repowered max. 36 months before the electrolyser, and
- Does/has not received Capex or Opex support (or support has been fully repaid)
- *Applicable as of 1 Jan 2028 (First mover reward: exemption from additionality criterion if electrolyser started operating before 2028, see Art. 11).*

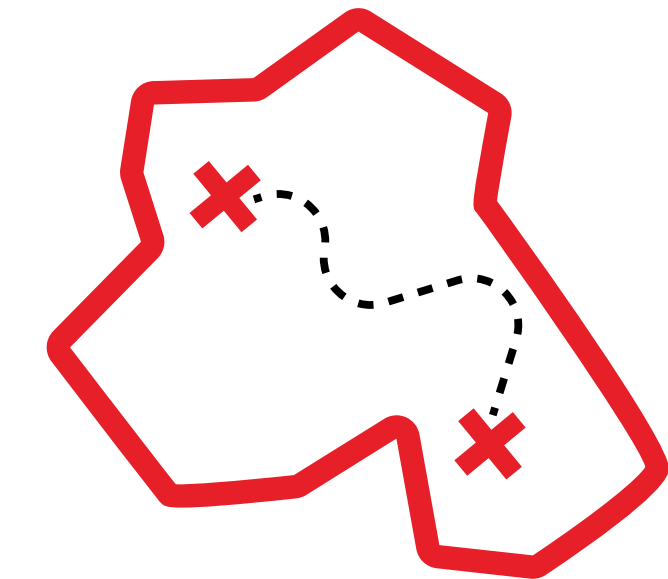


Temporal Correlation:

- RFNBO production takes place within the same calendar month* as contracted renewable energy generation. (*Will change to during the same hour-period, either from 2030 or from 2027 if the Member State directs.)
 - Temporal correlation also applies to storage with a new storage asset behind the same network point.

Guaranteed compliance routes:

- Day-ahead electricity market prices in the bidding zone ≤ 20 € / MWh OR
- Day-ahead market prices < 0.36 times the price of an allowance to emit 1 tCO_{2e}.



Geographical Correlation:

- Same bidding zone as RES plant at time of commissioning or
- Neighboring bidding zone where day-ahead electricity prices for the same hour \geq bidding zone where electrolyser is located (market coupling) or
- Offshore bidding zone adjacent to bidding zone of electrolyser.

What's it all about? | The Additionality Delegated Act

RFNBOs must meet the requirements for the relevant case of electricity sourcing in order for the electricity to be considered fully renewable. For electricity from the grid, the additionality, temporal and geographical correlation requirements must be met, unless in the exempt categories.

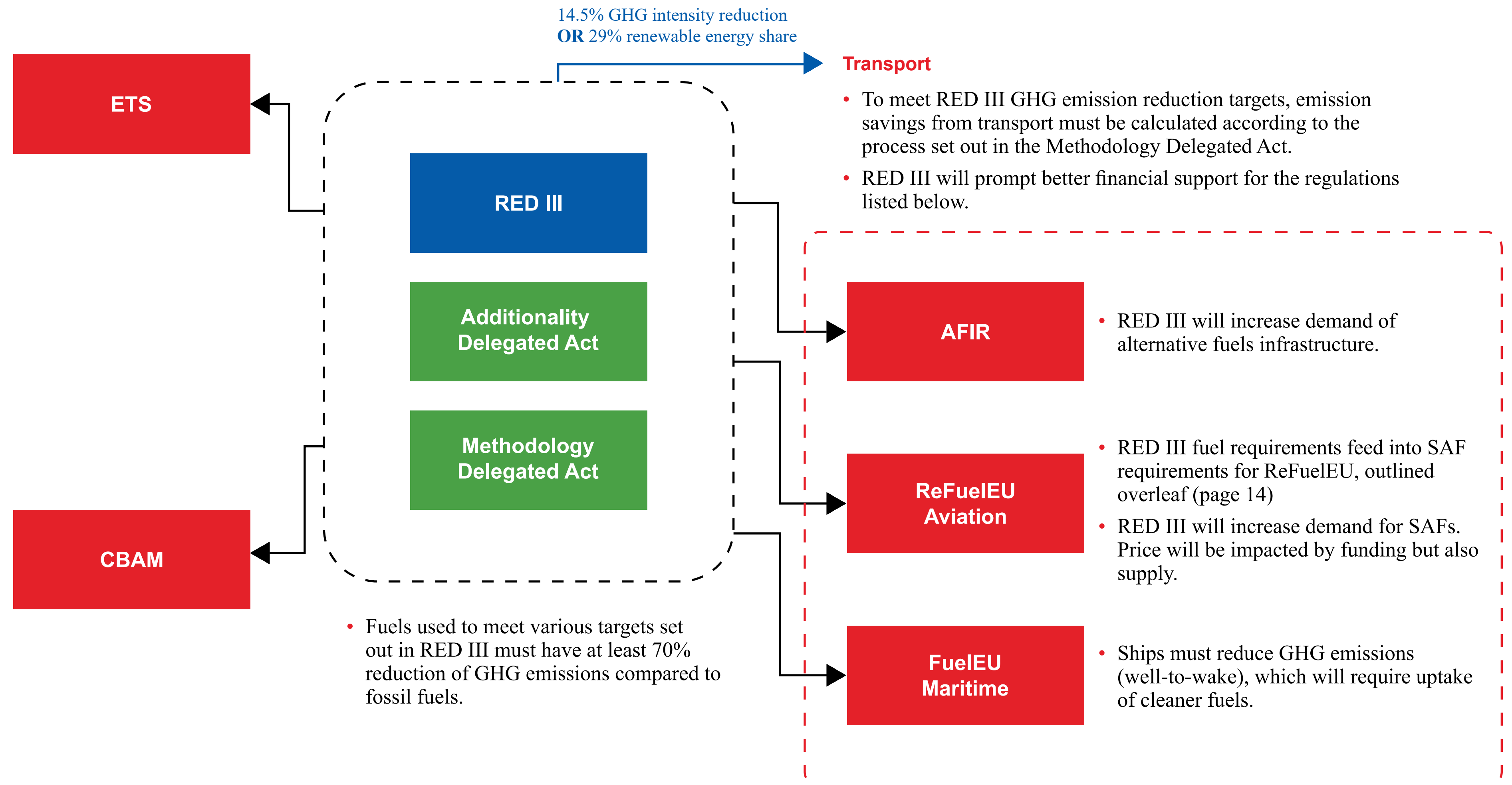
	Scenario	Requirements
CASE 1 Direct Connection	1.1	<ul style="list-style-type: none"> The renewable electricity plant is new, i.e. starts operating no earlier than 36 months before the electrolyser Production and consumption take place within the same installation or are directly connected The RFNBO production facility does not utilise grid power even if grid connected (if connected, must have smart metering)
CASE 2 Grid Connection (renewable offtake via PPAs)	2.1 General	When sourcing renewable electricity from the grid, the electricity may only be considered as fully renewable if the additionality, temporal correlation and geographical correlation requirements described on the previous page are met. There are exemptions to these criteria in certain situations, outlined in scenarios 2.2 – 2.4
	2.2 Where renewable energy share in the grid exceeds 90%	<p>Exempt from additionality, temporal and geographical correlation rules provided the following conditions are met:</p> <ul style="list-style-type: none"> The electrolyser needs to be located in a bidding zone where the average share of renewable grid electricity exceeds 90% in the previous calendar year and Production must not exceed a set maximum number of hours, defined by the number of hours in a calendar year multiplied by the renewable energy share of the bidding zone <ul style="list-style-type: none"> Production exceeding this share is considered non-renewable <p>Applies to the bidding zone where RFNBO production takes place for the next five calendar years</p>
	2.3 Power grid is sufficiently decarbonised	<p>Exempt from additionality rule provided the following condition is met. Temporal and geographical correlation rules still apply:</p> <ul style="list-style-type: none"> Emission intensity of the bidding zone grid is below the value of 18 gCO₂e/MJ. (NB: This is common in France and Sweden due to high nuclear share.) <p>Applies for the next five years if the threshold is reached</p>
	2.4 RFNBO production facility improves grid stability	<p>Exempt from additionality, temporal and geographical correlation rules if the RFNBO producer can prove with the help of the national TSO that during an imbalance settlement period (nation dependent):</p> <ul style="list-style-type: none"> Power-generating installations using renewable energy sources were redispatched downwards The electricity consumed for RFNBO production reduced the need for redispatching by a corresponding amount

What's the impact of RED III on other legislative items?

