Contracts for Difference for electrification of Dutch industry

For the Ministry of Climate Policy and Green Growth (KGG)

Final Report

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Glossary and abbreviations

Term	Definition
Applicant/participant	Commercial entity that applies for (applicant) or is awarded (participant) CfD support.
Capture price	The **weighted average realised electricity price** (e.g. on energy markets or over the counter) within the reference period by the participant by shifting operations based on market signals within the reference period. The capture price may deviate from the reference price.
CfD	Contract for Difference. A long-term financial contract designed to stabilize prices for energy producers or consumers by bridging the gap between a fixed strike price and the fluctuating market price.
Compensation	A payment made to the industrial consumer when the reference price exceeds the strike price. It ensures price stability and reduces exposure to volatile electricity markets.
Dynamic efficiency	Indicates how a policy measure would improve long-term market integration, such as long-term investment certainty.
ESG	Environment, Social and Governance
GOOs	Guarantees Of Origin
Industrial consumer	A company or facility in the industrial sector that consumes large amounts of electricity and is eligible to participate in CfDs to support electrification and decarbonisation.
Issuer	The entity (typically a government or public agency) that offers the CfD and manages the financial flows between the strike and reference prices. The issuer bears the financial risk of price volatility and ensures the mechanism's integrity.

Term	Definition
Pay-back	A payment made by the industrial consumer to the issuer when the reference price is below the strike price (in two-sided or corridor CfDs). This ensures symmetrical risk-sharing.
PPA	Power Purchase Agreement between a renewable energy project developer or operator and a corporate consumer. The PPA defines the commercial and legal terms for the sale and purchase of electricity generated by a specific renewable energy project.
RECs	Renewable Energy Credits
Reference price	**The market-based electricity price used to compare against the strike price**. Typically derived from the day-ahead wholesale market (e.g., EPEX Spot). The difference between this and the strike price determines the level of compensation or pay-back.
Renewable Developer	An entity that develops and operates renewable energy generation assets (e.g., wind, solar). In four-sided CfDs, they are linked to industrial consumers through coordinated strike prices.
RES	Renewable Energy Sources which includes electricity from wind, solar, hydropower, geothermal sources, biomass, biogas.
Static efficiency	Indicates how a policy measure would improve short-term market integration, such as dispatching behaviour for efficient energy system operation.
Strike price	**A fixed electricity price agreed upon in a CfD**. If the reference price exceeds this level, the industrial consumer is compensated. If the reference price falls below it, the consumer pays back the difference.

Table of content

To support competitive power prices and unlock the electrification potential of Dutch industry, this study analyses potential CfD options and provides recommendations

Background: Price risks and uncertainty as a structural hurdle

Electrification of Dutch industry can contribute to climate goals…

- Netherlands aims to be climate neutral by 2050 and achieve 55 % emission reduction from 1990 levels by 2030
- Emission reduction in industry is driven by EU ETS and the national CO_2 tax (which may be abolished, according to current discussions in the parliament), and supported by, among others, SDE++ and DEI+
- The Electrification Roadmap shows the enormous potential for industrial electrification and identifies priorities

… but the necessary investments are hindered

- Uncertain development of electricity prices with significant upside risk, such as grid congestion, queues, and rising grid tariffs, results in low willingness to invest
- SDE++ provides limited protection against the variability and uncertainty of electricity costs for decarbonizing industrial processes

Scope: Suitable CfD design in line with EU regulation as solution

Contracts for Difference may offer a solution

- The European Commission says member states should introduce two-way CfDs to promote the production of carbon-free electricity
- Demand-side CfDs can reduce uncertainties and risks among industrial parties and increase investment readiness
- In order to implement most suitable CfD design overcoming the current limitations of industry electrification and in line with EU legislation, the Department of Sustainable Industry at KGG has asked E-Bridge and Guidehouse to explore options for a CfD model focused on the electricity demand-side

KGG calls for analysis of options for potential policy implementation

- The study assesses the international context of CfDs, analyses different CfD alternatives and evaluates boundary conditions and design criteria. Moreover, PPAs are assessed and compared to CfDs
- Feasible and realistic CfD instrument design options are analysed and implications for parameter variations are examined. Advantages and disadvantages of the different design options and configuration of design parameters are evaluated. Based on this, we derived recommendations for next steps
- It was not in scope to quantify effects

The study was structured to five work packages to investigate the potential and effectiveness of CfDs for the electrification in Dutch industry

1 Quick scan of CfDs and regulatory assessment

EU Clean Industry deal Action Plan for Affordable Energy	Quick scan in selected countries regarding existing CfD options
Boundaries and options / Regulatory framework	Assessment of existing CfD options

2 CfD analysis and comparison with PPA

- Comparative analysis: CfD vs. PPA (added value of instruments and combination possibilities)
- Assessment and evaluation of different CfD design options: one-sided, two-sided, corridor CfD and four-sided CfD, incl. possibilities for coordination with RES production

3 Analysis of CfD instrument design

- Defining objectives and boundary conditions for a CfD instrument design (contractual model and tender design)
- Impact assessment of design options on achieving objectives within preconditions through literature review and expert workshop
- Assessment if preferred options are in line with EU state aide guidelines

4 Discussion and market consultation

- Governance of CfD and role of government
- Settlement basis, congestion impact, consumer energy prices, and SDE++ co-existence
- Market consultation summary

5 Results and recommendations

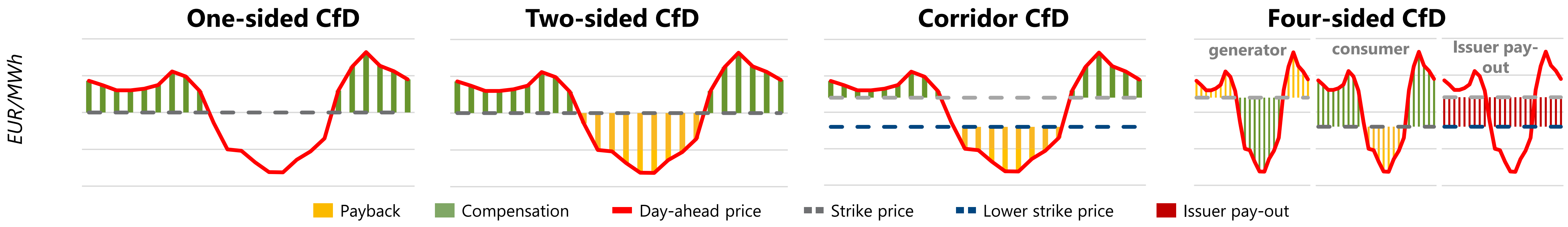
- Clear objective of the instrument
- Assessment of regulatory framework (state aid, CISAF, EU framework)
- Description of CfD instrument design options (for NL)
- In-depth overview of implications of design parameters on achieving desired impact
- Recommendation of preferred CfD instrument design options and for next steps
- Assessment of potential coordination level of industry demand CfDs with RES production CfD

CfDs for industry can contribute to electrification via reduction of electricity price risk and price uncertainties and indirectly support RES investments of the Netherlands

The following objectives for CfDs for industry should be considered, to support the Netherlands on its way to a cost-efficient decarbonisation without deinstruialisation.

Policy objectives of CfD instruments		***Contributions of CfD for industry***
Accelerate electrification of Dutch industry 1. This way the Netherlands support cost reductions and technology maturation of electrification technologies	→	Reducing price risks and uncertainty - After being awarded (price risk exposure, compensation level, procedural efficiency) but also of not being awarded in application process. This covers also avoidance of uncertainty through non-discriminatory application terms and a level-playing field (eligibility)
Support further investments in renewable electricity generation	→	Through improved coordination with demand and positive price effects of additional demand
Avoid undue market distortions and support network integration	→	Maintaining energy market incentives for industry and ensuring compatibility for congestion management instruments (as much as possible)
Limiting financial risks for issuer (state budget)	→	Avoiding one-sided risk exposure, avoid double subsidization of industry and provide coordination with RES-CfDs

Overview: The evaluated CfD variants for industry follow different approaches



The one-sided CfD (only) offers compensation when the reference price exceeds the strike price, but no payback when prices fall below. Participants benefit from prices below the strike price, but uncertainty (about this upside potential) remains.

While administratively simple, it exposes the issuer to high financial risk because uncertainty about exposure to high market prices remains.

Anyhow, it is likely not in line with EU state aid guidelines.

The *two-sided CfD* provides symmetrical compensation and payback for the difference between the reference price and strike price, offering strong investment certainty since uncertainty in application process is limited. Yet, operational upside potential is limited.

It is administratively only slightly more complex than the one-sided CfD but limits issuers financial risks.

The *corridor CfD* introduces a cap-and-floor mechanism to balance risk and market responsiveness. In the corridor no paybacks to the issuer are necessary for industry customer (additional upside potential) and energy market incentives may be maintained best.
Yet, uncertainty about this upside potential lead to uncertainty in applications process since bidding strategy of CfD applicants may vary; worst case this could lead to disappearance of advantages since bids lower upper strike price.
Depending on the design, the lower strike price may also provide (limited and indirect) coordination with RES technologies.

The *four-sided CfD* links industrial consumers and renewable generators through direct coordination between demand- and supply-side policy instruments. It offers the highest potential for aligning RES supply and demand, supporting primarily medium- to long-term investment certainty and short-term access to green power for industry. It can be tailored to also optimise short-term dispatch behaviour via temporal correlation requirements. However, it is administratively complex and requires careful design and implementation.

*industrial participant / CfD buyer from consumer side

The initial assessment of CfD design variants shows that none fully meet all objectives – however, the four-sided CfD appears most attractive for industry

- While the assessment depends heavily on the specific CfD design choices (reference period, award mechanism, and more), only the four-sided CfD enables direct coordination with RES CfDs – potentially helping industry meet shareholder expectations for a fully decarbonized energy supply
- We strongly recommend to validate this initial assessment by quantifying effects. Please note that criteria are not equally important and importance may vary depending on perspective of stakeholder

Stakeholder Perspective / Objective of CfD	**Criterium**	**CfD option: one-sided**	**two-sided**	**corridor**	**four-sided**
Issuer "avoid risks for state budget, be in line with EU legislation and support network integration (if possible)"	Avoiding one-sided risk exposure (only to state)	★☆☆☆	★★★☆	★★★★	★★★☆
	Proportionality (avoid cross, over, under subsidisation)	★☆☆☆	★★★★	★★☆☆	★★★★
	Maintain energy market incentives	★☆☆☆	★★☆☆	★★★☆	★★☆☆
	Compatibility to congestion management instruments	★☆☆☆	★★☆☆	★★☆☆	★★☆☆
	In line with EU guidelines for state aid	~	✓	✓	✓
Industry "Accelerate electrification of industry – and decarbonize this way"	Competitiveness (likelihood of being awarded with CfD)	★☆☆☆	★★★☆	★★☆☆	★★★☆
	Eligibility (non-discriminatory terms, level playing field)	★★★☆	★★★☆	★★★☆	★★★☆
	Investment security provided after being awarded	★★★★	★★☆☆	★★★☆	★★☆☆
RES investors "Support RES investments"	Additional ("more efficient") demand	★★★★	★★★☆	★★★☆	★★★☆
	Coordination with RES-CfDs	★☆☆☆	★☆☆☆	★★☆☆	★★★★

Favourable ★★★★
★★★☆
★★☆☆
★☆☆☆
Unfavourable ☆☆☆☆

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*industrial participant / CfD buyer from consumer side

Several critical design parameters influence the CfD's effectiveness, proportionality, and market readiness

- ***Reference Period***: The choice of reference period for determining the reference price for the subsidy allocation is critical. An hourly or daily reference price limit exposure to wholesale market signals and discourage flexible operation. The study recommends using adequate reference periods, weekly or monthly, to incentivise industrial consumers to respond to price signals, thereby enhancing market integration and operational efficiency. This approach balances investor certainty with system efficiency because annual reference periods are deemed too risky for industry application (low market price visibility).
- ***Award Criteria***: Competitive bidding based on strike price or subsidy intensity is preferred over a first-come-first-served model. Strike price-based awards are simpler and align with the CfD's objective of price stability, while subsidy intensity ensures fair competition and emissions reduction. A hybrid approach may balance both goals.
- ***Contract Duration***: A 15-year duration aligns with asset lifetimes, provides investment certainty, and provides consistency with the SDE++ scheme. This has implications for via which legislative route the instrument can be implemented on a European level.
- ***Budget* Allocation**: Budgets can be administered as a single fund or divided into technology or sector-specific buckets. Volume limitations, minimum and maximum reference prices, and strike price floors help manage financial exposure but may affect operational behaviour.
- ***Indexation***: Indexation mechanisms can mitigate inflation risks between CfD award and final investment decision (FID), and during operations. Inverse indexation (reducing strike price for rising costs) and positive indexation (adjusting strike price during operations) enhance investor confidence and reduce non-realisation risk.

