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PERSPECTIVE

CARBON CONTRACTS FOR DIFFERENCES IN EUROPE

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INTRODUCTION

Carbon Contracts for Differences (CCfDs) serve as long-term financing and delivery agreements between the signing parties, designed to mitigate the regulatory risks associated with climate policy. These risks often arise due to fluctuations in carbon market prices. Essentially, CCfDs allow industrial decarbonisation projects to compete for funding by offering a price and quantity of CO_2 reductions they can achieve relative to the business as usual (BAU) scenario. Projects awarded a contract are guaranteed payments to bridge the gap between their offered strike price (cost of CO_2 reduction per tonne) and a reference carbon price, typically tied to the domestic carbon market price.

CCfDs have been implemented in several countries, including the United Kingdom (UK), Germany, France, the Netherlands, and Denmark. The Netherlands and Denmark can be considered frontrunners in some respects, as projects funded through their schemes - such as Ørsted's two carbon capture facilities and the Porthos project - are already under construction. In the UK, the Northern Endurance Partnership and Net Zero Teesside Power confirmed their financial close Investment Decision (FID) in December 2024.

The UK government has also developed one of the most detailed and structured approaches to supporting CCS through its CCfD schemes. Given that these initiatives are still evolving, more time is needed to assess their long-term success.

These schemes are largely based on the Contracts for Difference (CfD) model, which has been widely used to support renewable energy projects. While traditional CfDs provide revenue certainty by stabilising electricity or fuel prices, CCfDs focus on bridging the gap between the cost of implementing low-carbon technologies and fluctuating carbon market prices.

This paper explores the practical implementation of CCfDS, examining how they function from a theoretical perspective, and provides a review of five European schemes, comparing key design elements such as project selection criteria, CCS-specific requirements, payment structures, cross-chain risk management, and penalties for underperformance. By analysing these differences, the report aims to explore the implications of various design choices.

ABOUT THIS REPORT

This summary report examines Carbon Contracts for Difference within various European schemes, all of which either focus on, or plan to focus on, financing CCS projects. We analyse the key design elements of these schemes, such as subsidy payment calculations, selection criteria, and risk management strategies, highlighting the distinct implications of each approach.