RED III defines what can be considered as RFNBOs/RCFs, which will be very relevant to the ReFuelEU regulation. For calculating emission savings in transport, the Methodology Delegated Act will have to be followed. The RED III targets will accelerate the transition which may impact the ETS price.

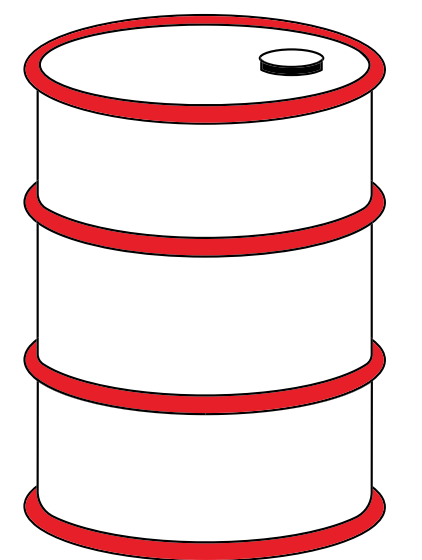
- As industries transition to cleaner energy sources and fuels in response to RED III, reduced emissions will mean companies will be able to sell unused ETS credits from their free allowances on the secondary market, until free allowances are phased out (in 2034).
- The market price of ETS credits may be impacted by the accelerated transition prompted by RED III.

- RED III and the associated funding to support innovation and transition will impact prices of products produced in the EU. CBAM will make imported products more expensive, which may mean EU products could become cheaper than imported products, or else comparable in price.



Legislation Spotlight

Fuels recognised by EU carbon legislation



What fuels are recognised by EU carbon legislation?

RED III classifies sustainable alternative fuels into renewable liquids and gaseous fuels of non-biological origin (RFNBOs) and recycled carbon fuels (RCFs), and defines the criteria for each. ReFuelEU defines which fuels, both RFNBOs and RCFs, can be classified as sustainable aviation fuels.

Fuel categories in RED III and ReFuelEU

- The Renewable Energy Directive (RED III) defines what constitutes RFNBOs and RCFs, which is relevant for other legislative items, particularly ReFuelEU. These are summarised below. For both RFNBOs and RCFs, the life cycle GHG emission savings must exceed the minimum threshold of 70% compared to the fossil fuel comparator.

Fuel type	Energy source	Examples	Examples of relevant EU legislative items (non-exhaustive)
RFNBOs: Renewable fuels of non-biological origin	Made from renewable energy, mostly leading to a renewable hydrogen derived energy carrier, often combined with an allowed source of captured CO ₂	<ul style="list-style-type: none"> Power-to-X fuels (3rd Gen SAFs) e.g. power-to-liquid (PtL) Renewable (green) hydrogen (H₂) Synthetic natural gas (SNG) Green Ammonia E-fuels: eMethanol, e-diesel, e-kerosene 	<ul style="list-style-type: none"> RED III: Target of 5.5% for advanced biofuels and RFNBOs (mostly green hydrogen and hydrogen-based synthetic fuels) out of renewable energies supplied to transport sector by 2030 <ul style="list-style-type: none"> Minimum 1% requirement for RFNBOs Additionality Delegated Act: defines under which conditions hydrogen, hydrogen-based fuels or other energy carriers can be considered as an RFNBO ETD: changes in taxation policies will make RFNBOs more affordable ReFuelEU mandates aviation fuel to include 2% SAF from 2025, increasing to 70% SAF by 2050 Sets minimum threshold of GHG emission savings for RFNBOs and distinct set of RCFs (at 70% compared to fossil fuels)
RCFs: Recycled carbon fuels	Made from existing carbon-carrying (hydro-carbon) molecules, i.e. using carbon that's already there	<ul style="list-style-type: none"> Biofuels/biogas Synthetic diesel, SAFs or methanol made from municipal waste or industrial waste gases <ul style="list-style-type: none"> (i.e. Waste-to-Energy) 	<ul style="list-style-type: none"> RED III: Member States may choose whether or not to count RCFs towards national renewable energy targets in transport RED III defines conditions for eligible RCFs Methodology Delegated Act: Min required threshold for emission reductions and calculation method for GHG emission savings Sets minimum threshold of GHG emission savings for RFNBOs and distinct set of RCFs (at 70% compared to fossil fuels)

Difference between RFNBOs and RCFs

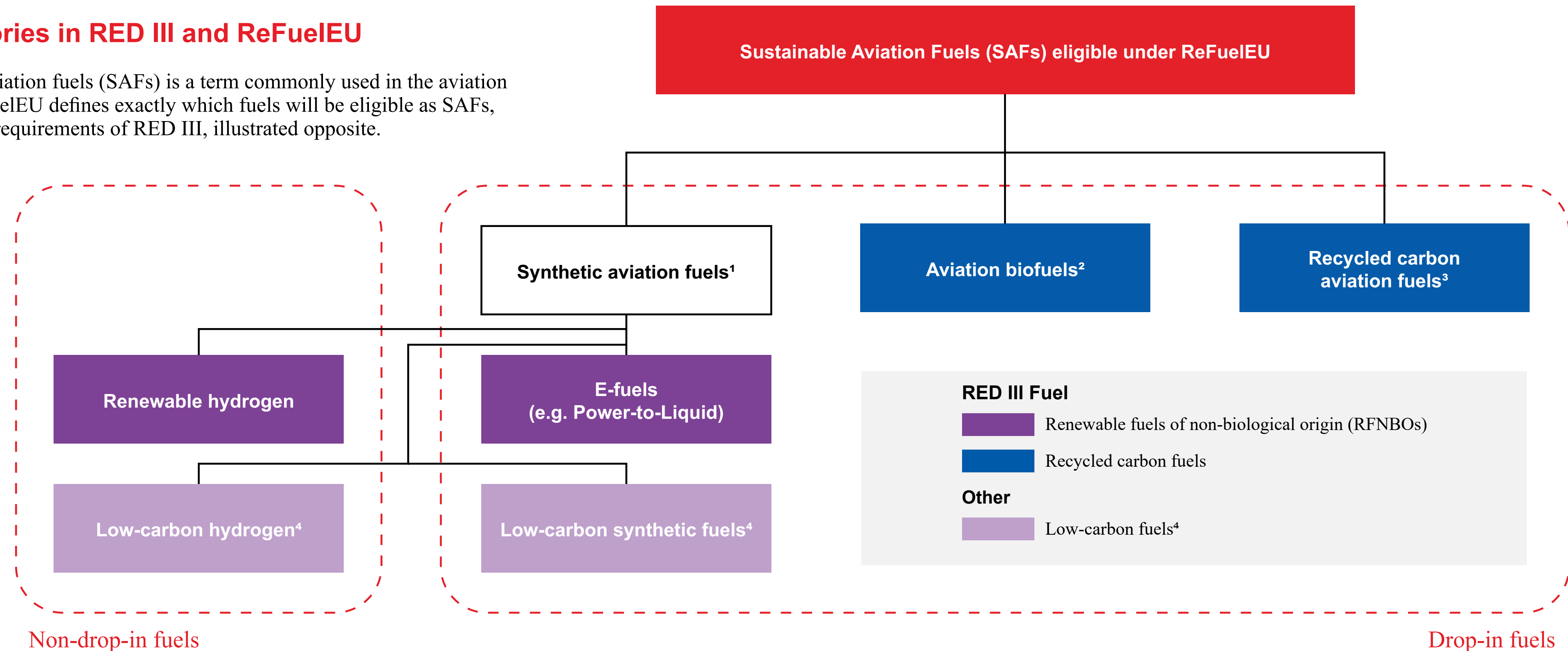
Source: European Commission

What fuels are recognised by EU Carbon Legislation?

ReFuelEU defines which fuels are eligible as sustainable aviation fuels (SAFs) to be counted towards ReFuelEU annual SAF targets. The eligibility criteria refer to requirements set out in RED III for RFNBOs and RCFs.