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Coordination with RES investments is an important aspect for CfD instrument design

- A central conclusion of the report is the importance of aligning demand-side CfDs (targeting industrial consumers) with supply-side CfDs (targeting renewable electricity producers). This coordination ensures consistency in subsidy allocation, stimulates a parallel growth of renewable electricity supply and demand, and enhances the effectiveness of the mechanism.
- It would provide investment security for industrial consumers as well as renewable generators, while the issuer benefits from a natural hedge between the respective strike prices and increased levels of coordination can enhance this hedge.
- Four coordination models are explored: Policy coordination (separate CfDs for supply and demand), Four-sided PPA CfD for consortia, Four-sided PPA CfD for individual projects, and Four-sided CfD: Portfolio aggregation (pooling of multiple projects).
- The lightest version of coordination is policy coordination, where demand and supply side CfDs coexist. The governing authority can then adapt the mechanisms regularly (e.g., annually) and allocate budgets and set award criteria based on system balancing needs.
- Portfolio aggregation offers the most robust alignment but is the most complex to implement. Regardless of the model, coordination is essential to ensure that electrification demand is matched with renewable supply, both in the short- and long-term.

CfDs for industry are regulatory compliant and a key instrument – governance model can follow SDE++

Regulatory Alignment and EU Support

- The proposed CfD designs align with the EU's Clean Industrial Deal (CID) and Action Plan for Affordable Energy (APAE), which promote investment in clean technologies and price stability. The Clean Industrial Deal State Aid Framework (CISAF) provides guidelines for state aid, including investment and operating aid for renewable energy and electrification.
- ***CfDs are recognised as a key instrument under these frameworks, particularly when designed to avoid overcompensation and ensure proportionality***.
- However, CISAF is intended to provide short-term relief, offering a route for swift implementation, yet short duration. Implementation via Climate, Energy and Environmental Aid Guidelines (CEEAG) offers more robustness in the instrument design.
- Transparency, stakeholder engagement, and alignment with EU frameworks (e.g., CEEAG, CISAF) are essential for legitimacy and effectiveness.

Governance and Implementation

- There is strong consensus that the Ministry of Climate Policy and Green Growth (KGG) should lead the governance of the CfD mechanism. Implementation and execution should be delegated to the Netherlands Enterprise Agency (RVO), with the Netherlands Environmental Assessment Agency (PBL) providing market research and reference calculations. The existing SDE++ ecosystem offers a solid foundation for CfD deployment.

CfDs are a strategic tool for electrification. They offer a powerful mechanism to de-risk industrial electrification and provide long-term price certainty

Unlike PPAs, which are market-based contracts between renewable generators and corporate buyers, CfDs are state-supported and directly hedge electricity costs for industrial consumers. This makes them particularly suitable for energy-intensive sectors where investment decisions are highly sensitive to electricity price volatility.

Central recommendations at a glance

- Apply adequate reference periods (weekly or monthly) to balance investment certainty with market integration; either with a two- or with a four-sided CfD variant (seems favourable, also according to market consultation). We suggest further quantification of benefits and risks as well as in a quantitative study before final decision. This could also serve assessment of state budget requirement.
- Ensure policy coordination between demand-side and supply-side CfDs to align renewable supply with industrial demand and consider four-sided CfDs for enhanced integration of demand- and supply-side instruments.
- Use competitive bidding with clear award criteria (strike price or subsidy intensity) to ensure transparency and cost-effectiveness.
- Leverage the existing SDE++ governance structure for implementation, while ensuring alignment with EU regulatory frameworks.
- Adress further concerns of market parties (grid congestion, ability to secure a grid connection) with other instruments and ensure compatibility of CfD design. Without instruments addressing such critical investment barriers, CfDs for industry may not be sufficient to stimulate electrification; i.e. CfDs will be most effective when combining it with such instruments.

Table of content

Table of content

The country assessment is structured in six categories to capture the relevant features and criteria for CfD instruments

Main features and criteria for evaluating international CfD instruments:

- Instrument type and settlement mechanism
- Eligible technologies
- Strike price / guarantee price
- Reference market price (electricity market price which is used for CfD settlement)
- Contract duration of scheme
- Annual expenditure / cost dependent on market price
- Completed CfDs in number of contracts / Contracted energy production megawatt-hours (MWh) per year
- Funding: Publicly or privately issued CfDs
- Maximum spending over maturity CfDs

Description
- …

Mechanism
- …

Technologies
- …

Funding
- …

Key Parameters

Strike or reference price
(Reference) Market price
Duration
Funding volume
Number of contracts/ subsidized capacity
Issuance private/public

Summary of the latest tender results
- …

All countries are supporting renewable energy generation – only Germany and France have started to support (industry) consumers with respective CfD schemes

	Germany	UK	France	France	Belgium	Spain
Type or support generation/ consumption	Climate protection agreement – **industry**	CfD scheme for Renewable generation	CfD scheme for Renewable generation	CfD scheme for **dedicated consumption**	CfD scheme for Offshore wind generation	CfD scheme for Renewable generation
Guarantee price (strike price)	Technology-dependent	Technology-specific, via sealed-bid allocation	Technology-specific, via bid allocation	Determined in tender offer ('pay as bid')	Tender-based, EUR 95/MWh cap	Technology-specific, via sealed-bid allocation
Reference price	Effective CO_2 price (EU ETS-linked, varies by sector/opulation)	BMRP (forward-based) IMRP (hourly spot)	Day-ahead hourly market price	Special calculation – see link for details	Day-ahead hourly market price or PPA + EUR 3/MWh	Day-ahead hourly market price
Min/max maturity	15 years	15 years	12-20 years	15 years	20 years or 80.000 FLH	12 years
Maximum spending over maturity[1]	2,8 bln. EUR (first round)	Budget set per allocation round	30.5 bln EUR for Solar, Onshore Wind, Hydro	4 bln EUR (for the first 1 GW)	682 mil. EUR - not full CfD volume	-
Cashflow	Depending on the market prices (two-sided)	Depending on the market prices (two-sided)	Depending on the market price (two-sided)	Depending on the market price (two-sided)	Depending on the market prices (two-sided)	Depending on the market prices (two-sided)
Contracted energy volume, # contracts	15 contracts	ca. 43 GW	4 GW RES (solar, wind, hydro)	200 MW across up to 12 projects	3.15-3.5 GW planned	6.4 GW
Issuance private/ public	German government - public	Low Carbon Company - state owned	French government - public	French government - public	Belgian government - public	Spain government - public

[1]corresponds to the maximum announced funding volume

Comparison of CO_2 abatement scheme (CCfD Germany) with electrification support scheme for industry (CfD): a CfD for industrial electrification is simpler to design and easier to implement

Aspect	**CO_2 Abatement CfDs** (e.g. German CCfDs)	**Electrification CfDs for Industry**
Primary Objective	Maximize **CO_2 avoided** per EUR spent	Promote (clean) **electrification** of industrial processes
Incentive Basis	EUR/t CO_2 abated compared to fossil benchmark	EUR/MWh consumed via low-carbon electricity (or avoided CO_2)
Targeted Technologies	All CO_2 reducing technologies (green H_2, green gases, biomethane, CCS, electrification, etc.)	Electrification-specific (e.g. electric furnaces, electric heaters and -boilers)
Sector Focus	Hard-to-abate industry (tech-neutral) e.g. steel, cement, chemical	Electrifiable processes in industry
Monitoring Metric	Verified CO_2 reduction	Electricity consumption
Contract Complexity	High – tailored per project	Medium – more standardizable if focused on electricity use
Policy Logic	Decarbonize by outcomes	Decarbonize by electrification consumption

- **CO_2 abatement** rewards direct emission reductions, is **technology neutral** and **encourage more effective technologies** but is **complex to implement** and may disincentives electrification against cheaper technologies.
- **Electrification** is **simpler to design** and to verify, **promotes sector coupling with renewable generation** and is **easier implementable** for small-to medium enterprises (SME). However, it may not be most CO_2 effective, **limits technology** and **may need additional investments in grid infrastructure**.

Existing industrial demand-side support schemes are primarily aimed at reducing CO_2 emissions and promoting renewable hydrogen production

Take-aways quick scan European countries

- CfD schemes have mainly been implemented on the production side for renewable generation technologies in Europe.
- Only Germany and France have introduced support schemes for the demand-side of electricity.
- Germany is supporting industry electrification through Carbon Contracts for Difference however electrification technologies also compete with other low carbon technologies (e.g. green gas).
- France has introduced a dedicated support scheme for electrolysers based on a guaranteed strike price mechanism in 2024.
- There are no dedicated CfD schemes for the electrification of industry established in the investigated countries.
- CfD schemes on the production-side have been effective in driving down the cost of capital (UK).
- The UK production-side CfD is designed with the day-ahead hourly market price as reference period. This has been criticised as it limits generators' market exposure, meaning renewable assets are not exposed to price signals and lack incentives to operate flexible.
- There is a consensus that more flexible asset operation and market supporting behaviour can be achieved through longer reference periods of the strike price, i.e. weeks or months.
- Cost indexation: Most CfD schemes in other countries (except Spain) include an annual adjustment of the strike price based on inflation (CPI).

Table of content

Clean Industrial Deal (CID)* and Action Plan for Affordable Energy (APAE) aim to strengthen industry competition and lower energy cost

The **Clean Industrial Deal (CID)**, **including** the **Action Plan for Accelerating Energy (APAE)** addresses high energy costs, global competition, and investment decline in EU industries. By framing decarbonisation as an economic opportunity, these frameworks provide planning certainty, reduce bureaucracy, and support energy-intensive sectors and clean technologies. The CID builds on **six core pillars**, each with specific timelines and measures – **two of which are particularly relevant:**

Global Network

- Free Trade Agreements + Clean Trade and Investment Partnerships
- Reducing **CBAM** complexity and expanding sectoral coverage
- Protecting EU industry through stronger investment (FDI) screening, trade defence, and fair competition rules

Boosting Clean Markets

- Procurement criteria: sustainability, resilience and EU value creation
- Reform of the EU public procurement framework
- (voluntary) **green label** for products; steel already by 2025
- delegated act on low carbon hydrogen and Hydrogen Bank's third funding call (€1 bln.)

Establishing a Circular Economy

- Prioritising the implementation of the Critical Raw Materials Act
- Circular Economy Act (2026)
- EU Critical Raw Material Centre to jointly purchase raw materials
- Trans-Regional Circularity Hubs to scale up **recycling** and pool **regional material streams**

Development of expertise and high-quality jobs

- **Union of Skills:** EU strategy to align education with industrial needs
- **Social leasing** for EVs, heat pumps, and other clean products
- Erasmus+ will strengthen education & training programs (€90 mil.)

Affordable Energy and Lowering Energy Costs (APAE)

- Lower electricity taxes and remove non-energy costs
- Decouple retail bills from volatile gas prices
  - Launch pilot program with EIB for Power Purchase Agreements (PPAs), €500 mil.
  - Promote cross-border PPAs and provide guidance on contracts for difference
  - Support European forward markets and increase hedging opportunities
- Gas market oversight to ensure (price-) stability
- Establish tripartite contract for affordable energy

Attracting investments and ensuring delivery

- Adopt a state aid framework to expedite renewable energy, decarbonisation, and clean tech approvals
- Strengthen the Innovation Fund, propose a €100 bln. Decarbonisation Bank, leveraging Innovation Fund and ETS revenues
- Amend InvestEU regulation to increase guarantees, mobilizing €50 bln. for clean technologies, among others

*announced by European Commission in February 2025

CID and APAE supporting the roll out and implementation of CfDs and PPAs

CID influence on CfDs and PPAs:

- Promotes CfDs as part of carbon pricing support: e.g. Carbon CfDs under the Innovation Fund help bridge the cost gap for low-carbon industrial production
- Enables project bankability for capital-intensive clean technologies
- CID fosters market-based demand for clean technologies pushing large industries to enter green PPAs for electricity or hydrogen

Policy instruments:

- Public tenders with CfD frameworks (e.g. for green steel, hydrogen, electrification)
- EU-level Innovation Fund co-financing
- Support for industrial buyers in matchmaking for PPAs

APAE influence on CfDs and PPAs:

- APAE aims to reduce energy costs and volatility:
  - Encourages hedging mechanisms such as PPAs
  - Promotes aggregated demand models for SMEs to enter PPAs
- APAE complements CfDs by addressing infrastructure bottlenecks:
  - Investment in grids, storage, and flexibility markets
  - Makes PPAs more viable

Policy instruments:

- State aid guidelines (Temporary Crisis Framework)
- Grid fee reform, accelerated permitting
- Potential EU-level PPA facilitation platform
- Guarantee fund for SME

➢ CID and APAE are both **supporting investments in renewable energy and further electrification** as well as **addressing affordability and competitiveness of clean energy**. The deployment and roll out of green electricity generation and consumption will be facilitated and incentivized.

CID and APAE are important supporting instruments for decarbonisation and electrification, facilitating CfD and PPA adoption

Aspect	CID Impact	APAE Impact	Net Effect
Bankability	CfDs improve project viability and business cases	Stable prices through APAE improve financing terms	Easier project development to decarbonize
PPA Uptake	Green electricity demand targets encourages buyers	Lower barriers for SMEs	PPA volume growth, renewable energy support
Market Stability	Industrial clean demand increases	APAE reduces energy price volatility	Enhanced investment certainty
Regulatory Framework	New CfD models incentivized	Simplified access to PPAs	Legal clarity and uptake

- **CID** is **facilitating** new support instruments like **CfDs** which targets industry decarbonisation and electrification.
- **APAE supports the PPA rollout**, investment security for renewable energy generation and lowers entry hurdles for clean energy for small and medium size businesses.