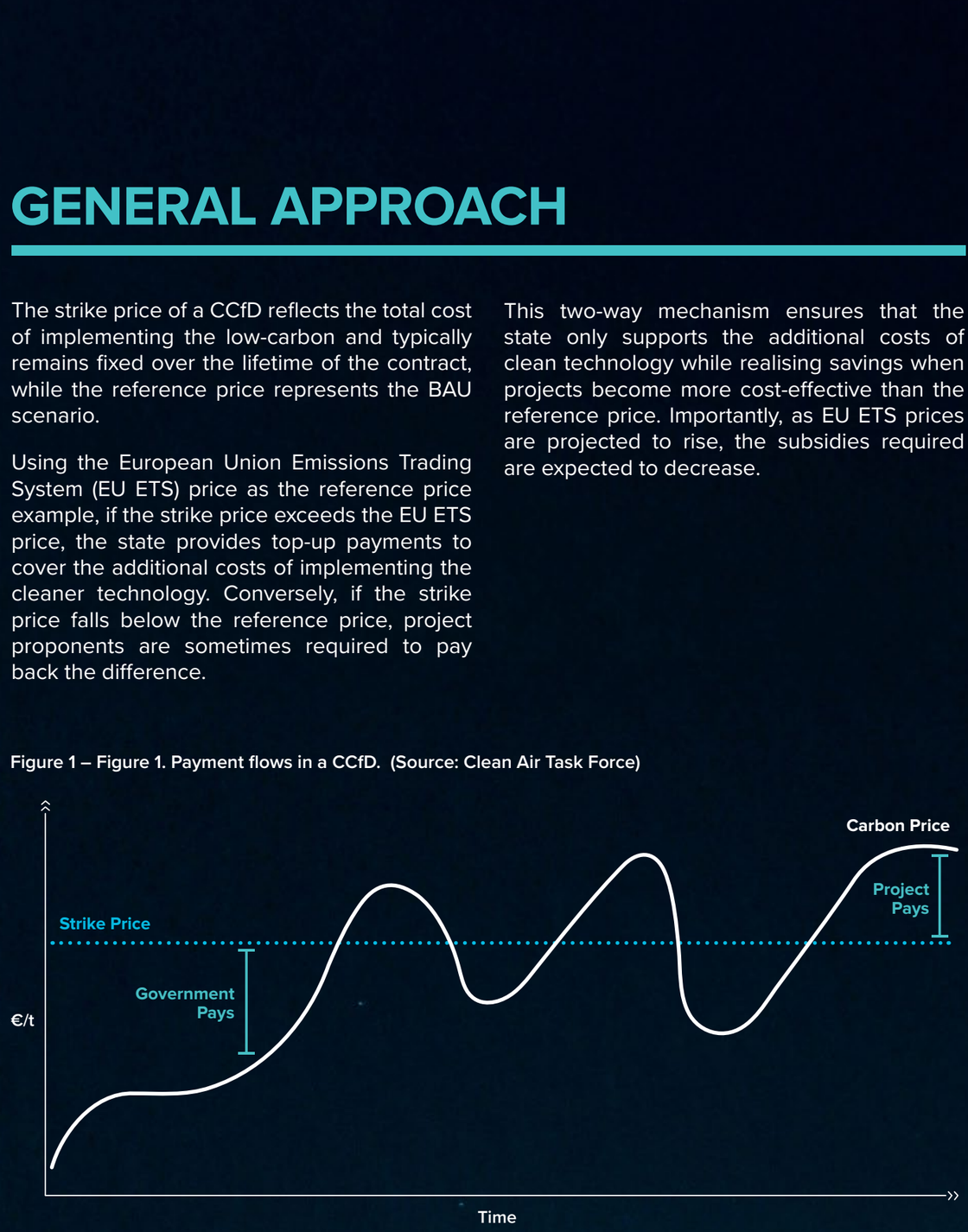
GENERAL APPROACH

The strike price of a CCfD reflects the total cost of implementing the low-carbon and typically remains fixed over the lifetime of the contract, while the reference price represents the BAU scenario.

Using the European Union Emissions Trading System (EU ETS) price as the reference price example, if the strike price exceeds the EU ETS price, the state provides top-up payments to cover the additional costs of implementing the cleaner technology. Conversely, if the strike price falls below the reference price, project proponents are sometimes required to pay back the difference.

This two-way mechanism ensures that the state only supports the additional costs of clean technology while realising savings when projects become more cost-effective than the reference price. Importantly, as EU ETS prices are projected to rise, the subsidies required are expected to decrease.

Figure 1 – Figure 1. Payment flows in a CCfD. (Source: Clean Air Task Force)



POLICY LANDSCAPE AND SUPPORT FOR CCfDs

European Union (EU)