Fuel categories in RED III and ReFuelEU

- Sustainable aviation fuels (SAFs) is a term commonly used in the aviation industry. ReFuelEU defines exactly which fuels will be eligible as SAFs, linking to the requirements of RED III, illustrated opposite.



¹ Synthetic fuels have sub-targets under ReFuelEU SAF blend percentage mandates

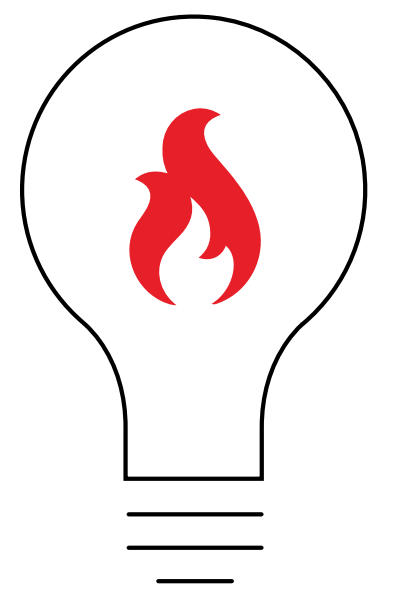
² Certified biofuels complying with RED III. Excluding biofuels from food and feed crops. Eligible feedstocks: agricultural or forestry residues, algae, bio-waste, used cooking oil or certain animal fats

³ Must be RED III compliant. E.g. from waste gases and waste plastic

⁴ Differentiated from RFNBOs because they don't need to be produced using 100% renewable electricity, however must still be non-fossil based and achieve 70% emission reduction compared to fossil fuels

Legislation Spotlight

ETS and the Compliance Carbon Market

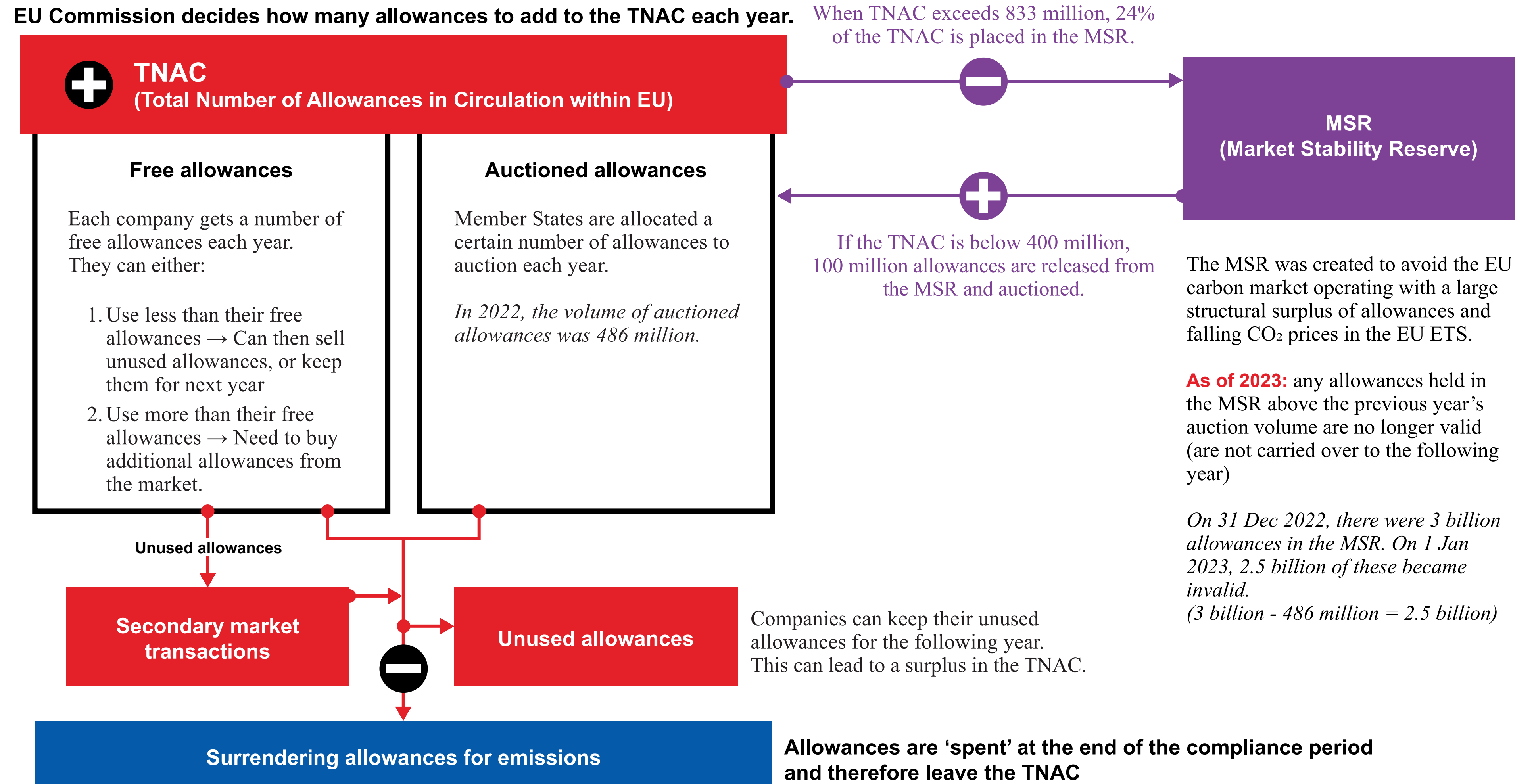


ETS allowances and the Compliance Carbon Market

The EU ETS is applicable to energy, energy-intensive industries (steel, iron, cement, etc.) and aviation sectors primarily. Mapped below is where the ETS allowances go within the Compliance Carbon Market (under the ETS). The voluntary carbon market is separate and not included.

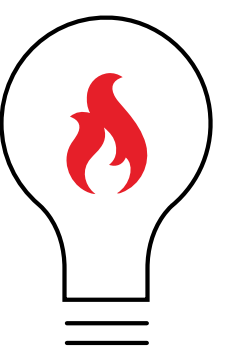
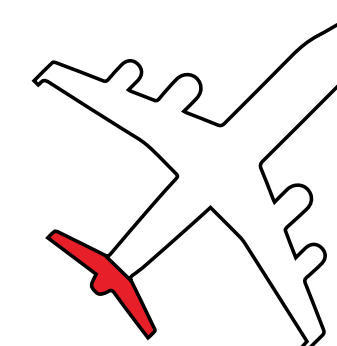
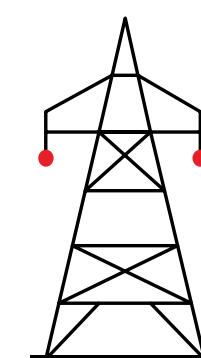
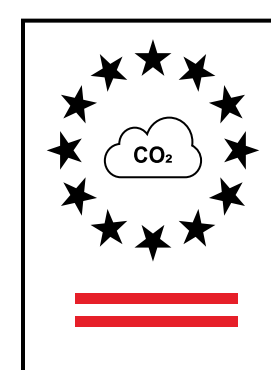
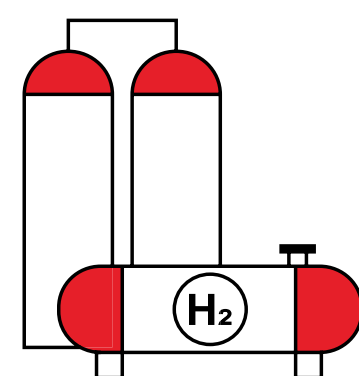
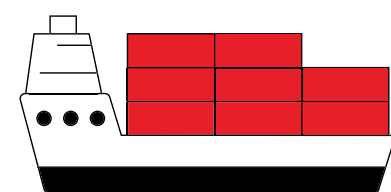
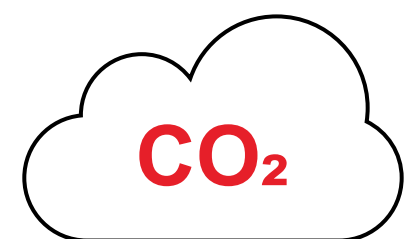
The TNAC should match the set emissions cap each year, which is **targeted to reach a 65% reduction by 2030 compared to 2005**.