The Clean Industrial State Aid Framework (CISAF) provides a predictable set of rules to facilitate public funding for renewable energy and industrial decarbonisation

Description

- The CISAF[1] is the **cornerstone of the Clean Industrial Deal** (CID) and is a new set of EU State Aid rules to **enable Member States to financially support industrial decarbonisation and clean tech** development more freely and quickly.
- CISAF "recognises the state as a strategic investor in our future", laying out **conditions under which EU countries can grant state aid** (subsidies, grants, compensations) for certain **investments or costs.**
- CISAF simplifies rules in **five main areas**; (1) renewable energy and low-carbon fuel rollout, (2) temporary electricity price relief for energy-intensive users, (3) decarbonisation of production facilities, (4) development of clean tech manufacturing capacity and (5) de-risking clean investment & infrastructure.

Dec 2021: New EU State Aid Guidelines (CEEAG). Climate, Energy and Environmental Aid Guideline, endorsing tools like Contract for Differences to spur RES and decarbonisation investments.

Mar 2022 – Mar 2023: Temporary Crisis and Transition Framework (TCTF). Addressing surging energy cost and US Inflation Reduction Act by relaxing rules, allowing more aid for clean energy and industrial transition.

Feb 2024: Net-Zero Industry Act agreed. Political agreement on regulation to boot EU manufacturing of clean tech (at least 40 % deployment by 2023) and streamline permitting for net-zero projects.

Feb 2025: Clean Industrial Deal & Action Plan for Affordable Energy. Unveiling of CID, a comprehensive plan to support industrial decarbonisation and competitiveness – alongside the Affordable Energy Plan to lower energy prices for industries and consumers.

June 2025: New Clean Industrial State Aid Framework. Adoption of CISAF, replacing the TCTF. Framework, in place until 2030, simplifies approval of state aid for clean energy, industrial decarbonisation and electricity cost relief for industry.

Conditions and limits

- **Timeframe**: Implementation must happen by end of 2030, reflecting the urgency to act, and can only be granted for three years. After 2030, standard guidelines or a new framework may be adopted, setting a clear window of opportunity.
- **Targeting**: Electricity cost support is targeted to "energy-intensive users" in trade-exposed sectors, focusing on industries truly at risk from high energy costs and carbon leakage.
- **Decarbonisation commitments**: Aid is contingent on climate action. Firms getting electricity subsidies must commit to invest part of the support into emissions-reducing measures, echoing earlier schemes where beneficiaries had to invest at least 50 % of aid in decarbonising their processes.
- **Aid intensity and competition**: CISAF often requires aid to be minimised. Competitive bidding is encouraged (or mandated above certain thresholds) to allocate aid efficiently. Auctions or tenders can determine aid based on cost per ton CO_2 reduced, preventing wasteful over-subsidisation.

[1] European Commission, CISAF, July 2025. (Link)

The CISAF framework targets renewable energy sources and industrial decarbonisation

Renewable energies, fuels and storage technologies

Investment Aid (e.g. storage systems, RES plants):
- Competitive bidding → Aid up to 100 % of eligible costs
- Administrative route → Aid capped at 45 %, with bonuses for SMEs (+10-20 p.p.)

Operating Aid (for electricity marketing):
- Instruments: Two-way Contracts for Difference (CfD) (mandatory if RES-based), or feed-in premiums
- Award method: Via auction or administrative procedure

Temporary Electricity Price Relief for Energy-Intensive Industries

Eglibility:	Only for sectors where electricity intensity × trade intensity ≥ 2 %, and both ≥ 5 %
Aid Level:	Max. 50 % discount on up to 50 % of electricity consumption, must not result in a yearly average wholesale market price below EUR 50/MWh
Condition:	At least 50 % of aid must go to green investments (e.g. RES, storage)
Bonus:	+10 % if >80 % is invested in demand-side flexibility
Duration:	Up to 3 years, no payments after 31 Dec 2030
Cumulation:	Allowed with other aid, subject to maximum thresholds

Industrial Decarbonisation & Energy Efficiency

Aid for investments in industrial sites to:
- Significantly **reduce GHG emissions**, or
- Substantially **improve energy efficiency**

Project requirements:
- Direct emission reduction, or
- ≥20 % energy savings per output unit (≥10 % if already low-carbon)
- Start-up within 60 months, and ≥80 % of projected savings must be achieved

Three possible support Mechanisms **(up to € 200m per project)**:

1. Aid intensity* *(direct subsidization of eligible investment costs)*

Renewable Hydrogen	60 % max. Aid Intensity
RES, storage, electrification, CO_2 capture	45 % max. Aid Intensity
Low-carbon fuels (e.g. blue H_2)	35 % max. Aid Intensity
Fuel production	20 % max. Aid Intensity
Other technologies	30 % max. Aid Intensity

2. Funding gap *(covers gap between project costs and profitability)*
- Above € 30m**:** claw-back mechanism required in case of windfall profits

3. Competitive bidding *(aid may be awarded via auction)*

*Maximum aid amount under an aid scheme can be determined on the basis of the eligible costs of an investment. The maximum aid intensity is an approximation of the extra environmental costs of using the respective technological decarbonization solutions (Source 154).

CISAF provides a swift pathway for implementation of a CfD instrument

Step 1: Define clear policy objective	Explicitly frame CfD as decarbonisation support mechanism, enabling sector x and y to electrify production processes, reducing z tonne CO_2 emissions by year X.
Step 2: Target eligible sectors	Target energy-intensive, trade-exposed industries that are known to qualify. This ensures the CfD addresses carbon leakage risk and competitiveness issues.
Step 3: Link to decarbonisation commitments	Participants should commit to specific decarbonisation action on the short- and long-term. The CfD must use clean electricity to maximise climate impact.
Step 4: Determine CfD instrument design details	Setting the term to balance long-term certainty with the 2030 framework timeline, but also setting the reference period, budget allocation and award criteria.
Step 5: Use competitive allocation	To satisfy the "minimal aid" criteria, an auction or tender should be held based on subsidy-intensity or strike price, ensuring cost-effectiveness and transparency.
Step 6: Integrate with energy suppliers	A tripartite structure (government, industry and electricity supplier, as proposed by the AEAP) could be used to facilitate supply and demand of renewable electricity.
Step 7: Notification and legal basis	Notify the Commission, including economic analysis of funding gap, showing consistency and complementarity with relevant EU legislation (e.g. EU ETS).

!

The CISAF framework offers a swift pathway to implementation of an electricity cost relief instrument, but with a limited contract duration. CEEAG offers a more robust, though rigorous implementation route.

CISAF offers direct and flexible aid to industry users through a combination of dedicated CAPEX and OPEX support for decarbonization, energy efficiency and electrification measures

Criterion	CEEAG (2022)	CISAF (2025)
Primary Focus	Climate, environment, energy sectors – including industry electrification	Broader: industry, clean tech, energy, critical raw materials – directly tied to EU industrial competitiveness
Relevance for CfDs	Primarily for RES generation support (Section 4.1)	Includes RES CfDs and allows electricity price OPEX support for energy-intensive users
Support for Electrification (Demand-Side)	Limited to CAPEX-based aid (Section 4.11) – only investment aid for switching to electricity	Allows direct operational support for electricity price (not just CAPEX) – incl. to offset market electricity costs
Eligibility for OPEX Support (Electricity Price)	Not directly allowed – electricity price support for end-users is not covered	Allowed for energy-intensive users under specific conditions (see below)
Conditions for Power Price Aid	Not applicable – CEEAG does not cover electricity price components as OPEX aid	Up to 50 % of wholesale electricity price, up to 50 % of electricity consumption, minimum effective price € 50/MWh; max. 3 years
Form of Aid for OPEX	Only permitted in indirect form (e.g., via RES CfD lowering market price)	Direct power price support (operating aid) allowed for energy and trade intensive sectors
Aid for Combined CfD + Electrification Projects	Can combine RES CfD (Section 4.1) with industrial electrification CAPEX aid (Section 4.11), but not OPEX	Can combine CfD for RES supply + power price OPEX support + CAPEX electrification aid, with cumulative safeguards
Risk of Overcompensation	Must avoid double funding – requires cost gap analysis, claw-back, environmental standards	Similar, but power price support capped and linked to minimum contribution & decarbonization investments

➢ CISAF offers a more flexible and wide-ranging framework for supporting industrial electrification. CAPEX and OPEX support for electrification can be combined under CISAF. It enables OPEX aid directly linked to electricity costs for industrial decarbonization (max. 3 years).

EU regulation is supporting industrial carbonization and electrification through CID and and APAE – CISAF provides dedicated state aid rules for industrial decarbonisation

Take-aways from regulatory analysis

- CID and APAE are both supporting investments in renewable energy and further electrification as well as addressing affordability and competitiveness of clean energy.
- EU Clean Industrial State Aid Framework (CISAF) – officially allows industrial electricity price support (up to 50 % of annual electricity consumption, not below 50 €/MWh, max. duration 3 years not beyond 2030).
- CISAF focuses on industrial decarbonization and electrification through flexible and a wider range of OPEX and CAPEX aid possibilities. It comprehends CfDs for renewable energy production but doesn't address CfDs for demand-side electrification explicitly.
- Germany announced to introduce a power price relief for "energy- and trade-intensive" companies within the CISAF regulation:
  - Power price reduction to 50 €/MWh) for up to 2.200 energy intensive companies
  - Coverage of 50 % of annual electricity demand, duration of the power price relief 3 years; estimated state budget requirement up to € 4 bln.
- France's CfD model for electrolysers was approved by the European Commission under the Temporary Crisis and Transition Framework (TCTF), adopted on 9 March 2023. Approved budget up to € 900 mil.

Table of content

Table of content

CfD analysis: Introduction

What is a Contract for Difference?

A Contract for Difference (CfD) is a long-term financial contract designed to stabilize prices for energy producers or consumers by bridging the gap between a fixed strike price and the fluctuating market price. In essence, a CfD guarantees a fixed price for each unit of electricity. For a demand-side CfD the contract provider (often a government entity) pays the difference to the consumer if the reference price (typically a wholesale market index) is higher than the strike price. Conversely, if the market falls below the strike price, the beneficiary of the contract pays back the difference to the provider.

This two-way payment mechanism ensures that the recipient of the CfD effectively receives a stable price for electricity, guarded from market volatility. By shielding industrial electrification projects from fluctuating electricity prices, CfDs provide the price stability and predictability needed to make long-term investments viable.

Alternative instruments include corporate power purchase agreements (PPAs) which also provide a long-term fixed price agreement between seller and buyer of electricity. However, PPAs are a market-based mechanism and serve a distinctly different purpose than CfDs.

How can CfDs be used to unlock industrial electrification?

Industrial electrification is the process of switching industrial processes from fossil fuels (like natural gas or coal) to electricity. Heavy industries such as steel, chemicals, cement, and manufacturing often face high up-front costs and market risks when attempting to electrify their operations. One of the key barriers is uncertainty of future electricity prices: if power prices spike or remain unpredictably high, an electrified process could become uneconomical compared to sticking with fossil fuels. This is where CfDs can play a transformative role. By offering a long-term fixed electricity price to an industrial operator, a CfD dramatically reduces the financial risk associated with electrification

The Netherlands has seen a rapid growth of renewable electricity generation over the past decade; however, demand for green electricity has not followed a similar path. A CfD mechanism can lead to demand growth by making it economically feasible for companies to invest in electrified equipment and processes. It effectively de-risks the operating costs of using clean electricity.

In this section, we provide a comparative assessment between CfDs and PPAs and introduce four potential CfD mechanisms for industrial electrification.

Table of content

Introduction and description of common PPA contract structures

- A **Power Purchase Agreement (PPA)** is **a long-term bilateral contract** between an **electricity producer**, typically a renewable energy project developer or operator, and a **buyer (offtaker)** such as a utility, corporate entity or energy trader. The agreement defines the **commercial terms for the sale and purchase of electricity** generated by a specific renewable energy project.

- Where a **CfD contract structure guarantees a maximum energy price** through the strike price mechanism **PPA contract structures typically only provide a share of the energy** demand (30-70 %*) of the consumer through a **fixed price mechanism**. The remaining demand (30-70%) is exposed to wholesale market prices and risk.