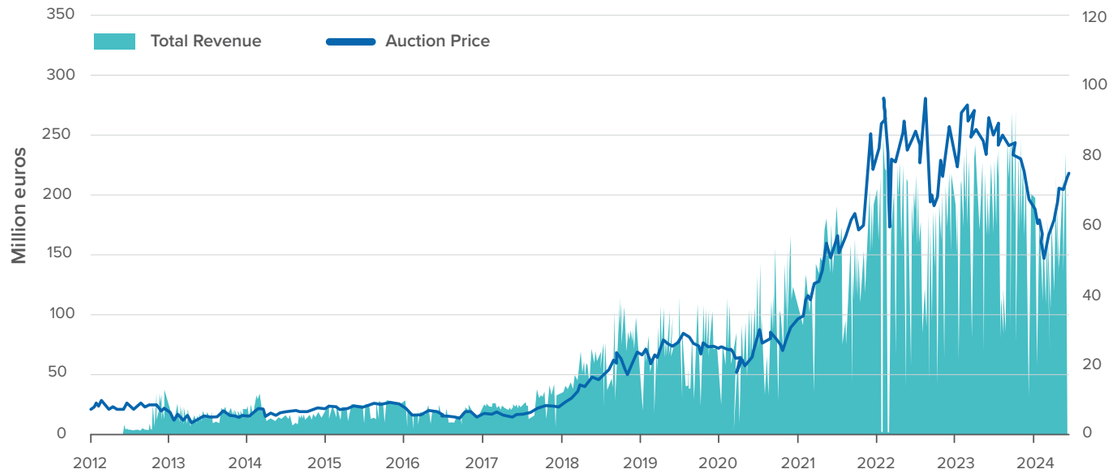
The policy landscape for CCfDs has evolved significantly in the EU. Adopted in 2022, the revised Climate, Energy and Environment State Aid Guidelines explicitly support CCfDs. These guidelines, which aim to prevent competition distortion through public funding, now recognise CCfDs as a viable mechanism for industrial decarbonisation. Furthermore, the Recovery and Resilience Facility, a temporary instrument established in 2021 to support post-COVID economic recovery, required member states to outline specific policy reforms and interventions for public fund allocation by 2026 in their national recovery and resilience plans. This has accelerated the inclusion of CCfDs in national plans and has led to the announcement of schemes such as Germany's climate protection agreements.

In Europe, countries including France, Germany, the UK, the Netherlands, Denmark, Spain, Sweden, and Hungary have expressed public interest or have actively developed national CCfD approaches. Discussions continue on the potential implementation of an EU-wide scheme through mechanisms such as the EU Innovation Fund. The recently announced Clean Industrial Deal introduces the concept of an industrial decarbonisation bank, which aims to finance industrial decarbonisation efforts using revenues from the Innovation Fund. Notably, CCfDs have been identified as the primary financial instrument for this initiative. As a result, the rollout of an EU-wide CCfD scheme is likely in the coming years.

Such an approach could enhance competition, especially for smaller member states that may struggle to foster competitive bidding markets. However, interdependencies between CCfDs and the Innovation Fund pose challenges. The Innovation Fund is financed through the sale of EU ETS emission allowances, meaning a drop in ETS prices reduces available funding while simultaneously increasing government payment obligations under CCfDs. However, EU ETS prices can also pose challenges for member states, which receive most of the revenues generated by the sale of allowances and, since June 2023, are required to allocate these funds to climate action and energy transformation, thus potentially fuelling their CCfD schemes.

Figure 2 illustrates the volatility in EU ETS revenues, highlighting how fluctuations in auction prices and the volume of emission allowance purchases directly impact the level of funding available through the Innovation Fund. This volatility creates uncertainty around the availability of funding streams to support CCfD subsidy payments, making it challenging to ensure stable and predictable financial support for decarbonisation projects under a potential European-wide CCfD scheme.

Figure 2 – ETS Auctions from 3/1/2012 to 10/6/2024 (in euros) (Source: Florence School of Regulation)



United Kingdom (UK)

In the UK, significant momentum for CCS development began in 2022, when the government set a target to deploy CCUS across four industrial clusters, aiming to capture and store 20–30 megatonnes of CO_2 annually by 2030. To facilitate this, the government introduced business models for industrial carbon capture to attract private investment and scale deployment, a critical step toward achieving these ambitions.

The Industrial Carbon Capture and Waste business models were shaped following consultations on design in July 2019 and April 2022, and are structured as CCfDs.

Additional business models have also been launched or announced, including:

- Hydrogen Production Business Model
- Dispatchable Power Agreement
- Transport and Storage Regulatory Investment Model (TRI model)
- Power BECCS Model
- Greenhouse Gas Removals Business Model

All are expected to follow a similar CfD framework.