In 2022, TNAC in the EU carbon market stood at nearly 1.135 billion allowances (EU Commission).



Timeline of implementation in various sectors

Understanding individual pieces of EU carbon legislation is important, but the interaction between them and their accumulated effect is critical to understanding business plan impacts in the transport and carbon-intensive industries.



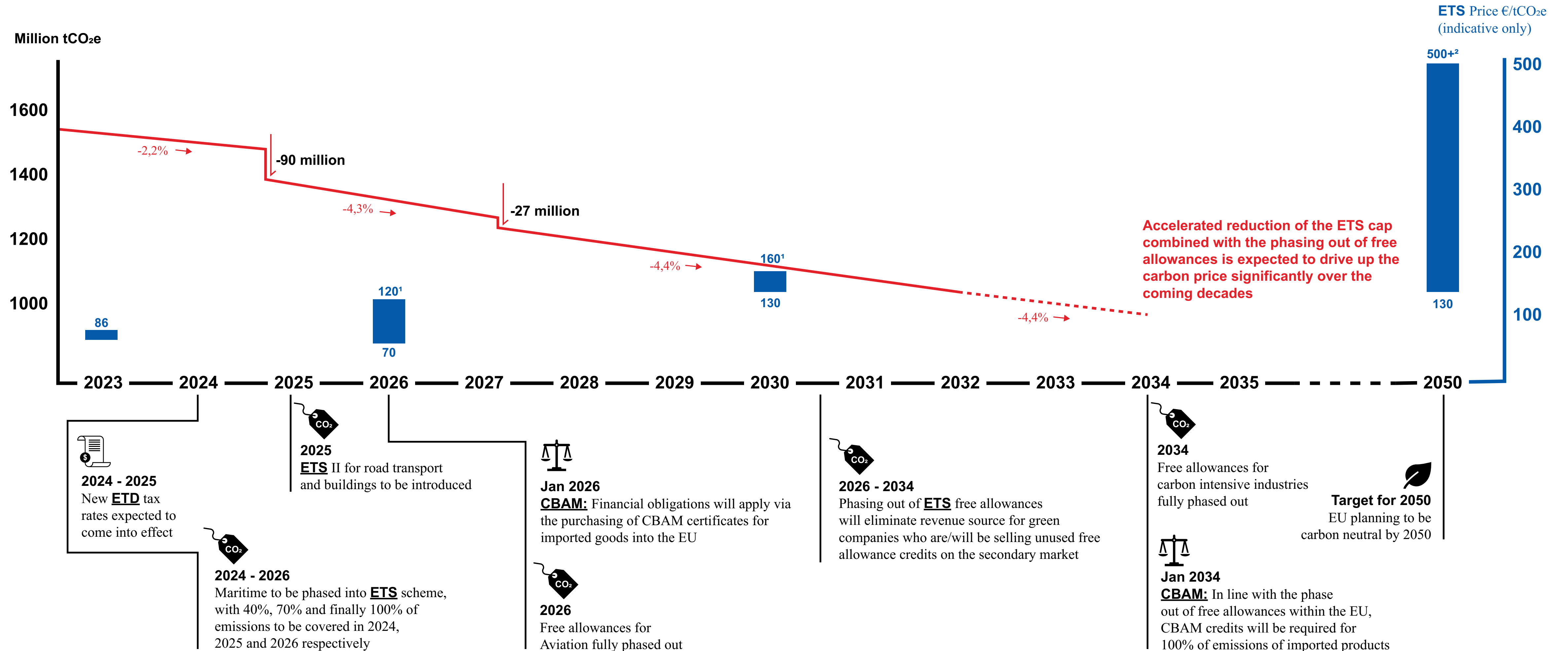
Timeline of implementation in various sectors

Presented on the following slides are timelines of policy implementation for the EU compliance carbon market and in some key sectors.

1. In the EU **compliance carbon market**, the phasing out of free allowances in the aviation and industry sectors and an accelerated reduction to the total ETS allowances cap is expected to impact the price of ETS, with some increases forecasting the price to nearly double by 2030. This coincides with the phasing out of free allowances in the aviation and industry sectors, as well as introducing other sectors such as maritime and buildings into the ETS system, meaning more companies will be paying for their emissions.
2. In the **aviation** sector, with the phasing out of ETS free allowances, airlines will strive to reduce their emissions despite increasing flight demand over the coming decades. ReFuelEU mandates fuel suppliers to supply certain increasing percentages of SAF over the coming years, with requirements for airlines and airports to adopt/enable this greater uptake of SAF. The increased demand for SAF (also encouraged by a planned introduction of a tax on kerosene in the revisions to the ETD (pending approval)) creates a stronger market for new SAF production, particularly synthetic fuels.
3. The **maritime** sector is under pressure to reduce their emissions through sustainable fuel uptake very promptly, since the sector is being introduced into the ETS (without any free allowances) from 2024-2026, and FuelEU is mandating emission reduction targets to be met over the coming years to 2050.
4. **Carbon intensive industries** (e.g. construction material production, electricity, hydrogen) will have their ETS free allowances fully phased out by 2034, coinciding with the gradual introduction of the CBAM tax for importation of goods from outside the EU, intended to 'level the playing field' between products in the EU and those outside the EU which may currently be cheaper due to less strict carbon legislative mandates. Additionally, RED III introduces stricter criteria for eligible carbon sources for RFNBO and RCF production, meaning only biogenic sources will be valid from 2041.

Sector focus

Decarbonisation pathway | Carbon market



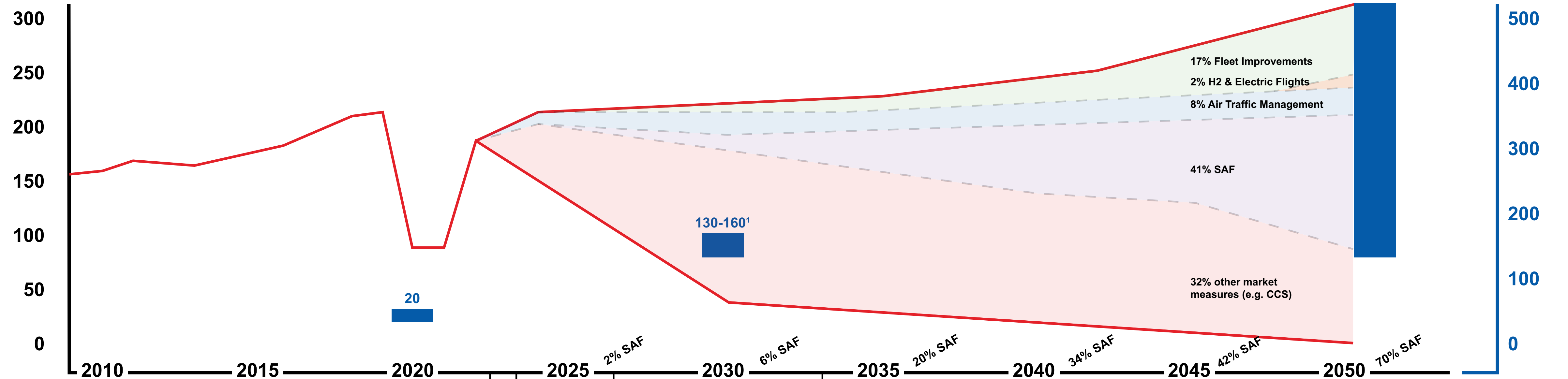
¹ Source: Kopernikus-Projekt Ariadne (2022)

² 2050 Estimates vary greatly. Sources: CE Delft (2021) and Tol (2020)

Sector focus

Decarbonisation pathway | Aviation industry

Emissions of EU flight sector
(in million tonnes tCO₂e)



ETS Price €/tCO₂e
(indicative)

Jan 2023
ReFuelEU Aviation commands SAF mixing increase every 5 years (see % shown)