Physical PPA

- **Real electricity** is **delivered** to the buyer through the grid
- Requires both parties to be in the same physical price and market area
- Electricity is physically nominated to the buyer
- Buyer receives power and **pays agreed price**
- Used by utilities or large industrials with grid access

Financial/Virtual PPA

- Buyer pays or receives the **difference** between **market** price and **fixed PPA price**
- Acts as a **financial hedge**
- Allows flexibility in location
- Popular with corporates to meet ESG or climate goals
- Often cross-border and involves country risk*

*Share depends on renewable technology and consumer demand profile

**Physical delivery is addressed by seller and buyer individually in their respective price zone

Common contract structures of physical PPAs are "Pay as produced" and "Baseload (fixed profile)" PPAs

- The contract structure of the PPA defines how the power is delivered, priced, and settled.
- **Pay as produced PPA** structures are most used by corporates as they establish a direct connection with renewable generation and offer **competitive pricing and high sustainability** effect with direct offtake of the production profile. However, it involves a higher market risk profile for the buyer.
- **Baseload or fixed profile PPAs** are designed to deliver a constant volume of electricity over a defined period (e.g., 10 MWh every hour, 24/7). It mimics base load power supply and eliminates the profile and volume risk from renewable generation. However, it involves a **higher contract price which is benchmarked against wholesale prices**. It also comes with a lower degree of sustainability as there is no direct connection with a dedicated renewable installation established.

Key differentiating factors between "Pay as produced" and "Baseload" PPA

	Pay-as-Produced PPA	Baseload (fixed profile) PPA
Volume delivered	Variable (actual production of renewable plant)	Fixed delivery profile (e.g., 24/7 delivery)
Volume and profile risk	With buyer; involves mismatch of RES production profile and consumption profile of buyer	With seller; seller structures fixed profile from various renewable sources
Capacity sizing	Complex due to mismatch between supply and consumption	Rather easy, contracted PPA profile should match desired consumption profile
Market risk	High market risk for buyer from under- and oversupply, less predictable	Low market risk for buyer, predictable volume and sourcing cost
Price and cost	Low PPA price but less predictable sourcing cost due to market exposure	High PPA price close to wholesale market price, predictable sourcing cost due to low market risk
Demand coverage	Typically, 30 -70 % of corporate demand dependent on renewable profile and consumption profile	Typically, 40-80 % of corporate demand, high profile certainty and better match with consumption profile
Complexity	Buyer need to manage various additional risks	Buyer only need to manage own consumption risk versus agreed PPA profile

Corporate PPAs: Key Benefits, Risks and Design Considerations

Key benefits and risks of corporate renewable PPAs (pay as produced*)

Benefits	Risks
▪ **Price Stability:** Fixed or predictable energy costs over contract term ▪ **Bankability:** Secures financing for renewable projects ▪ **Sustainability:** Enables green energy claims (e.g. via GoO) ▪ **Long-Term Supply Security:** Locks in energy availability for buyer ▪ **Brand & ESG Impact:** Supports decarbonisation and climate goals	▪ **Volume Risk:** Less energy generated than expected ▪ **Profile Risk:** Timing of generation don't fit timing of high prices ▪ **Balancing Risk:** Cost of forecast errors and grid imbalance ▪ **Negative Price Risk:** Paying fixed price even when market is negative ▪ **Over-/ Under-Supply Risk:** Mismatch between generation and contracted volumes

*Pay as produced PPA structures are most used by corporates as they establish a direct connection with renewable generation and offer competitive pricing and high sustainability effect with direct offtake of the production profile

Important design aspects

Oversizing & Over-/Undersupply Risk:

- In pay-as-produced PPAs, oversizing the plant can lead to surplus energy not accepted by the buyer. Undersupply may require expensive market purchases. Proper sizing and forecasting are critical.

Negative Price Risk Management:

- Buyers may pay a fixed price even during negative market prices. Common mitigation tools include price floors, curtailment clauses, or dynamic pricing mechanisms.

Contract Duration:

- Typical terms range from 5-15 years. Longer contracts support financing and price stability but increase exposure to long-term market and regulatory changes.

Credit risk:

- The risk that one contractual party, typically the buyer or seller, fails to meet financial obligations under the PPA. This includes delayed payments, payment defaults, or insolvency. Mitigation measures include creditworthiness checks, parent company guarantees, bank guarantees, or the use of collateral.

Comparative analysis of PPA versus CfD – both instruments differ in purpose

- While a state supported **CfD** scheme is a **policy tool to accelerate industrial electrification** by reducing exposure to high electricity prices corporate **PPAs** are a **market-based tool** that **enable** corporates to procure **renewable electricity** for direct decarbonisation and ESG compliance.
- Both **CfD** and corporate **PPA** structures serve to **hedge power price risk**, but they **operate** very **differently** and come with a **different risk profile** for the buyer/ consumer.

	CfD for industrial demand (stated supported)	Corporate PPA (renewable energy)
Purpose	Protect industrial users from wholesale power price volatility and market risk by fixing a maximum level of electricity cost "strike price" (price cap)	Provide long-term clean electricity supply and hedge against power price volatility using renewable sources
Counterparties	Typically, between **state entity** and **industrial consumer**	Between **corporate industrial buyer** and **renewable energy generator**
Delivery of Power	Industrial user purchases electricity from the market or supplier; CfD provides **financial compensation** if market prices exceed strike price	Power to be physically delivered to the industrial site or settled financially (PPA)
Settlement Basis	Reference market price (e.g., day-ahead price)	Physical delivery of renewable power at fixed PPA price; remaining demand at market price
Payments	**State pays industrial user** if reference price > strike price; user pays back difference if reference < strike price	**Corporate buyer pays generator** fixed price for PPA volume; remaining volume needs to be bought at the market price
Renewable Certificates /GOs	Not included; CfD is about energy cost support, **not renewable attribution**	Included; buyer typically receives RECs or GoOs to **claim renewable electricity use**
Government Role	Active counterparty providing **price hedge** and supporting industrial electrification	None; **purely market-based** contract

Both CfD and PPA have advantages and disadvantages on its own

Criteria	1. State-Supported two-sided CfD (for Industry)	2. Corporate PPA
Price Stability	**High** – Industrial consumer gets fixed strike price regardless of market fluctuation	**Moderate** – PPA hedges price but exposes buyer to profile and balancing risks; at cross border PPA also to basis risk of different price zones.
Market Risk Exposure	**Low** for industrial user; government assumes risk	**Moderate to High** – Corporate buyer exposed to market price dynamics on "unmatched" volumes
Energy Cost Advantage (vs. spot market)	**High** – Government absorbs volatility and provides hedged price	**Variable** – Depends on PPA price and short-term power market price development
Effectiveness for Electrification	**High** – Encourages fuel-switching by lowering and stabilizing electricity costs	**Moderate** – Clean energy linked to corporate decarbonisation, but may not ensure cost competitiveness vs. fossil fuels
Efficiency (economic, system-wide)	**Medium** – May lead to overcompensation or underutilization; not always market-reflective	**High** – Market-based contracting aligns supply and demand, if well-structured
Investment incentive (for consumer and generation)	**High** for industrial user - electricity cost are capped; **Low** for Generator - no guaranteed revenue stream	**Moderate to Low** for industrial user – exposure to market price; **High** for generator, PPAs underwrite new renewable capacity
Public Support Required	**High** – Government bears price delta; fiscal burden in volatile markets	**None** – Fully private arrangement

- **CfD** offer **high energy cost advantage** and **investment security** for industrial consumers. At the same time **CfD** create **potentially high funding needs** and **power market exposure for the state. PPAs** are an **effective market-based instrument** which **secure investments** in **renewable energy** supply. However, as **PPA prices** are **benchmarked against wholesale prices** they typically do not offer sufficient additional incentives for electrification of demand. While PPA provide price predictability for the contracted PPA volume (typically 30-70% of the consumer demand) over a longer period they come with additional profile and market risk from the offtake of the renewable generation profile.

While both CfD and PPA have disadvantages on its own a combined instrument would offer the most benefits – this is further elaborated in Chapter 3.3 (four sided CfD) and in Chapter 3.4

Criteria	1. State-Supported CfD (for Industry)	2. Corporate PPA	3. Combination CfD+ PPA
Price Stability	**High** – Industrial consumer gets fixed strike price regardless of market fluctuation	**Moderate** – Depends on PPA structure; vPPA hedges price but exposes buyer to basis and profile risks	**High** – Both generator and industrial buyer face a fixed and predictable price path
Market Risk Exposure	**Low** for industrial user; government assumes risk	**Moderate to High** – Corporate buyer exposed to market price dynamics	**Low** – Market risks split between generator, offtaker, and state via layered contracts
Energy Cost Advantage (vs. spot market)	**High** – Government absorbs volatility and provides hedged price	**Variable** – Depends on PPA price and short-term power market price development	**High** – Efficient coordination reduces cost for both generator and buyer over time
Effectiveness for Electrification	**High** – Encourages fuel-switching by lowering and stabilizing electricity costs	**Moderate** – Clean energy linked to corporate decarbonisation, but may not ensure cost competitiveness vs. fossil fuels	**Strong** – Cost-reflective power + renewable source improves business case for electrification
Efficiency (economic, system-wide)	**Medium** – May lead to overcompensation or underutilization; not always market-reflective	**High** – Market-based contracting aligns supply and demand, if well-structured	**High** – Efficient capital allocation + system optimization (public and private roles aligned)
Investment incentive (for consumer and generation)	**High** for industrial user – electricity cost are capped; **Low** for Generator - no guaranteed revenue stream	**High** for generator, PPAs underwrite new renewable capacity; **Moderate to Low** for industrial user – exposure to market price	**High** – Generator receives fixed revenue, improving bankability, **High** for user as energy cost are capped by strike price.
Public Support Required	**High** – Government bears price delta; fiscal burden in volatile markets	**None** – Fully private arrangement	**Moderate** – Requires state role in price stabilization but less than pure CfD model

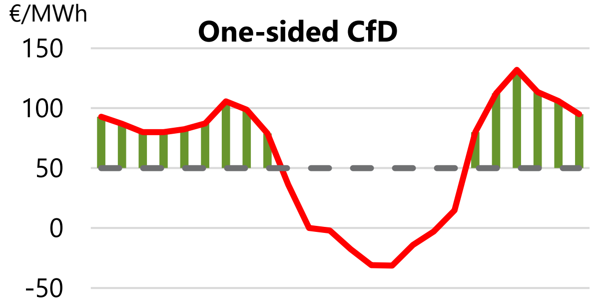
➢ A merged structure of **CfD and PPA** hat combines **the advantages of an energy price cap with the supply of renewable power** at a fixed price **would offer the most benefits** for all parties involved. It would **provide investment security for industrial consumers** as well as **renewable generators** at the same time **limits the market price exposure of the state** as subsidy provider. It would also address the risk of declining PPA demand from corporates if CfDs would be introduced stand alone without linkage. Further details are elaborated in Chapter 3.3 (four sided CfD), Chapter 3.4 (Demand- and supply side coordination) and Chapter 4.3 (PPA carve-out).

Table of content

This study considers four CfD mechanisms for industrial electrification

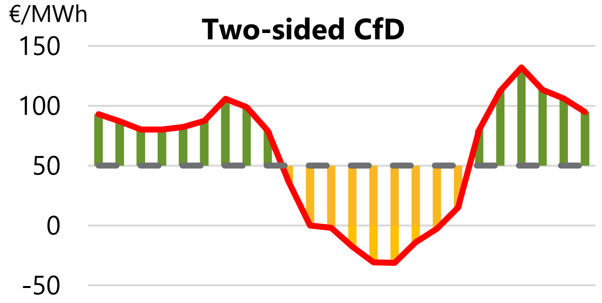
1. One-sided CfD

Industrial consumer receives compensation when the electricity price reference exceeds the strike price but has no repayment obligation when the electricity reference price is lower than the strike price.



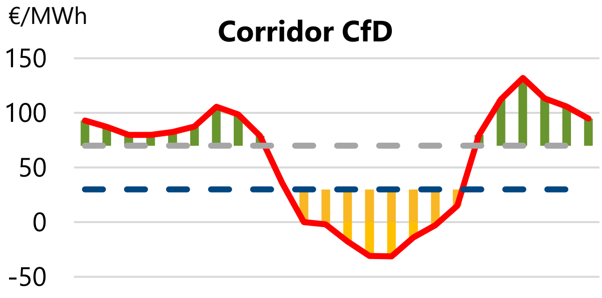
2. Two-sided CfD

Industrial consumer receives compensation when the electricity reference price is above the strike price. When the price is below the strike price, the operator pays back the difference.



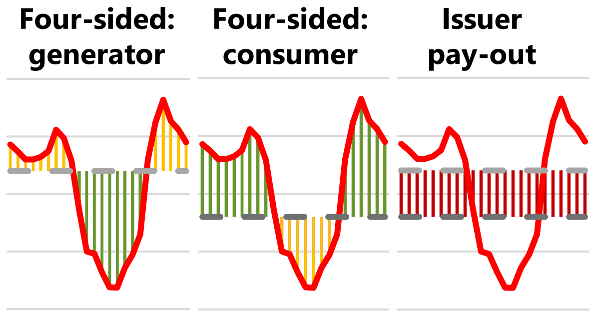
3. Corridor CfD

Two-sided CfD with a cap-and-floor mechanism. When the price is above the cap (upper strike price), the industrial consumer receives compensation; when the price is below the floor (lower strike) price, the operator pays the difference.