In 2023, the government pledged £20 billion for CCS investment, with plans to allocate this funding through the various business models. By October 2024, this commitment had increased to £21.7 billion over the next 25 years. These funds have been specifically allocated to projects in Teesside and Merseyside, with the aim of capturing over 8.5 Mtpa of CO_2. While final confirmations around funding distribution are still pending, it is likely that:

- The bp/Equinor Net Zero Teesside gas power station will receive funding through the Dispatchable Power Agreement.
- The Protos Energy-from-Waste plant with CCS will be supported via the Industrial Carbon Capture (ICC) contract.
- HyNet's EET Hydrogen Production Plant 1 will be financed through the Hydrogen Production Business Model.
- Transport and Storage (T&S) projects, led by Eni and the Northern Endurance Partnership, are expected to receive support through the TRI model, which aims to alleviate demand-side risks.

However, the distribution of these funds across the different business models has not yet been disclosed.

KEY STRENGTHS OF CCfDs

ENHANCES GOVERNMENT COMMITMENT

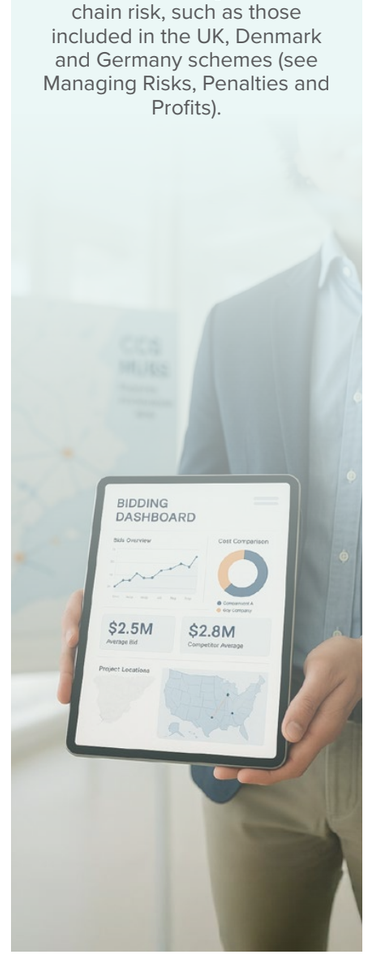
CCfDs incentivise high reference prices by increasing government payout obligations when prices are low, deterring policymakers from diluting ETS policies.

SUPPORTS COMPETITIVE BIDDING

CCfDs help establish the true cost of decarbonisation technologies through competition rather than top-down government decisions. However, the extent of this benefit depends on the bidding design and the priority given to cost in the selection process. For CCS deployment, simple competitive bidding alone is unlikely to minimise costs effectively. A more strategic approach, for example aligning project selection with regional infrastructure development, can enable economies of scale. This coordination ensures that each awarded project influences the required strike price for future projects, driving overall cost reductions.

DE-RISKS INVESTMENT

By ensuring long-term revenue certainty, CCfDs encourage innovation and the adoption of emerging technologies, eliminating the first-mover disadvantage and unlocking finance. However, the scheme could also include protective measures to mitigate cross-chain risk, such as those included in the UK, Denmark and Germany schemes (see Managing Risks, Penalties and Profits).



COMPARATIVE ANALYSIS OF CCS-RELATED EUROPEAN CCfD SCHEMES

A detailed analysis of CCfD schemes used to support CCS across five European countries reveals notable differences in eligibility criteria, scope, and implementation requirements. This analysis extends to the Netherlands' Sustainable Energy Production and Climate Transition (SDE++) scheme, the UK's Industrial Carbon Capture (ICC) Contract, Denmark's CCUS Fund (first round), Germany's Climate Protection Agreements, and France's Contracts for Difference.