Feb 2023
CBAM Increases costs of non-EU fuels

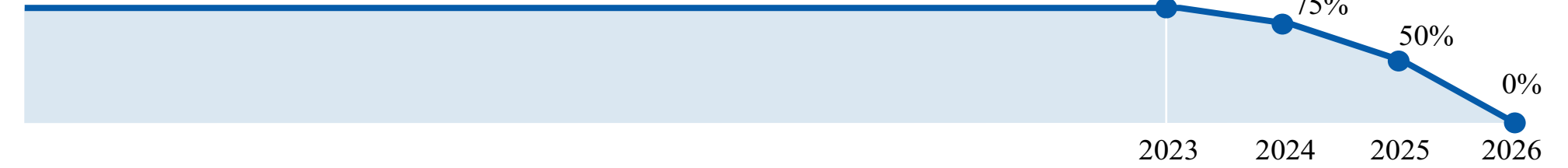
2024 - 2025
Introduction of revised **ETD** expected to gradually introduce kerosene tax

2026
Free allowances for Aviation fully phased out

2034 - 2035
Kerosene tax under **ETD**, expected to be fully enacted min. tax rate of ~ €10,75/GJ

Jan 2026
ETS Reform: free allowances fully phased out after a 3-year period, see graph in blue to the left

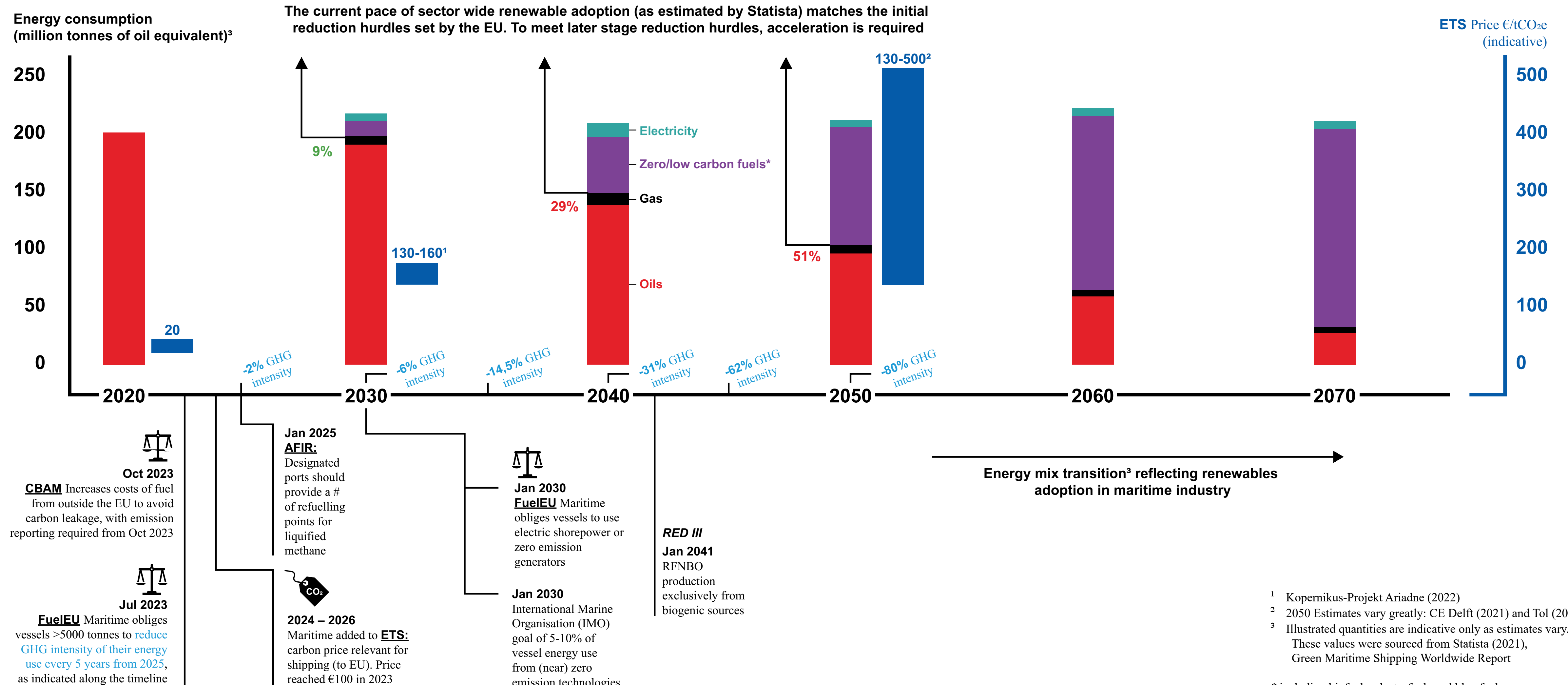
Phasing out of Aviation Free ETS Allowances



¹ Kopernikus-Projekt Ariadne (2022)
² 2050 Estimates vary greatly: CE Delft (2021) and Tol (2020)
³ Eurocontrol (2022) Aviation Outlook 2050

Sector focus

Decarbonisation pathway | Maritime industry

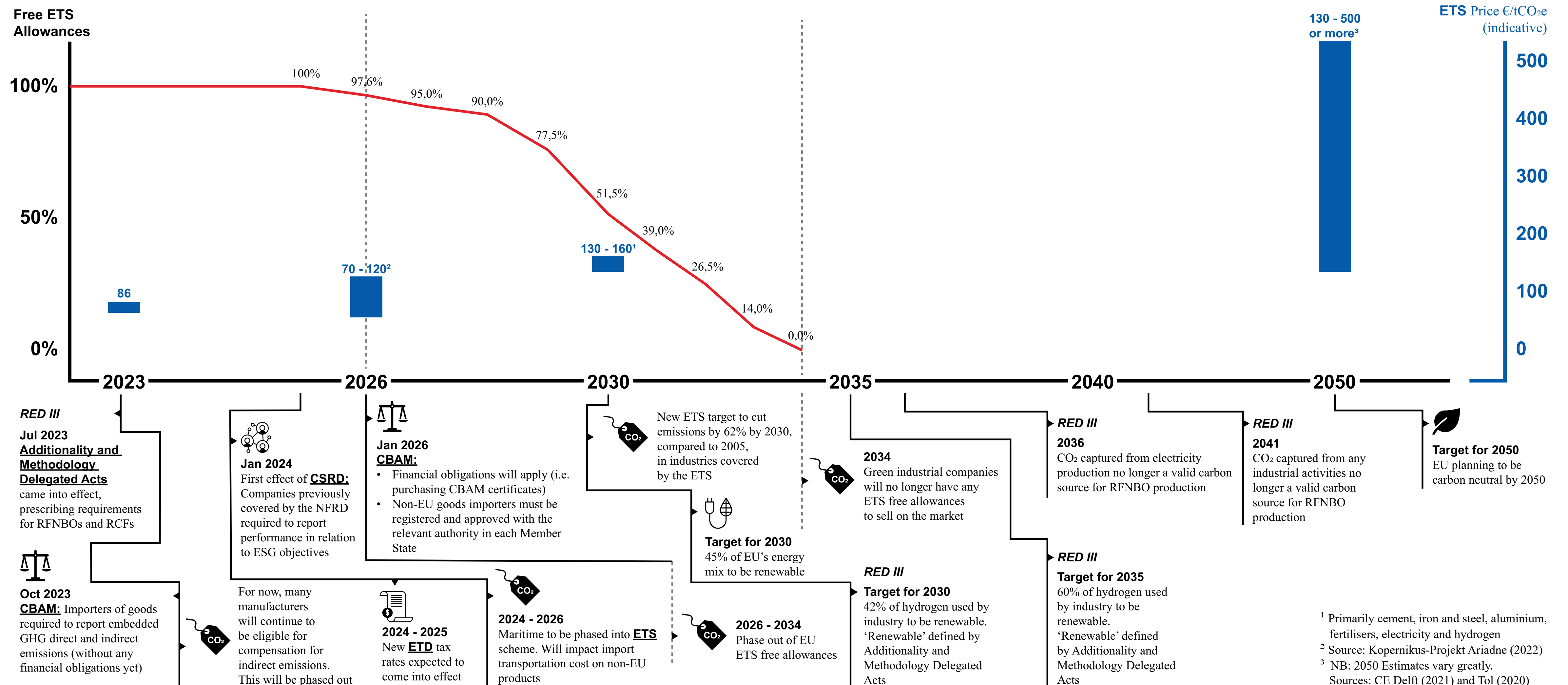


¹ Kopernikus-Projekt Ariadne (2022)
² 2050 Estimates vary greatly: CE Delft (2021) and Tol (2020)
³ Illustrated quantities are indicative only as estimates vary. These values were sourced from Statista (2021), Green Maritime Shipping Worldwide Report