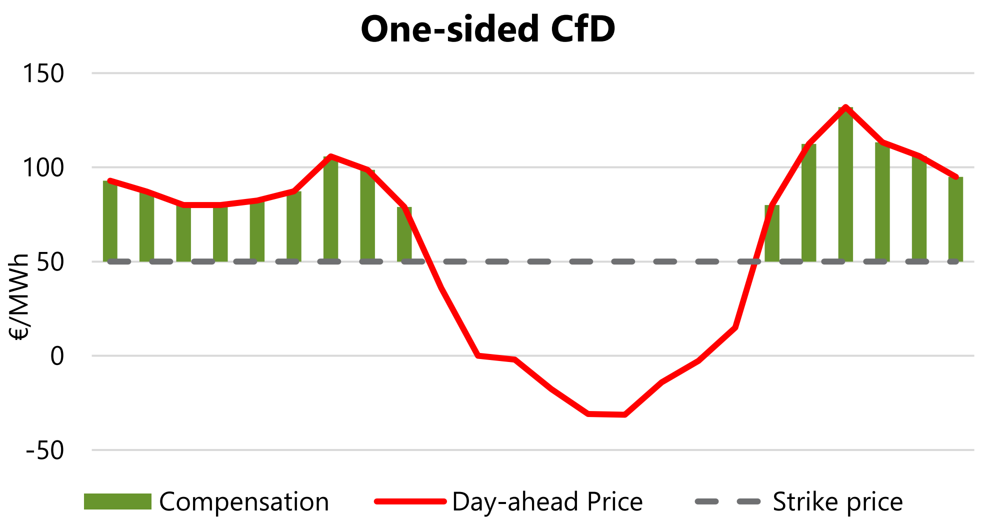
4. Four-sided CfD

Establishes an (in)direct link between an industrial consumer and a renewable developer. The issuer settles the difference between the supply- and demand-side strike prices. The mechanism essentially consists of two "two-sided" CfDs.



Payback | Compensation | Day-ahead price | Strike price | Lower strike price | Issuer pay-out

Option 1: **One-sided Contract for Difference**



Description

- An industrial company is compensated when the reference price of electricity exceeds the strike price. There is no obligation to repay if the reference price falls below the strike price.
- Straightforward structure with a single strike price and minimal administrative burden compared to other mechanisms.
- The EU guidelines recommend two-sided CfDs for renewable energy generation, leaving uncertainty regarding their implications for demand-side support mechanisms.

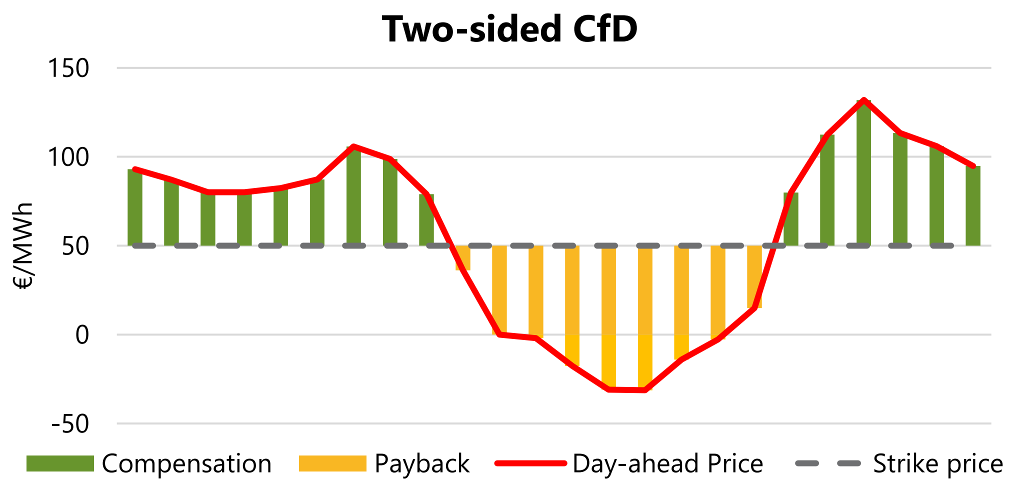
Evaluation

- **Risk allocation**: Creates a risk and cost exposure for the *issuer* of the CfD if market prices rise. While the industrial company can benefit from low electricity prices, it adds to uncertainty as the bidder must include uncertain upsides into its bid calculation. An applicant sets their strike price based on expected gains taking a position on how frequent and how long market prices fall below the strike price, and the gap between those price points. Assuming frequent, prolonged price dips leads to a higher strike price bid, which, in turn risks exposure if prices rise.
- **Investment conditions:** Simplicity could encourage early-stage investments, though gains below strike price are inherently uncertain.
- **Market operation and distortion**: Limited incentive to adjust operational behaviour based on wholesale market price signals below the strike price. Introducing a longer reference periods can improve market integration.
- **Balancing supply and demand**: No direct coordination between demand and supply. However, a one-sided CfD is likely to accelerate demand growth, indirectly benefitting investors in renewable generation.

Conclusion

- The uncertainty stemming from the one-sided nature and merchant exposure below the strike price makes this CfD unfavourable for industrial companies, not outweighing the low administrative burden and opportunity to benefit from low electricity prices.
- The one-sided CfD will not be analysed in further detail since uncertainty about EU compliance remains as guidance on demand-side CfDs is yet to be developed.

Option 2: **Two-sided Contract for Difference**



Description

- An industrial company receives compensation when the electricity reference price is above the strike price. When the reference price is below the strike price, the industrial company pays back the difference to the issuer of the CfD.
- Straightforward mechanism with a single strike price. Slightly more complex than the one-sided CfD due to the payback mechanism, but easier to implement than the four-sided CfD.

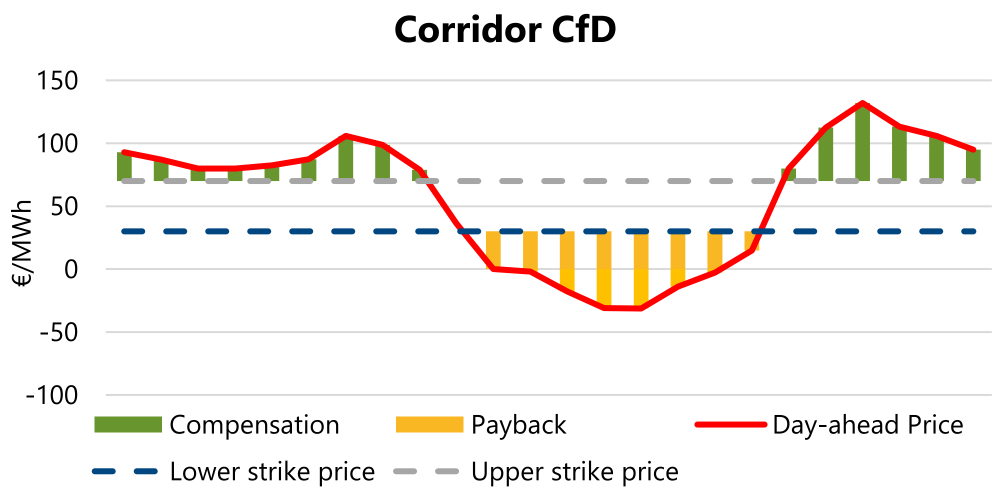
Evaluation

- **Risk allocation:** Provides symmetrical protection – participants receive compensation when prices exceed the strike price and repay when prices fall below the strike price. This provides high protection against merchant risk, though this risk is borne by the issuer.
- **Investment conditions:** Creates certainty for participants by offering long-term predictability for investors.
- **Market operation and distortion:** Industrial company has very limited incentive to respond to wholesale market signals, potentially resulting in market distortion. This can be mitigated by introducing a longer reference period.
- **Balancing (renewable) supply and demand:** No direct coordination between demand and supply. However, a two-sided CfD is likely to accelerate demand growth, indirectly benefitting investors in renewable generation.

Conclusion

- The two-sided CfD is an attractive option for industrial companies as it provides strong protection against market volatility.
- Increased risk of market distortion compared to the one-sided CfD due to further shielding from market signals, though introducing a longer reference period is well suited to mitigate this effect.
- Mechanism is in line with EU guidance on *supply-side* CfDs, potentially a lower hurdle to introduce than the one-sided CfD.

Option 3: **Contract for Difference with Corridor**



Description

- Two-sided CfD that features a cap-and-floor mechanism. If the reference price exceeds the upper strike price, the industrial company is compensated; if the reference price falls below the lower strike price, the industrial company must pay back the difference.
- This approach is more intricate than one-sided or two-sided CfDs because it involves managing two strike prices.
- Establishing criteria for the strike prices (e.g., maintaining a minimum difference between the lower and upper strike prices or setting a minimum lower strike price based on cost of RES) allows for design optimization but also makes the mechanism more complex.

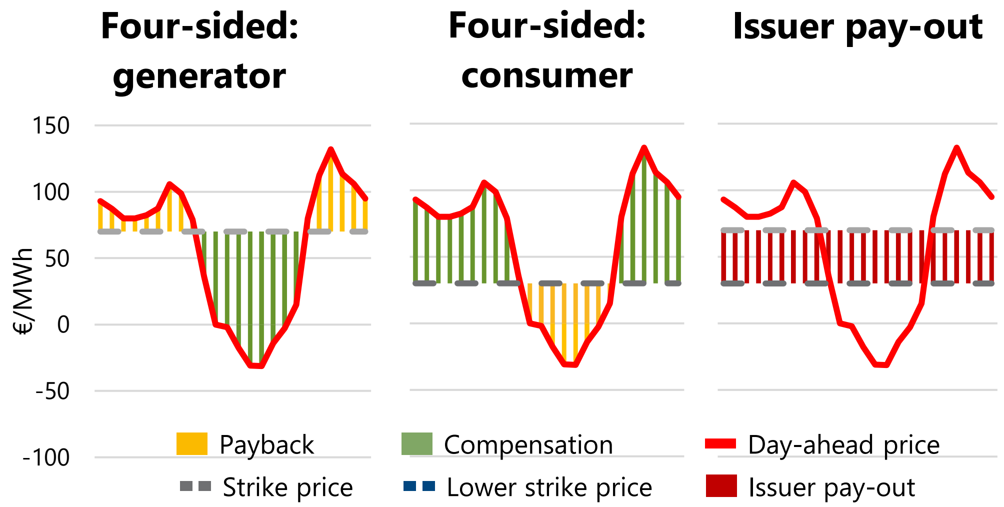
Evaluation

- **Risk allocation:** Risks are comparable to the two-sided CfD, however the CfD with corridor has a slightly higher price risk due merchant exposure within the corridor. Price risk for the issuer is, in turn, reduced due to the width of the corridor.
- **Investment conditions:** Investment conditions are similar to the one-sided CfD, as financial institutions will assume the least favourable of the two strike prices (upper strike price), not leveraging risk reduction optimally.
- **Market operation and distortion:** The bandwidth encourages market integration within the corridor. However, from a market integration perspective, it is preferable that participants respond to signals outside of the bandwidth. This may, in turn, be achieved with a longer reference period but dissipates the necessity of a bandwidth.
- **Balancing (renewable) supply and demand:** Encourages efficient behaviour within the corridor but there is no direct coordination between supply and demand. A lower strike price that is based on the cost of RES can provide electricity price stimulus for renewable generation investments.

Conclusion

- The corridor CfD balances investor risk mitigation with efficient market operation (within the corridor) but does not create more favourable investment conditions than a one-sided CfD.
- An upper and lower strike price adds to the complexity of the mechanism and introduces uncertainty in the allocation procedure. Design parameters, such as minimum strike price or “width” of the corridor are critical for the effectiveness of the mechanism and for establishing a balanced risk profile.

Option 4: **Four-sided Contract for Difference**



Description

- A four-sided CfD (sometimes referred to as *double-sided* or *double-two-sided*) has two strike prices, one for electricity demand and one for RES supply. It creates link between generators and consumers.
- Provides certainty for investors on the long-term for generators and consumers. Generators are compensated at low prices and need to cover the difference with high prices, while for the industrial consumer, this is the other way around.
- Complex mechanism, in which coordination is required and in which the issuer settles the difference between the supply- and demand-side strike prices.

Evaluation

- **Risk allocation:** The issuer is exposed to the difference between two strike prices; It introduces higher profile and volume risks due to interdependencies. A portfolio approach (see section 3.4) may provide some relief of these risks.
- **Investment conditions:** Can offer price stability for both producers and consumers, reducing financing costs, specifically if pooling (aggregation) is implemented (see section 3.4).
- **Market operation and distortion:** Impacts wholesale and potentially bilateral (PPA) electricity market as both generation and demand volumes are supported by the mechanism. A combined mechanism is feasible, where demand- and supply projects enter in a PPA where the issuer settles the difference in price level.
- **Balancing (renewable) supply and demand:** Best suited for aligning renewable supply with industrial demand, but with the highest complexity. It primarily supports dynamic efficiency.

Conclusion

- The four-sided CfD is the most suitable mechanism to align and scale up the supply for renewable energy and the demand for industrial electrification, primarily supporting long-term investment certainty for generators and consumers.
- The challenge for the four-sided CfD lies in the complexity to coordinate generators and industry, and the role for the issuer. The design of the mechanism, for instance the (in)direct coupling of actors and the possible pooling of generators, will be vital to minimise market distortion. Adding temporal correlation requirements to enhance static efficiency further complicates the instrument.