The first three schemes are currently active and have allocated funding for CCS projects. In the German scheme, the second bidding round has been approved by the European Commission, with a total funding amount of €5bn, and its scope has been expanded to include CCS. The French scheme, which was recently approved by the European Commission, plans to use its funding to support CCS projects.

- **Scope of technologies:** The Dutch, German, and French schemes all allow a broad range of climate mitigation technologies. However, Denmark's CCUS fund and the UK's ICC Contracts focus specifically on CCS.
- **Thresholds and restrictions:** Germany requires installations to have at least 5 kilotonnes of annual emissions, while Denmark prioritises projects storing a minimum of 100 kilotonnes per annum from 2030. France excludes projects using coal or oil, and the SDE++ prohibits coal- and gas-fired electricity plants.
- **Delivery timelines:** Germany, France and the Netherlands impose strict delivery deadlines post-award (three, five and six years respectively), whereas Denmark and the UK set specific operational criteria deadlines.
- **Storage location requirements:** Some CCfD schemes impose specific storage location requirements. For example, under the SDE++, CO_2 must be stored within the Dutch continental shelf, while in the UK, installations must access storage sites within designated regional clusters. This approach has both potential drawbacks and benefits:
  - **Challenges:** The limited availability of eligible storage sites can lead to several cost pressures for emitters. With fewer storage options, competition for access increases, potentially driving up storage fees. Emitters located far from designated storage sites may also face higher transport costs to move CO_2 to compliant locations. Additionally, if only a small number of storage providers operate in a given area, they may gain market power, allowing them to charge higher prices. Furthermore, infrastructure bottlenecks – such as capacity limits or delays in expanding storage facilities – could add further costs and uncertainty for emitters relying on these sites.
  - **Opportunities:** Concentrating T&S activities in specific regions can also have advantages. Economies of scale can be achieved through shared infrastructure, leading to higher utilisation rates and lower unit costs over time. By clustering projects, governments can ensure more efficient investment in storage capacity, potentially offsetting the cost pressures associated with limited site availability.
- **T&S prerequisites:** These schemes also include bid prerequisites around T&S. In the case of the SDE++, a formal CO_2 offtake agreement with a T&S operator is required. Similarly, Denmark awards bids based on the delivery of a full CCS value chain, ensuring a more integrated approach. In contrast, France and Germany require projects to be in advanced discussions with T&S operators or have a sufficiently secured storage solution, offering a slightly less formal requirement compared to the other schemes.

While these specific requirements help reduce the risk of project failure after award, they may also limit the number of competitive bids or innovative projects. Additionally, by effectively locking emitters into a contract with a T&S operator while there is still significant price uncertainty in the T&S tariff, and without the ability to adjust the strike price (as with the SDE++), emitters could face substantial financial risk if costs exceed expectations.

On the other hand, informal arrangements – where projects are required to be in advanced discussions or have a loosely secured storage solution – can be problematic for T&S developers. These developers are forced to manage demand uncertainty created, in part, by government decisions on awards to emitters. However, T&S developers in most schemes do not directly receive government awards or guarantees, which leaves them exposed to risk.

A DETAILED ANALYSIS OF CCfD SCHEMES USED TO SUPPORT CCS ACROSS FIVE EUROPEAN COUNTRIES REVEALS NOTABLE DIFFERENCES IN ELIGIBILITY CRITERIA, SCOPE, AND IMPLEMENTATION REQUIREMENTS.