* including biofuels, electrofuels and blue fuels

Sector focus

Decarbonisation pathway | Carbon-intensive industries¹



¹ Primarily cement, iron and steel, aluminium, fertilisers, electricity and hydrogen
² Source: Kopernikus-Projekt Ariadne (2022)
³ NB: 2050 Estimates vary greatly. Sources: CE Delft (2021) and Tol (2020)

Appendix A:

Acronyms and Terminology

Appendix A

Glossary of Acronyms

Abbreviation	Term
AFIR	Alternative Fuels Infrastructure Regulation
CBAM	Carbon Border Adjustment Mechanism
CO ₂	Carbon dioxide
CO _{2e}	Carbon dioxide equivalent
CSRD	Corporate Sustainability Reporting Directive
ETD	Energy Taxation Directive
ETS	(EU) Emissions Trading System
EU	The European Union
g	Gram
GHG	Greenhouse gas
GW	Gigawatt
H ₂	Hydrogen
kg	Kilogram

Abbreviation	Term
kW	Kilowatt
MSR	Market Stability Reserve
MJ	Megajoule
MWh	Megawatt hour
PPA	Power purchase agreement
PtL	Power-to-liquid
RCF	Recycled carbon fuel
RED III	Renewable Energy Directive III
RES	Renewable energy source
RFNBO	Renewable fuel of non-biological origin
SAF	Sustainable aviation fuel
SFDR	Sustainable Finance Disclosure Regulation
SNG	Synthetic natural gas

Abbreviation	Term
t	Tonne (1000kg)
TEN-T	Trans-European Transport Network
TNAC	Total Number of Allowances in Circulation
WtE	Waste-to-Energy

Appendix A

Carbon Terminology

Term	Explanation
Carbon credits	Carbon credits are tradeable certificates that constitute an offset of 1 tonne of CO ₂ e (carbon dioxide equivalent) from the atmosphere
Carbon emissions	The release of carbon dioxide into the atmosphere. In practice it tends to be a catchall term related to other GHG emissions when quantified and converted to CO ₂ e
Carbon offset	A project or an activity that reduces or removes carbon emissions from the atmosphere to compensate unavoidable emissions produced by others
Carbon tax	An environmental tax or penalty regulated by governments that organisations have to pay for their excessive emissions of carbon dioxide and other GHG
Carbon sink	A natural or engineered resource that has the ability to store and remove carbon dioxide from the atmosphere (e.g. forests, peats)
Carbon neutral	Anthropogenic carbon dioxide emissions emitted into the atmosphere are balanced with carbon dioxide offsets from reduction and removal projects
Carbon dioxide equivalent (CO ₂ e)	A metric used to calculate GHG emissions. It combines all greenhouse gases (e.g. methane, nitrous oxide) in one, by representing their global warming potential in terms of equivalent quantity of CO ₂
Carbon market	There are two types: compliance market and voluntary market. Both of these markets conduct the trade of carbon credits
Carbon registry	An organisation that verifies and validates the reduction/protection/removal of carbon emissions, and issues carbon credit certificates based on its developed methodologies
Carbon accounting	The quantification of carbon emissions and reductions, it complements greenhouse gas (GHG) accounting
Carbon leakage	The event that carbon emissions reduced in one geographical area would be replaced with carbon emissions in another geographical area (e.g. by companies moving operations overseas to fall under different legislation)
Decarbonisation	The act of reducing carbon intensity through any measure taken (e.g. process optimisation or using alternative fuels)
Conventional fuels	Refers to fossil-based fuels which are inherently depleting and have a high carbon intensity (e.g. oils, natural gases, coals)

Appendix B:

Brief description of legislative items

EU carbon legislation

Brief descriptions of legislative items related to or falling under the Green Deal | Strategy and policy drivers

Name	Type	Explanation	Expected Impact
Green Deal	Legislative Package	<ul style="list-style-type: none"> Presented in Dec 2019, the Green Deal outlines goals to ensure the EU reaches carbon neutrality by 2050 This target is legally binding as it is enshrined in European Climate Law (since June 2021), as is the commitment to reduce net GHG emissions by at least 55% by 2030 (compared to 1990 levels) All of the EU carbon legislation either comes under this policy initiative via the Fit for 55 programme or is aligned with this policy initiative 	<ul style="list-style-type: none"> Long term commitment from EU to support the transition and decarbonisation Provides some long-term certainty to companies to inform investment decisions
RePowerEU	Legislative Plan	<ul style="list-style-type: none"> Adopted 14 Feb 2023, RePowerEU is the EU Commission's plan to (i) end EU's dependence on Russian fossil fuels and (ii) tackle the climate crisis by proposing to: <ul style="list-style-type: none"> Increase Energy Efficiency Target from 9% to 13% and encouraging energy saving practices Diversify/increase supply of LNH and hydrogen Accelerate the rollout of renewables (with specific initiatives suggested for solar, heat pumps, permitting, hydrogen, biomethane) Issue carbon contracts for difference (CCfDs) which, in effect, promise a future minimum price for carbon that clean fuel producers can rely on, pressing the cost of capital and stimulating investment decisions in these industries 	<ul style="list-style-type: none"> Leads to public investments in gas pipelines / LNG infrastructure which can be used for (liquid) hydrogen as well Decreases risk for private investments in green energy production
Net Zero Industry Act	Implementing Act	<ul style="list-style-type: none"> On 7 December 2023, EU ministers adopted a common position (general approach) on the proposal for a net-zero industry act. A provisional agreement in the trilogue has not yet been reached, with discussion about to start in the trilogue Main aim of the act is to accelerate industrial deployment of critical technologies needed to support the transition to climate neutrality, aiming for production in the EU to cover 40% of EU's needs in strategic technology products by 2030, such as photovoltaic panels, wind turbines, batteries and heat pumps The act would develop a simple legal framework for EU-based net-zero industries, and would accelerate permit-granting processes 	<ul style="list-style-type: none"> Greater support for production within the EU of net-zero technologies Hydrogen could represent 20% of the EU's energy mix by 2050 Wind energy could make up 42.5% of EU's renewable energy by 2030 Max permitting time of 12 months for projects <1GW annually
Fit for 55	Legislative Package	<ul style="list-style-type: none"> Overarching legislative program (realisation of the Green Deal), adopted July 2021 Short term goals for 2030 (55% reduction of carbon emissions w.r.t 1990) 	See items on following pages

EU carbon legislation

Brief descriptions of legislative items related to or falling under the Green Deal | Carbon levies