Table of content

Demand- and supply side CfD coordination can be achieved via careful policy design and four-sided CfDs

Comparison of four-sided CfD with two-sided CfD

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- **Coordination:** A four-sided CfD may achieve better coordination between supply and demand growth.
- **Price hedging:** There exists an inherent hedge for the issuer in the supply- and demand-side strike price, resulting in a pay-out equal to only the difference in strike prices when both sides are in balance in terms of volume and profile.

(−)

- **Governance complexity:** While various levels of coordination are possible (next slide), the role of the issuer is complex and, depending on the details, the issuer takes up counterparty- price- and volume risks, with large budget implications. Potentially at odds with electricity market liberalisation.
- **Reduced transparency and predictability:** The more parameters a CfD includes, the harder it becomes for market participants to participate in the bidding, possibly deterring investments.
- **Risk allocated with issuer:** profile and volume risks in large part borne by the issuer. Issuer's financial risk is decoupled from actual market prices and depends only on the strike price difference.

Key take-away:

Enhanced coordination can help to better match supply and demand-side instruments. However, with increasing level of coordination, more complexity would be added, while also reducing transparency and predictability.

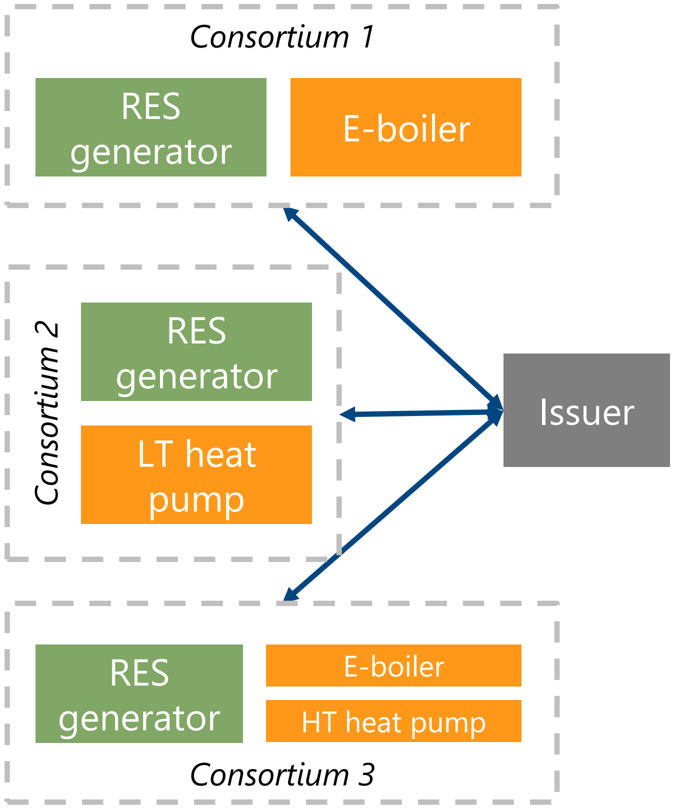
Light involvement → Strong involvement

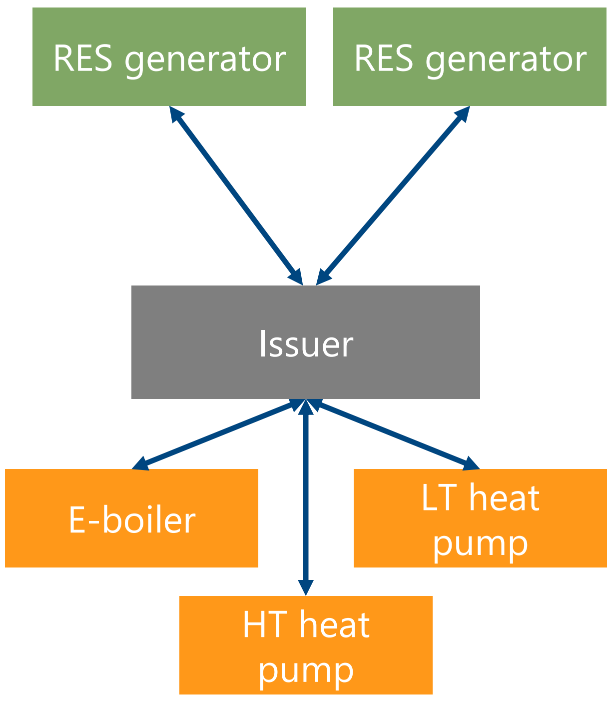
Type of coordination	Description
Policy coordination with two-sided CfDs	▪ Two separate, two-sided CfD schemes, one for renewable generation and one for industrial electrification. ▪ Issuer coordinates budget allocation and award criteria between supply and demand-side instruments and sets supporting policies.
Four-sided PPA CfD (consortium)	▪ Consortia of renewable generation and industrial electrification compete for lowest funding gap in the consortium PPA ▪ Alignment responsibility and risks partly remains with the consortium, while price difference is settled by issuer.
Four-sided PPA CfD (bilateral[1])	▪ Issuer facilitates match of individual renewable generation and industrial electrification projects. ▪ Essentially a PPA between generator and industrial consumer, where both compete for a fixed price with the issuer, who will settle the difference.
Four-sided Portfolio aggregation	▪ Facilitates match between pool of renewable generation and industrial generation electrification projects. ▪ The larger the respective pools, the lower the profile and volume risks.

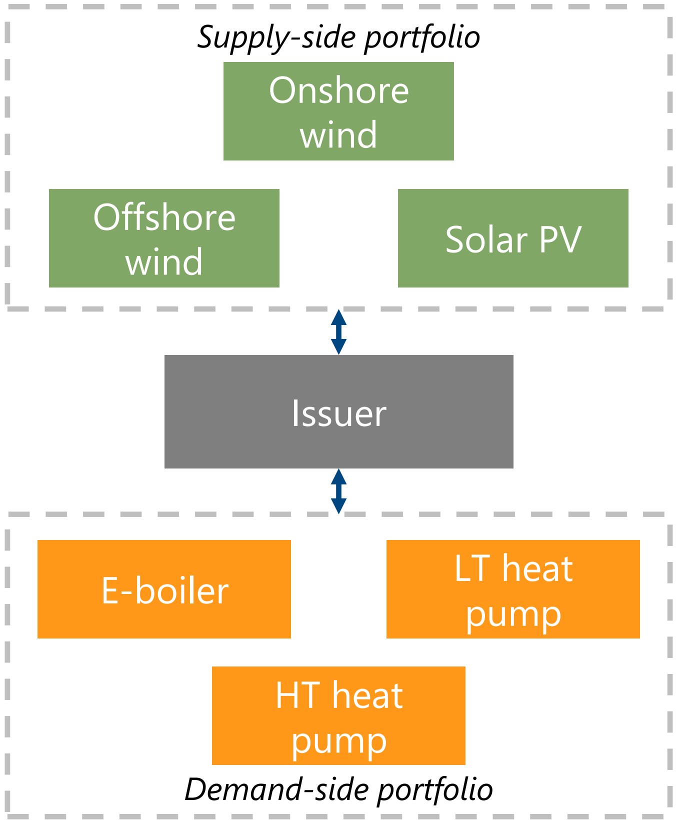
[1]AEAP suggests innovative aid instruments in the form of *tripartite* arrangements between governments, producers, and off-takers

Four-sided CfD: different variants to coordinate supply and demand matching

Four-sided PPA CfD (consortium)	Four-sided PPA CfD (bilateral)	Four-sided Portfolio aggregation
Applicants establish a consortium of generation and demand projects and negotiate PPA-like price levels. Consortia compete for the four-sided CfD based on smallest funding gap between these prices.	Generation and demand projects compete based on strike PPA price levels with other generation and demand projects, respectively. Issuer matches projects and settles price difference.	The issuer acts as aggregator (or broker) of supply and demand-side portfolios, ensuring a continuous balance between the two. Issuer is liable for the price difference between the portfolios.







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Coordinating industrial demand and renewables supply in relation to CfDs

Large-scale **supply of renewables** and **industrial electricity demand must be balanced** on to ensure both static (short-term dispatching) and dynamic (long-term investment planning) efficiency of the energy system

	Advantages	Disadvantages
Policy coordination	▪ Opportunity to tailor both mechanisms individually to achieve specific policy objectives. ▪ Potentially lower administrative burden for participants in both mechanisms.	▪ No guaranteed match short-term balancing (static efficiency) and long-term match between supply and demand (dynamic efficiency).
Four-sided PPA CfD (consortium)	▪ Responsibility of consortium formation, price setting, and coordination lies with market parties. Competition on price gap pushes applicants to efficient and innovative bids. ▪ Combining supply- and demand-side has lower price (budget) risk than project-based approach.	▪ Risk of low auction turnout as consortium formation, stakeholder management, and price setting within a consortium with diverging interests is highly complex. ▪ Strong counterparty risk, as the success of the consortium depends on the "weakest link" member. May impact financing conditions.
Four-sided PPA CfD (individual)	▪ Avoids the highly complex consortium formation and stakeholder management of the consortium PPA CfD. ▪ Potentially lower price (budget) risk for issuer than for policy coordination due to smaller, project-based scope.	▪ High counterparty risk, which is in large part borne by the issuer. Separating supply- and demand-side has higher price (budget) risk than consortium-based approach. ▪ Scale difference between supply and generation projects likely requires matching "shares" of generation project with the demand of an electrification project.
Portfolio aggregation	▪ More active coordination possible by the issuer to ensure static and dynamic efficiency. ▪ Pooling generation and demand provides more robustness and "liquidity" in mechanism, reducing profile and volume risk.	▪ Large and highly complex role for the issuer as they must participate in a market-like mechanism – raising concerns about market liberalisation and market distortion. ▪ Complexity of mechanism will require long implementation timeline.

Table of content

CfD analysis: Conclusion and recommendations

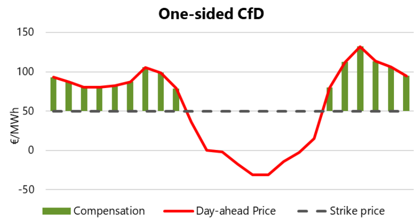
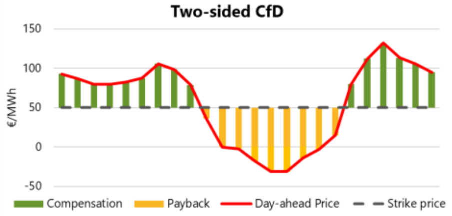
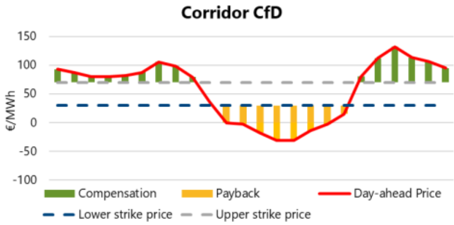
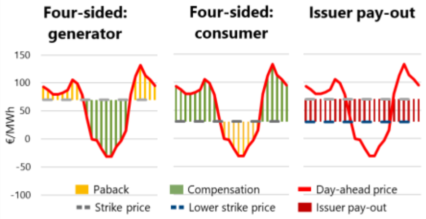
	Conclusions	Recommendations
	While administratively simple and potentially attractive for early-stage projects, the one-sided CfD exposes the issuer to significant price risk and offers limited investment certainty for industrial users.	Not preferred due to merchant exposure and lack of EU compliance clarity. Should only be considered for niche applications or transitional support.
	**Preferred option 1, combined with policy coordination** Provides strong investment certainty and aligns with EU guidelines. May distort market signals unless carefully designed.	A viable and implementable option. Recommended with well-considered design adjustments such as adequate reference periods to mitigate market distortion.
	Can improve market efficiency and may aid RES coordination, depending on the design of the two strike prices. Market response outside the bandwidth is crucial and can be managed with a proper reference period. Financiers focus mainly on the worst-case (upper) strike price for funding decisions.	The corridor is an elegant option for market integration between the two strike prices. However, the same level of market integration can be achieved in a two-sided CfD without the complexity of administering two strike prices.
	**Preferred option 2** Most comprehensive, direct link of industrial demand with renewable supply, possible with various levels of coordination. Supports both short-term dispatch and long-term investment certainty.	The level of coordination must be carefully considered to balance growth of renewable generation and electricity demand, minimise market distortion, and be implementable at the short- to medium term.

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Table of content

Table of content

CfD instrument design: introduction

This section presents the conceptual framework for designing a Contracts for Difference (CfD) instrument to support the electrification of Dutch industry. Building on the analysis of CfD mechanisms in earlier chapters, this section shifts focus from the “what” to the “how”, exploring how a CfD instrument can be effectively structured to meet policy objectives while operating within regulatory and market constraints.