SELECTION CRITERIA FOR PROJECTS

Selection criteria across schemes share similarities but diverge in weighting and focus:

CRITERIA	DESCRIPTION	WEIGHTING BY COUNTRY/SCHEME
Cost-effectiveness	Central criterion assessing cost per tonne of CO_2 reduced. Overemphasis may favour "lowest-hanging fruit," discouraging innovative or long-term technologies.	Germany and Netherlands: Sole criterion. Denmark: 80% of the score. France: Main criterion, while other parameters act as bonus factors to the overall score.
Deliverability	Focus on operational readiness, organisational credibility, and early CO_2 storage capabilities to reduce risks and project default likelihood.	UK: 30% of score. Denmark: Scores based on project maturity i.e. deliver commercial operation on time and achieve contracted CO_2 quantity.
Innovation	Encourages technological ambition and demonstration of novel decarbonisation methods.	UK: 10% of score. France: 10% of score depends on whether the project is a recipient of the Innovation Fund.
Emission reductions	Evaluates emissions reduction through relative or absolute metrics, including project energy intensity and transport-related emissions.	UK: 25% for absolute reductions. France: 20% of score is based on the carbon intensity reduction.
Economic benefits	Recognises the role of fostering community support and reducing public opposition for projects.	UK: 20% of score. Other countries: Not included.

STRIKE AND REFERENCE PRICE CALCULATIONS

Strike Price

The strike price typically includes capital expenditure (CAPEX) and operational expenditure (OPEX) but varies by country. In the UK, CAPEX is reimbursed separately over five years, while OPEX is paid over the lifetime of the contract.

Some schemes cap the strike price through market analysis, thereby limiting subsidies and establishing benchmarks. This approach helps protect the state by providing certainty regarding maximum payouts. However, it requires careful and informed decision-making to set the cap at a level that accurately reflects the true market capabilities.

Dynamic adjustments are less common but exist in Germany (energy price-based adjustments) and the UK (one-time OPEX reopening). This approach could have merits, especially considering energy price spikes that could cause the actual strike price to exceed the initially agreed level. Without adjustments, such discrepancies could negatively affect the project operator by leaving them uncompensated for these unforeseen costs.

This challenge is further compounded in CCS value chains where T&S costs play a critical role. In some schemes, such as the UK, T&S fees are regulated and handled separately from the strike price. This ensures that subsidies can adjust to compensate for the exact cost of T&S, minimising financial risks for project operators. However, other approaches, like the Netherlands' SDE++, include fixed base rates for T&S within the strike price, derived from market analysis. If actual transport utilisation leads to higher fees, operators are only compensated for the base amount, exposing them to potential financial risks.

Reference Price

EU schemes typically use the average EU ETS price as a reference, while the UK and France apply a fixed linear price for 10 years before shifting to their domestic ETS. The Netherlands sets a price floor at two-thirds of the 15-year EU ETS projection, ensuring a cap on government payouts.

Different countries take varied approaches:

- Market-linked (Germany & Netherlands): Follows real ETS prices, aligning with the market but creating expenditure uncertainty.
- Fixed linear (UK & France): Uses a predictable price trajectory, providing financial stability but potentially misaligning with market fluctuations.
- Hybrid (Denmark): Adjusts upward if ETS prices rise but does not lower if they fall, protecting the state budget but raising fairness concerns.
- Projection-based floor (Netherlands): Limits government payouts but does not support emitters if ETS prices drop.

Payments

Payments are generally made annually and linked to CO_2 quantities stored over 15 years. Over-delivery in one period may qualify for capped additional payments. For instance, the UK's ICC scheme caps OPEX payments at 110% of the pre-determined CO_2 maximum. In France, up to 50% of the nominal CAPEX stated in the bid can be provided as an advance on the subsidy.

MANAGING RISKS, PENALTIES AND PROFITS

Cross-Chain Risks

Approaches to risk management vary. The UK compensates for delays in T&S infrastructure but has an exit clause for defaults. Denmark, France, the Netherlands, and Germany exempt emitters from penalties for factors beyond their control. However, subsidies are only paid for CO_2 successfully delivered, with no payments if no CO_2 reaches storage. Compensation is expected to be recovered through private contracts with T&S developers.