Name	Type	Explanation	Expected Impact
EU Emissions Trading System (ETS)	Regulation	<ul style="list-style-type: none"> Reform formally adopted in April 2023 Puts a price on carbon dioxide equivalent emissions and sets an annual cap for emissions in the sectors covered (predominantly energy, energy-intensive industries (e.g. oil, steel, cement) and aviation within the EU) Free allowances are currently given to certain emitting sectors each year, and for emissions above this threshold additional allowances must be purchased either from the secondary market (other companies selling their unused free allowances) or from auctions from the Member States With the latest reform, free allowances for the aviation sector – currently 85% – will be phased out by 2026; free allowances for energy-intensive industries will be phased out by 2034; a separate ETS (ETS II) will be created for buildings and road transport; and the maritime sector will be phased into the ETS between 2024 and 2026 	<ul style="list-style-type: none"> GHG emissions will become more expensive for included sectors Will drive up costs of fossil fuel based products and energy, to make renewable sources more cost competitive. CBAM will ensure level global playing field on carbon penalties applied in the EU ETS extension to maritime (2024-2026) will improve competitiveness of RFNBOs and RCFs for maritime sector Free allowances phase out of the aviation sector will stimulate uptake of RFNBOs and RCFs for SAF production. A separate ETS for road transport will improve competitiveness of RFNBOs and RCFs for transport
Carbon Border Adjustment Mechanism (CBAM)	Regulation	<ul style="list-style-type: none"> Adopted 16 May 2023. The transitional phase begins 1 October 2023 and runs until the end of 2025, during which time reporting of emissions will be required according to the Implementing Regulation, but financial obligations won't begin until the start of 2026 A tool to combat carbon leakage and encourage decarbonisation outside of the EU's borders, by forcing importing EU companies to buy certificates that mark the cost difference between the carbon price in the country of production and in the EU under ETS In first instance CBAM only applies to (bulk, above certain threshold) (i) Steel, (ii) Aluminium, (iii) Cement, (iv) Fertiliser, (v) Energy and (vi) Hydrogen and their precursors. After 2030 more downstream products can be included Financial obligations will be phased in in alignment with the phasing out of ETS free allowances. (i.e. until the free allowances within the EU are completely phased out by 2034, products from outside of the EU will only have to buy certificates for emissions above the level of the free allowances.) 	<ul style="list-style-type: none"> Will increase carbon penalties of carbon intensive products produced outside of the EU to put these on a level playing field with EU carbon penalties Increases costs and administrative burden of imported carbon intensive products such as steel, aluminium, cement, fertiliser, energy and hydrogen. In later stages more upstream products and chemicals may be added Slight form of protectionism for EU production, especially when considered in line with Net Zero Industry Act
Energy Taxation Directive (ETD)	Directive	<ul style="list-style-type: none"> Forms an integral part of the Green Deal legislative package. The EU is working on a revision to the ETD, proposed in July 2021, which introduces fuel taxes for the first time to the shipping and aviation sectors. Taxes will be phased in over 10 years from the date of adoption Revision aims to ensure that the taxation of energy products and electricity better reflects the impact they have on the environment and on health, by removing disadvantages for clean technologies and introducing higher levels of taxation for inefficient and polluting fuels <ul style="list-style-type: none"> Minimum tax rates adjusted to ensure conventional fossil fuels are taxed the highest on a per energy content basis A tax for conventional fossil fuel (e.g. kerosene) use in the maritime/aviation sectors will be introduced, being phased in over 10 years from a minimum rate of €0/GJ from the year of adoption to €10.75/GJ ten years later Sustainable and alternative fuels in both the aviation and maritime sectors will enjoy a zero minimum tax rate until 2033 Fuels have separate tax rates for use as motor fuels versus use for heating. (Heating use tax rates much lower, e.g. €0.9/GJ for conventional fossil fuels) No distinction in tax rates for types of use of fuels/electricity (in commercial vs non-commercial, for example) 	<ul style="list-style-type: none"> Will lead to increased cost competitiveness of sustainable fuels with fossil fuels Big impact on shipping and aviation sectors: they've enjoyed zero taxes on fossil fuel usage up until now. The taxes being introduced for kerosene use combined with the temporary zero tax rate for sustainable/alternative fuels until 2033 will create a lot of incentive for these sectors to transition quickly to more sustainable fuels

EU carbon legislation

Brief descriptions of legislative items related to or falling under the Green Deal | Energy

Name	Type	Explanation	Expected Impact
RED III	Directive	<ul style="list-style-type: none"> Recent amendments to RED II were formally adopted on 9 October 2023 by the EU Council after being approved by Parliament RED III increases the requirement for share of renewables in EU energy mix to 42.5% in 2030, with a goal of 45%. It defines decarbonisation sub-targets for Member States regarding the share of renewable energy or fuels to be used and/or GHG reduction requirements by 2030, to meet across the transport, industrial, buildings, heating and cooling sectors Sets minimum threshold of GHG emission savings for RFNBOs and distinct set of RCFs (at 70% compared to fossil fuels) Aims to shorten permitting processes, requiring national authorities to take no longer than 12 months to approve new renewable energy installations, if located in so-called 'renewables go-to areas', and within 24 months in other areas 	<ul style="list-style-type: none"> Opens up significant investment opportunities in renewable energy and sustainable fuels Promotes the use of RFNBOs and RCFs to reach the new targets Phasing out of grey hydrogen to be replaced with green hydrogen Along with the Additionality and Methodology Delegated Acts, this directive provides some certainty to the fuel and energy industries on potential demands for RFNBOs and RCFs in the future and provides clarity on requirements for these, helping to de-risk investment opportunities in these emerging sectors
> Additionality Delegated Act	Delegated Act	<ul style="list-style-type: none"> The Additionality Act specifies requirements for fuels to be classified as RFNBOs, in order to be eligible to be credited towards the target specified under RED III. It determines clearly which electricity to use for RFNBO production and how to use it Connection between an electricity plant and a hydrogen plant can be done via a direct connection or via the grid <ul style="list-style-type: none"> For grid connections, additionality, temporal and geographical correlation requirements are detailed in this act 	<ul style="list-style-type: none"> Relevant for renewable energy developers and RFNBO (including hydrogen) plants as the conditions impact the timing, location and business cases of such projects
> Methodology Delegated Act	Delegated Act	<ul style="list-style-type: none"> The Methodology Act explains the methodology for calculating GHG emission savings of RFNBOs and recycled carbon fuels (which is necessary to determine whether RFNBOs comply with the EU's GHG emission thresholds). GHG emission savings will need to be calculated according to this methodology Defines valid carbon sources to produce RFNBOs, in order for the fuel to be classified as an RFNBO <ul style="list-style-type: none"> Captured CO2 from industrial processes will not be allowed from 2041 Sets minimum threshold of GHG emission savings for recycled carbon fuels (at 70% compared to fossil fuels) 	<ul style="list-style-type: none"> Will provide a standard method for calculating emission savings to ensure consistency across markets and provide a reference for certification RFNBO production can only use biogenic carbon from 2041, increasing the value of biogenic carbon already significantly
Hydrogen and Decarbonised Gas Market Package	Legislative Package	<ul style="list-style-type: none"> The purpose of the package is to accelerate the shift from fossil natural gas to renewable and low-carbon gases, in particular hydrogen and biomethane, aiming to increase the share of renewable and low-carbon gases in the EU from the current portion of 5% (in 2023) to 66% in 2030 The package includes a regulation that establishes common internal market rules for renewable and natural gases and hydrogen, for which a provisional agreement was made on 8 December 2023. The provisional agreement provides for a third separate (new) independent entity for the development of a hydrogen network, namely the EU entity for Hydrogen Network Operators (ENNOH) The package also includes a directive, for which a provisional agreement was made on 27 November 2023 	<ul style="list-style-type: none"> Increased structural support for the production of the hydrogen network in the EU to allow for earnest development of much needed hydrogen market and commoditisation Indicated intention for the EU to further support biomethane production

EU carbon legislation

Brief descriptions of legislative items related to or falling under the Green Deal | Transport