The tender design process is guided by four key elements:

- **Objectives**: These define the purpose of the CfD instrument; namely, to accelerate industrial electrification, reduce exposure to electricity price volatility, and unlock investment in renewable energy.
- **Boundary conditions**: These are the legal, regulatory, and market constraints within which the CfD must operate. They include compliance with EU state aid rules, market readiness aspects, and ability to contribute to national climate targets.
- **Design Parameters**: These are the adjustable features of the CfD instrument, such as contract duration, reference period, award criteria, and budget allocation that allow the instrument to be fine-tuned for effectiveness, proportionality, and market readiness.

The design parameters are prioritised by their ability to contribute or impact the meeting of the objectives within the boundary conditions. Critical design parameters include the reference period, budget allocation, and award criteria. These criteria are evaluated in detail, based on extensive internal deliberations with E-Bridge and Guidehouse policy design experts. The remaining design parameters are then presented at a higher conceptual level.

The section concludes with an overview of main take-aways and recommendations. We present a fundamental CfD auction model and two alternative models with increased levels of coordination between demand and supply.

This section outlines the objectives and boundary conditions of the CfD instrument and examines the influence of design parameters on these aspects

Table of content

We evaluated the impact of design parameters on meeting the boundary conditions and the objectives of the CfD instrument

Policy objectives of the CfD instrument:

- Accelerate electrification (and thereby decarbonisation) of Dutch industry
- Support further investments in renewable electricity generation
- Enable cost reduction and technology maturation of electrification measures*

By providing long-term certainty of energy costs, low enough to facilitate investments

Boundary conditions

Boundary condition	Criterium	Description
Regulatory	Effectiveness	Ability of the CfD instrument to address the policy objectives with manageable risk for the government
	Proportionality	Compensation appropriate for investment & avoidance of over and cross subsidisation
	Market distortion[1]	Impact to the functioning of existing liquid electricity markets
Market readiness	Eligibility	Non-discriminatory in terms of technology or application, level playing field for applicants
	Competitiveness	Likelihood of being awarded subsidy as an applicant
	Attractiveness	Impacted by the level of potential compensation, the risk profile, and procedural efficiency
Decarbonisation	Direct (process efficiency)	Reducing (overall energy demand and) emissions of the industrial process
	Indirect (unlocking RES)	Effect on unlocking investments in new renewable electricity generation

[1]A criterium for "market distortion" is also compatibility with congestion management instruments and products

*Cost reductions can be achieved particularly by avoiding market distortions, supporting network integration, and limiting financial risks.

Boundary conditions: regulatory and market

The **regulatory and market** boundary condition assesses whether the mechanism adheres to European and national legislation and guidelines. Key frameworks include the *EU State Aid Framework* and the Dutch *Aanwijzingen voor Subsidieverstrekking*. The regulatory conditions focus on effectiveness and proportionality while ensuring the mechanism minimizes any unnecessary market impacts.

Effectiveness pertains to the mechanism's capability to achieve the policy goals of the instrument with manageable risks for the issuer (government agency). The objectives have been articulated as: (1) accelerating industrial electrification and the decarbonisation of industry in the Netherlands, (2) facilitating cost reduction and technological advancement of electrification technologies and applications, and (3) stimulating investments in renewable electricity generation.

Proportionality involves multiple facets. The measure must deliver *adequate* support to encourage investments in industrial electrification while preventing *excessive* financial assistance (over-subsidisation). Furthermore, it should be structured to direct subsidies toward the intended investments rather than inadvertently benefitting other projects (cross-subsidisation).

Market distortion is ideally minimized, yet it is an inherent aspect of state aid. The design of the CfD mechanism significantly influences the extent of market distortion and the recipients' responses to market signals. This considers not only the day-ahead market but also futures and PPA markets, as well as compatibility with congestion management instruments and products.

Boundary conditions: market readiness

The **market readiness** of the CfD instrument evaluates its alignment with industrial needs to facilitate investments in electrification. Within this market readiness criterion, we identify three interconnected yet distinct aspects.

Eligibility pertains to how accessible the mechanism is for various electrification technologies. Ideally, it should cater to the intended electrification solutions without bias towards size, industry type, or geographical location. However, there may be justifiable reasons to prioritize certain sectors or focus electrification efforts in regions with high grid congestion. While this may compromise the eligibility criterion, it requires a careful consideration of the objectives and priorities of the mechanism.

Competitiveness refers to the mechanism's capacity to stimulate investments broadly and the likelihood of securing subsidies for specific technologies and applications. Essentially, it assesses whether an applicant stands a fair chance of obtaining the subsidy. The diversity of technologies and, crucially, applications necessitates a mechanism that evaluates bids on an equivalent basis and possesses a sufficient budget to create a significant impact.

Attractiveness assesses the balance between the costs and benefits of the scheme. It questions whether the effort involved in submitting an application is justified by the potential outcomes. This aspect encompasses the administrative burden of application submission, alongside the requirements and conditions necessary for participation, as well as the level of risk mitigation.

Boundary conditions: decarbonisation potential

The **decarbonisation potential** of the CfD instrument describes its ability to contribute to emission reduction in the Dutch energy system. This can be achieved directly within industrial processes, or indirectly by unlocking new investments in renewable generation.

Direct decarbonisation: The direct effect relates to the emissions reduction achieved by the electrified process compared to the existing alternative. Replacing fossil-fuel fired processes by electric alternatives avoids the emissions of the original process and potentially increases the overall process efficiency (requiring less energy for the same activity level). The ability of the CfD instrument to achieve this may be affected by the award mechanism, budget allocation, and other design parameters.

Indirect decarbonisation: Relates to the demand creation for (renewable) electricity. Investments in renewable electricity generation, most notably offshore wind, are currently hindered by an emerging imbalance between supply and demand for electricity. Measures to stimulate (industrial) electrification such as investment- and operational subsidies or demand-side credit support and guarantees for power purchase agreements have the potential to unlock new electricity demand and unlock new investments in renewable generation capacity, reducing the emission intensity of grid sourced electricity.

Table of content

The following design parameters have been considered in the CfD design

Design parameters	Description
Reference period	The period over which the price reference (hourly day-ahead market price) is averaged to determine the compensation and payback amounts for the same period.
Budget allocation	Methodology by which the total budget envelope is established and administered. For instance, is the budget administered in a single fund or with fences for specific technologies or applications.
Full-load hours	A limited subsidisable number of full load hours limits the budget envelope but may impact operational decision making and affect market dynamics.
Award criteria	Criteria by which the subsidy is granted to applicants, either by first-come first-serve basis or by competitive auction based on objectively measured criteria.
Minimum strike price	Using a minimum strike price to reduce the price risk for the subsidy provider (applicants can not bid below this strike price); a limit that is too low can lead to an unattractive instrument. Subcriteria to **budget allocation**.
Minimum/maximum subsidisable reference price	No compensation in case the reference price exceeds the maximum reference price and no payback obligation if the reference price is below the minimum subsidisable reference price. Subcriteria to **budget allocation.**
Contract duration	A subsidy is intended to provide support for a limited period; though longer duration provides more investment security for the recipient.
Indexation	A recurring strike price adjustment can reduce the effects of inflation in the period between subsidy award and FID/COD, as well as during the operational phase.
Stimulation of RES deployment and utilisation	Additional measures to ensure that the electrified process contributes to renewable electricity generation and utilisation.

Priority design parameters are selected based on their impact on boundary conditions

Priority design parameters

To ensure the effectiveness, proportionality, and market alignment of the CfD mechanism, it is essential to prioritise four key criteria for deeper assessment:

- **Reference period** is critical for determining the average market reference price, which influences subsidy levels and market exposure of participants. It has a substantial impact on market functioning and proportionality, particularly in volatile electricity markets.
- **Budget allocation** is foundational, directly influencing the ability to meet policy objectives such as accelerating electrification and unlocking renewable investments. It also significantly affects scheme attractiveness and proportionality, ensuring sufficient support without over-subsidisation.
- **Full load hours** determine the operational eligibility and efficiency of supported technologies. Misalignment here can lead to inefficient behaviour or exclusion of viable technologies. It also has a high impact on competitiveness and proportionality, especially when aligned with technology-specific characteristics.
- **Award criteria** are central to the fairness and effectiveness of the scheme. They shape the selection process and influence competitiveness, and the overall decarbonisation impact. A well-calibrated set of criteria ensures that the most impactful and cost-effective projects are prioritised.

Other design parameters

Remaining design parameters are interdependent with the priority parameters or have a limited effect on the ability of the instrument to meet the objective within the boundary conditions.

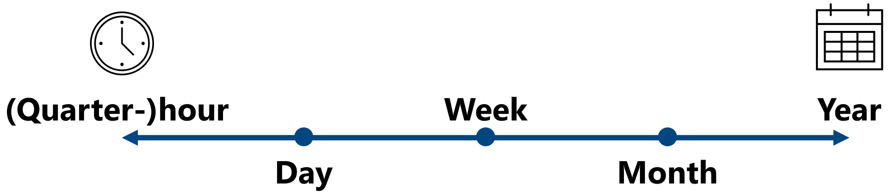
- **Minimum strike price** sets a floor below which participants cannot bid, ensuring financial viability of the instrument. It plays a critical role in maintaining proportionality by avoiding excessive settlement demands while still enabling competitive selection.
- **Minimum or maximum subsidisable reference price** sets financial boundaries by capping the reference price eligible for support. This limits excessive subsidy exposure and ensures proportionality in budget allocation. Strong interdependency with **budget allocation.**
- **Contract duration** defines the length of the support period, influencing investment certainty and risk. Longer durations may lead to overcompensation, while shorter ones could deter participation, making it a key boundary-setting parameter.
- **Indexation** adjusts the support level for inflation, maintaining real value over time. It affects proportionality and can influence technology neutrality depending on the chosen index.
- **RES stimulation** ensures that the mechanism supports renewable electricity generation, aligning with policy goals. It indirectly affects eligibility and attractiveness, especially where Guarantees of Origin or PPAs are involved.

Design parameter: **Reference period**

Definition and solution space

- The reference price is a variable determined for the CfD contract. The EPEX[1] average hourly spot price (day-ahead) is used as the reference price.
- Reference period is the period over which the reference price and settlement is averaged to determine the compensation amount.
- The choice of reference period impacts the operational incentives for flexible behaviour of operators and may help reduce market distortions.
- Operational optimisation within the reference period results in a weighted average *capture price*[2] which may be lower than the actual reference price for that period.

Options for the solution space are as follows, where the reference price is determined as the average price over the following reference periods:



EUR/MWh	2021	2022	2023	2024
Annual avg. price	103	242	96	77
Spread (monthly avg.)	49 - 238	155 - 447	72 - 135	58 - 114
Spread (weekly avg.)	45 - 312	43 - 577	18 - 165	41 - 165

Summary of insights:

- **Market exposure**: Longer reference periods expose participants to wholesale market signals, incentivizing flexible operations. However, too long a period (e.g., annual) may introduce unmanageable risks for industries as there is insufficient sight on the annual average.
- **Behavioural incentives:** The reference period can incentivise load shifting on various timescales. An annual reference period will incentivise month-to-month or seasonal operational optimisation whereas a monthly or weekly reference period allows for responding to shorter term market signals.
- **Annual planning:** The ability to “beat” the reference price is a key operational incentive to respond to short and long-term market signals. This ability is significantly lower in high-price periods (such as winter months), providing an incentive to plan downtimes in just those periods.
- **Operational reality**: Need to account for downtimes and recovery periods after load shifts; a shorter reference period might better reflect operational constraints. Delicate balance between technical feasibility and planning certainty, suggesting weekly, or monthly periods as viable options with potentially tailored sector- and/or technology-specific reference periods.

Key take-aways:

- We propose to exclude quarter-hourly, hourly, and daily reference periods from consideration, with a preference for weekly or monthly averaging. The choice of a reference period must match desired operational behaviour and operational reality of electrification projects.

[1] EPEX: European Power Exchange

[2] Capture price is a common term in renewable electricity generation and can be applied in this context for industry

Optimal reference period is a trade-off between cost stability and operational flexibility

Reference period	Advantages	Disadvantages
Weekly (7-day price averaging)	▪ **A reference price that adapts swiftly to** market swings, protecting participants from short-term price spikes caused by weather developments or other factors across weeks ▪ As a result, shorter timeframes provide **better electricity price visibility**, as the adjustment is closer to real prices. This would be easier to deal with for offtakers ▪ **Provides incentives for short-term demand-side flexibility** and operations planning based on price changes within a week's timeframe	▪ Still **exposes participants to day-ahead and sub-weekly price swings**. Means to respond to such swings via demand-side response and hedging via forward products may be limited depending on company size and industry ▪ Does **not incentivize demand shifts** or forward trading **beyond a week's time frame**, hence limits market integration on longer term markets
Monthly (28-31-day price averaging)	▪ **Longer reference periods give a larger incentive** for participants to adjust operations to obtain lowest capture price, **stimulating efficient and flexible operation** according to market signals. Moreover, consumers will still demand forward products at power markets up to month's timeframe ▪ Monthly reference price visibility aligns well with industries that have response and recovery times for operational adjustments and provides **incentives for short- to medium term demand-side flexibility**	▪ **Exposure** to daily and weekly price variability (for instance due to persistent weather fronts) **remains** ▪ **Means to respond** to such swings via demand-side response and hedging via forward products **may be limited** depending on company size and industry

Design parameter: **Budget allocation**

Definition and solution space

- A maximum available budget limits the financial risk of the issuer, while it may incentivise sub-optimal operational behaviour and gaming.
- Reserving budget for certain technologies or applications can increase competitiveness of the mechanism within the budget categories (similar technologies and applications competing in the category as opposed to competing with vastly different technologies or applications).