The degree to which cross-chain risk is managed by the public or private sector has significant implications. When the state provides protection to emitters, it can incentivise greater participation in the bidding process, potentially resulting in more competitive tender awards. Additionally, such protection reduces the likelihood of project defaults, thereby enhancing the long-term viability of the initiatives. However, if there are no financial consequences for T&S providers delivering subpar service, it could lead to complacency and inefficiencies in service delivery.

Underperformance Penalties

Penalties for underperformance are stringent:

- The UK requires an 85% capture rate, with possible termination if it falls below 80% for three months.
- Germany now requires at least a 60% reduction in emissions from the third full calendar year to continue grant eligibility. If reductions fall short, no grants will be awarded for the remaining contract term. Additionally, penalties apply if emission reductions deviate from targets, calculated based on the shortfall minus 30% of planned reductions, multiplied by the current CO_2 price.
- Denmark imposes a penalty of 50% of the Actual Subsidy Rate for each tonne of CO_2 not delivered.
- Netherlands allow shortfalls to be offset by over-performance in the following year by up to 25%.
- France imposes a 10% penalty on the aid linked to the additional forecasted reduction if CO_2 reductions fall below 90% of the expected performance for a given year.
- Paybacks:
  - Germany and the UK require paybacks if reference prices exceed strike prices. In Germany, any cost savings must be returned to the state.
  - In the UK, for non-waste sectors, paybacks are required in the final five years of contracts, with the reference price tied to domestic ETS prices. For waste sectors, however, the payback rule applies throughout the entire 15-year contract term.
- The Waste ICC Contract resembles a Contract for Difference more closely than the standard ICC Contract due to its use of an Applicable Carbon Reference Price, which is market-based and may rise above the strike price. As a result, symmetric payments are proposed to apply throughout the contract term, starting from the Start Date.

ADDITIONAL CONSIDERATIONS

Funding and Revenue

Countries have issued statements or imposed various rules for managing additional earnings or funding outside of the subsidy:

Germany: Any additional funding (i.e. funding outside the scheme, provided it qualifies as aid within the meaning of Article 107(1) of the Treaty of the Functioning of the European Union or as centrally administered Union funds that are not directly or indirectly subject to control by Germany) approved after the application is submitted will be deducted from the grant. If previously approved funding increases after submission, the same rule applies to the increase compared to the amount at the time of application. When determining the base contract price, applicants should account for any already approved funding, as it will be factored into the funding cost efficiency calculation. Failure to disclose any other funding applied for or granted at the time of application will result in a 10% penalty.

UK: The emitter is required to pay 90% of the monthly carbon removal credit revenue to the contract counterparty. This ensures that emitters do not benefit from a windfall due to the development of greenhouse gas removal (GGR) markets after contracts are signed, thereby protecting taxpayers' value for money.

Denmark: If any additional earnings arise from the sale of negative emission credits that were not included in the operator's submitted cost and earnings breakdown, the Danish Energy Agency (DEA) has the right to reduce the payment amount accordingly, based on 90% of these additional earnings.

Netherlands: Revenue and avoided costs are compensated through a correction amount. As part of the feasibility study that must be submitted, applicants need to disclose any additional funds to be invested by themselves, third parties, or shared partners.

France: Full disclosure of any public aid (granted or applied for) related to the same project is required, including subsidies, recoverable advances, loans, or guarantees. Additional funding must be justified in bid documentation and is factored into ex-ante profitability checks. If a project qualifies for multiple national aid schemes (e.g., DECARB IND, DECARB IND+), applicants must choose the most appropriate one. Coordination with ADEME is required to prevent double funding. Excess public aid (e.g., CEE subsidies) is deducted from the following year's payment. If total aid exceeds the EU State Aid Guidelines limit, the excess amount is either deducted from future payments or reimbursed.

Contract Duration

The contract period needs to strike a balance between providing enough revenue certainty to unlock funding and avoiding continuous support to inefficient technologies/projects. Signatories should consider the economic life of the plant, as well as the period over which free allocations of EU ETS allowances are phased out.

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