Name	Type	Explanation	Expected Impact																					
ReFuelEU Aviation	Regulation	<ul style="list-style-type: none"> Formally adopted 9 October 2023, this regulation obliges all fuel suppliers to provide the following minimum share of SAFs to operators at EU airports <table border="1"> <thead> <tr> <th></th> <th>2025</th> <th>2030</th> <th>2035</th> <th>2040</th> <th>2045</th> <th>2050</th> </tr> </thead> <tbody> <tr> <td>Percentage of SAF required</td> <td>2%</td> <td>6%</td> <td>20%</td> <td>34%</td> <td>42%</td> <td>70%</td> </tr> <tr> <td>(Sub-mandate for synthetic fuels)</td> <td>-</td> <td>(1.2%)</td> <td>(5%)</td> <td>(10%)</td> <td>(15%)</td> <td>(35%)</td> </tr> </tbody> </table> <ul style="list-style-type: none"> Flights departing from airports with $\geq 800,000$ passengers or more than 100,000 tonnes of freight traffic per year (including those from non-EU airlines) and from aircraft operators that have >500 passengers or >52 cargo flights per year must uplift with SAF-blended fuels and adhere to measures to avoid tankering and over-fuelling, and airports must provide appropriate infrastructure to support storage and blending of SAFs The proposal would require reporting of compliance (by 31 March each year) and would introduce penalties for fuel suppliers, operators and airports who fail to comply with the obligations. The collected funds would go towards research/innovation into improving affordability of SAFs 		2025	2030	2035	2040	2045	2050	Percentage of SAF required	2%	6%	20%	34%	42%	70%	(Sub-mandate for synthetic fuels)	-	(1.2%)	(5%)	(10%)	(15%)	(35%)	<ul style="list-style-type: none"> Puts onus on fuel producers to develop SAF and airlines to buy SAF, creating supply and demand for investment Directly incentivises airports and aircraft fuel distributors to improve SAF infrastructure, which will press its integrated cost price for end-users The labelling system will promote greener flights by better informing consumers, also reinforcing the above Growing SAF market will create around 200,000 additional jobs in the EU ReFuelEU SAF targets demand between 200-400 SAF production plants to be realised by 2050
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FuelEU Maritime	Regulation	<ul style="list-style-type: none"> Adopted in July 2023, vessels above 5000 tonnes calling at European ports are obliged through this initiative to reduce GHG intensity of energy used as follows compared to 2020. Additionally, requirements for connecting to electric onshore power while in the harbour will apply from 2030 <table border="1"> <thead> <tr> <th>2025</th> <th>2030</th> <th>2035</th> <th>2040</th> <th>2045</th> <th>2050</th> </tr> </thead> <tbody> <tr> <td>-2%</td> <td>-6%</td> <td>-14.5%</td> <td>-31%</td> <td>-62%</td> <td>-80%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> The requirements apply to the shipping company, who needs to monitor and report data on annual energy used on board vessels to an accredited verifier. Monitoring plans must be submitted to the verifiers by end of August 2024. Non-compliance will result in financial penalties and ultimately being banned from the EU 	2025	2030	2035	2040	2045	2050	-2%	-6%	-14.5%	-31%	-62%	-80%	<ul style="list-style-type: none"> Will increase production and uptake of RFNBOs and RCFs for maritime use at competitive costs Likely to lead to more investments and innovation in sustainable development of the maritime sector Together with ReFuelEU Aviation will lead to a level playing field where alternative fuels are stimulated for both sectors 									
2025	2030	2035	2040	2045	2050																			
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Alternative Fuels Infrastructure Regulation (AFIR)	Regulation	<ul style="list-style-type: none"> Adopted 25 July 2023, the AFIR sets targets for EU Member States to provide alternative fuel infrastructure including: <table border="1"> <tbody> <tr> <td>EV recharging</td> <td> <ul style="list-style-type: none"> Min. total power output at recharging stations relative to number of electric/hybrid vehicles registered in their territory, by Jan 2024 Fast-charging pools for small vehicles every 60km in each direction of travel along the core TEN-T by 2025 and along the comprehensive TEN-T by 2030. (Separate targets for vehicles $> 3.5t$) At the busiest ports, shore-side electricity supply for at least 90% of the total number of port calls by end of 2029 </td> </tr> <tr> <td>Hydrogen refuelling</td> <td> <ul style="list-style-type: none"> At least one publicly accessible hydrogen refuelling station at every urban node and every 200km along the core TEN-T by 2031 Hydrogen refuelling stations must be designed with a cumulative capacity of at least 1 t/day by the end of 2030 </td> </tr> <tr> <td>Other</td> <td> <ul style="list-style-type: none"> Liquefied methane refuelling stations to be provided at core TEN-T maritime ports and along the TEN-T core network at regular distances by 2025. At airports, electricity supply for all aircraft stands next to the terminal by 2025 and all remote stands by 2030 </td> </tr> </tbody> </table>	EV recharging	<ul style="list-style-type: none"> Min. total power output at recharging stations relative to number of electric/hybrid vehicles registered in their territory, by Jan 2024 Fast-charging pools for small vehicles every 60km in each direction of travel along the core TEN-T by 2025 and along the comprehensive TEN-T by 2030. (Separate targets for vehicles $> 3.5t$) At the busiest ports, shore-side electricity supply for at least 90% of the total number of port calls by end of 2029 	Hydrogen refuelling	<ul style="list-style-type: none"> At least one publicly accessible hydrogen refuelling station at every urban node and every 200km along the core TEN-T by 2031 Hydrogen refuelling stations must be designed with a cumulative capacity of at least 1 t/day by the end of 2030 	Other	<ul style="list-style-type: none"> Liquefied methane refuelling stations to be provided at core TEN-T maritime ports and along the TEN-T core network at regular distances by 2025. At airports, electricity supply for all aircraft stands next to the terminal by 2025 and all remote stands by 2030 	<ul style="list-style-type: none"> Road and maritime transport can rely on refuelling stations in the future when using of alternative fuels <ul style="list-style-type: none"> Positive impact for business plans of alternative fuel producers/providers Fair amount of infrastructure for Member States to provide by 2024, 2025 and 2030 															
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EU carbon legislation

Brief descriptions of legislative items related to or falling under the Green Deal | Green Finance

Name	Type	Explanation	Expected Impact
EU Taxonomy	Regulation	<ul style="list-style-type: none"> The EU Taxonomy is a key part of the EU's Sustainable Finance Action Plan and was adopted 12 July 2020 Provides regulatory technical standards to determine which economic activities are environmentally sustainable <ul style="list-style-type: none"> Sets out four overarching conditions that an economic activity must meet in order to qualify as environmentally sustainable Implementing and delegated acts have been issued. SFDR and CSRD (see below) measure alignment with the EU Taxonomy 	<ul style="list-style-type: none"> Both financial and non-financial companies need to meet requirements of the EU Taxonomy and report this via the SFDR and CSRD respectively Also, products such as RFNBOs, RCFs and other carbon intensive products and processes will have to align with the EU Taxonomy
Sustainable Finance Disclosure Regulation (SFDR)	Regulation	<ul style="list-style-type: none"> Applicable since 10 March 2021 (Level 1) to all financial market participants and advisors operating in the EU (including those based outside the EU who market their products to EU-based clients). Level 2 of the SFDR entered into force on 1 Jan 2023 European regulation to help improve the transparency of financial decisions by standardising ESG disclosures (at both product and entity levels) in the financial realm (i.e. a powerful tool against greenwashing) Product-level disclosures measure alignment with requirements set out in the EU Taxonomy. Financial products are classified as either 'Article 6' products (note green), 'Article 8' products (light green), or 'Article 9' products <ul style="list-style-type: none"> Level 1 arguably was too vague with the criteria for each classification, allowing financial actors to exaggerate the sustainable dimensions of their products and/or include assets linked to polluting activities as Article 9 products. Level 2 aims to rectify this by strengthening criteria 	<ul style="list-style-type: none"> It will increase transparency amongst financial market participants and might persuade them to more actively invest in sustainable assets With the introduction of Level 2 SFDR, financial actors will have to reevaluate the classification of their products to clearer distinctions. This will lead to more comparable asset portfolios in terms of their sustainability
Corporate Sustainability Reporting Directive (CSRD)	Directive	<ul style="list-style-type: none"> Entered into force on 5 Jan 2023. Replacing the Non-Financial Reporting Directive (NFRD). Contains disclosure requirements for many ESG aspects. Purpose is to improve transparency so investors and other stakeholders can understand a company's sustainability objectives and performance Applicable to <u>all large</u> non-financial companies operating in the EU. (NFRD only applied to large public-interest companies, mainly listed companies.) Companies can choose to report non-alignment, rather than complete an assessment <ul style="list-style-type: none"> Companies are considered large if they meet two of the following criteria: (i) turnover exceeds €40 million p.a., (ii) balance sheet totals more than €20 million, (iii) more than 250 employees (average over a year) Will come into effect as of fiscal year 2024 for companies already covered by the NFRD, and from fiscal year 2025 for other large companies. Listed small and medium-sized enterprises (SMEs) will also be required to report from fiscal year 2026 From fiscal year 2028, non-EU companies with a (consolidated) turnover of more than €150 million in the EU will be subject to a special disclosure regime 	<ul style="list-style-type: none"> CSRD will motivate companies to align with EU taxonomy standards as they may receive less interest from investors otherwise New systems, processes and a governance structure will have to be set up because of the huge amounts of data that companies will be required to collect, process and publish

Contact

If you would like to discuss how this vast body of carbon legislation may impact your investments, please contact Maarten Wessels at maarten.wessels@arup.com.

ARUP