There are various constraints to determine the allocation of budget and limit the total budget envelope:

1. **Budget allocation categories:** Budget could be put in a single fund or split across various categories (e.g. per technology category or industrial (sub)sector) via fences.
2. **Budget volume limitation:** Introduction of a maximum volume (MWh) covered by the mechanism to bound the budget reservation. This can also be translated into a maximum number of full load hours.
3. **Minimum and maximum subsidy eligibility of reference price (€/MWh)**: No compensation/payback would happen above or below these predetermined boundaries, limiting the budget. An upper limit protects the issuer from extraordinarily high prices; participants will likely ask for a mirrored mechanism to benefit from extraordinarily low prices.
4. **Minimum strike price (€/MWh):** Bidders can not bid below this strike price, preventing the need for extreme pay-outs.

Summary of insights:

- **Fences (technology or application categories):** Only justified if there exists a fundamental competitive gap between technologies or applications. Can be introduced to increase competitiveness within those categories, though competitiveness between categories is reduced.
- **Market sizing and competition**: Introducing fences requires appropriate market sizing and is important to ensure competitive auctions. A range of 10-25 bidders per bucket would be desirable for competitiveness. A detailed market assessment or consultation is required to determine the necessity and practicality of introducing fences within the electrification category.
- **Budget limits**: Several means can be used to ensure effectiveness and proportionality of the mechanism and budget envelope. E.g., a total volume limitation, bounding reference price limits or a minimum strike price. This will define the budget envelope but potentially come with an adverse effect on operational decision-making if budget is bound by a narrow full load hour limit (see next slide).

Key take-aways:

- The introduction of technology or application fences can increase competitiveness of the CfD mechanism within those categories but has an adverse effect on the overall competitiveness across categories.
- Setting budget boundaries such as volume limit helps manage the budget reservation but may introduce operational inefficiencies.

Design parameter: **full load hours**

Definition and solution space

The SDE++ subsidy establishes categories for industrial electrification that are determined by the number of full-load hours (FLH), among others to determine the subsidy intensity. The applications of electrification technologies exhibit different operational behaviours influenced by the specifics of the production processes, their integration with other processes, and various market-related factors. To **limit the budgetary envelope**, a full-load hour cap may be introduced. To **enhance competitiveness** within technology or application categories, full-load hour categories can be implemented.

Solution space:

- Generic full-load hour cap or full-load hour categories
  - 2000 FLH: suitable category for hybrid electrification options that can switch between conventional and electric processes based on market signals.
  - 4000 – 6000 FLH: part time operation of the electrification asset that goes beyond market-based dispatch. Aligns well with renewable electricity generation profiles and could be suitable for temporal matching of supply and demand.
  - 8000 FLH: near-full time operation of the electrification asset, most applicable in continuous processes that have high level of integration with other processes.

Summary of insights:

- **Proportionality and interdependencies:** Introducing FLH limits results in a more predictable and manageable budget envelope. Introducing full-load hour categories is only applicable if the budget is fenced by technology or application (FLH being one of the aspects) or if the award mechanism is phased based on subsidy intensity (like SDE++).
- **Market readiness:** Industrial electrification options strongly vary in operational behaviour and decision making, the number of FLH being a resultant of various factors that may not be known long upfront. Applying for a FLH category within the CfD instrument requires operational certainty long before operation, negatively impacting the attractiveness.
- **Operational incentives:** Having a limited number of FLH subsidised may give way to inefficient market behaviour. Operational decisions may be based on the remaining full-load hour budget, as opposed to responding to market signals.

Key take-aways:

- Introduction of a full-load hour cap may be necessary to provide more upfront certainty of the required budget reservation from an issuer's perspective. The efficacy of introducing full-load hour categories depends on the award mechanism
- The limit must be carefully designed and scaled to avoid undue operational incentives

Design parameter: **Award criteria**

Definition and solution

- The award mechanism determines how applications are reviewed; the award criteria determine which applications receive the contract with the issuing authority.
- Award mechanism is either on first-come-first-served basis (potentially with fences, like SDE++, where FCFS is applied within subsidy intensity thresholds), or via a competitive auction based on objectively measurable metrics.
- The award criteria need to be clear and based on the objective of the auction.

The following options can be considered to award the CfD:

1. **First Come – First Served (FCFS):** Applications are evaluated per round in which they are received.
2. **Subsidy-intensity:** Applications are ranked and awarded based on the subsidy-intensity, expressed in cost per ton CO_2 abated
3. **Strike price:** applications are ranked and awarded based on the strike price, favouring projects with a higher strike price.
4. **Additional criteria:** Should be introduced with caution as they add complexity for issuer and participants. If introduced, they must be clearly defined, objective, measurable, comparable, and legally robust.

Summary of insights:

- **FCFS versus competitive auction:** FCFS gives all applications (within a category) the same chance of receiving subsidy, but award is rather arbitrary. A competitive auction drives applicants to submit high quality and efficient bids.
- **Simplicity and transparency**: Awarding based on the strike price may be favoured as the primary objective of the CfD mechanism is to provide a stable electricity price – it also has low administrative burden and is easy to calculate and determine risks for industrial companies.
- **Fairness and technology-neutrality**: One concern could be that relying solely on strike price could structurally advantage certain technologies and applications. Subsidy-intensity may better ensure fair competition and effective CO2 reduction. However, it requires the definition of (potentially many) reference installations.
- **Additional criteria:** If introduced, they must be clearly defined, objective, measurable, comparable, and legally robust.

Key take-aways:

- Award based on strike is best suited to achieve the core objective of the CfD mechanism.
- Subsidy-intensity is more complex but may ensure fair competition and effective emissions reduction.

Other design parameters

Stimulation of RES deployment and utilisation

Measures to directly stimulate the deployment and utilisation of renewable electricity sources, embedded in the CfD design. This can be achieved by market integration, policy coordination, or power purchase requirements.

Market integration is best achieved by establishing a longer reference period, where industrial consumers are incentivised to respond to market signals to "beat" the reference price.

Policy coordination is discussed in more detail in section 3.4.

Power purchase requirements are another options, for instance by including a guarantee of origin (GOO) purchasing and reporting obligation as an eligibility requirement. Alternatively, the CfD instrument can be designed to settle a PPA price difference between a seller (renewable generator) and buyer (industrial consumer). This option is further explored in section 3.4.

We conclude that electrification in combination with market integration incentivizes industrial consumers to operate as much as possible at times when the generation mix is dominated by zero-to-low marginal cost electricity sources (i.e. demand-side flexibility). This in turn is the most fundamental, effective and efficient long-term approach to stabilize market values for RES - a core requirement for the stimulation of RES deployment.

Contract duration

Establishes the duration over which the CfD is provided. It needs to strike a balance between providing sufficient long-term operational certainty in line with the lifetime of the asset and managing the budget envelope.

Considering technology lifetime of approximately 10 - 15[1] years and the contract duration of the SDE++ scheme, there is good reason to apply a contract duration of 15 years in the CfD scheme. It should be noted that CISAF allows only 3-year support per beneficiary of electricity cost support, payments can not be made after 31 December 2030. No explicit guidance is provided on contract duration in CEEAG, though aid must be limited to the minimum necessary and granted for a period that ensures proportionality.

Indexation

CfD award to FID: commodity, component, and labour costs can increase between CfD award and FID. Providing an inverse indexation mechanism, i.e., reducing the strike price for increasing costs based on specific technology, component, or material indices provides additional investor certainty and can reduce the risk of non-realisation.

Operational phase: applying a positive indexation on the strike price provides a guard against excessive electricity price hikes for the issuer. An indexation of the strike price based on RES cost indices or electricity generation mix is justified as the conventional asset is not exposed as strongly to those cost parameters.

Selecting the appropriate index and indexation mechanism is highly complex and requires further assessment.

[1] Technology factsheets (TNO): E-Boiler, HT Heat Pump

Other design parameters: PPA carve-out or step-in mechanism

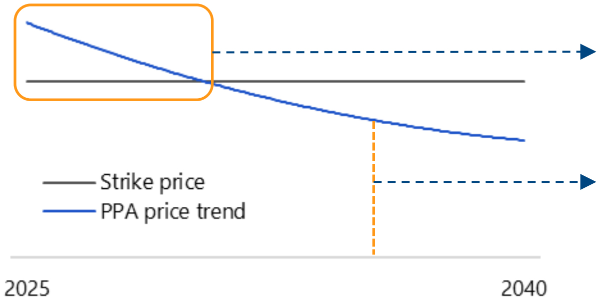
Carve-out [1]

Providing a CfD participant with an opportunity to exclude a certain electricity consumption volume from the CfD to participate in the PPA market; either upfront or throughout the duration of the contract.[2]

Advantages: allows participants to benefit from downward PPA market trends and spread their purchasing portfolio across multiple sources.

Disadvantages: there is a risk of cross-subsidisation when the CfD compensation is used to substantiate a higher PPA price. Measures may be introduced to limit the effect of cross-subsidisation, which adds to the complexity of the mechanism. An early exit clause is unfavourable, as it would incentivize opportunistic behaviour and hence affect the balance between government compensation and pay-back from the industrial consumer.

CfD and PPA market trends



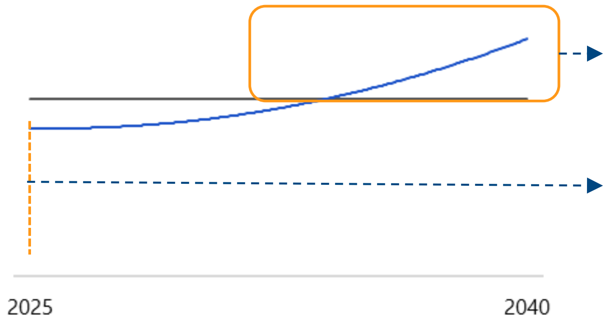
Step-in

Industrial consumers may invest in process electrification based on current costs but face rising or unstable electricity prices. A step-in mechanism lets existing electrified assets apply for a CfD if they use the same technology and applications as new ones. Conditions like initial start of operations, proof of operational challenges and unprofitable gap, and safeguards against misuse must be clearly defined.

Advantages: provides a safety net for industrial consumers in case of increasing electricity prices, while positioning the PPA market as basis instrument for stable electricity cost.

Disadvantages: potentially complex allocation procedure as existing projects would have to compete with new projects in a single auction round.

CfD and PPA market trends



[1] E.g., Princes Elisabeth Zone 1 offshore wind tender in Belgium

[2] CISAF allows max. 50-60% of annual electricity consumption to be subsidised (related to the legal entity), not the specific installation.

Table of content

CfD instrument design: Conclusions and recommendations

The **primary objective** of the CfD instrument is to stimulate electrification in Dutch industry by reducing exposure to volatile electricity prices. The design must comply with EU and national regulations by ensuring effectiveness, proportionality, and minimal market distortion. The instrument must meet the demands of industry (market readiness of the mechanism), while realising decarbonisation of the Dutch energy system.

The report identifies several key design parameters that influence the effectiveness and feasibility of the CfD mechanism:

Reference Period: Adequate reference periods (weekly or monthly) are preferable. They encourage industrial consumers to respond to market signals, improving system efficiency and supporting renewable integration. Shorter periods (e.g., hourly) offer strong price certainty but reduce flexibility incentives, whereas annual reference periods provide insufficient certainty.

Award Criteria: Three main options are considered: first-come-first-served (FCFS), competitive based on strike price, and competitive based on subsidy intensity. While FCFS is administratively simple, competitive auctions based on strike price or subsidy intensity are preferred for competition, transparency and cost-effectiveness. As price stability is a core objective of the mechanism, award based on strike price is preferable.

Budget Allocation: Budgets can be administered as a single fund or divided into technology or sector-specific "fences." Volume caps, minimum and maximum reference prices, and strike price floors help manage fiscal exposure but may affect operational behaviour.

Full-load hours: Introduction of a full-load hour cap may be necessary to provide more upfront certainty of the required budget reservation from an issuer's perspective. The introduction of full-load hour categories depends on the award mechanism, particularly the introduction of fences.

Contract Duration and Indexation: A 15-year contract duration is proposed to align with asset lifetimes. Indexation mechanisms (e.g., CPI-based) are recommended to mitigate inflation risks and enhance investor confidence.

Stimulation of Renewable Energy: Market integration is the most efficient and effective way to stimulate deployment and utilisation of renewable electricity sources. Coordination between demand and supply and can be achieved by establishing a longer reference period.

PPA carve out: a carve-out mechanism is not desirable, as it runs the risk of cross-subsidising the generator. Stepping out of the mechanism negatively affects the balance between compensation and pay-bac, a risk borne by the issuer. A step-in mechanism may be considered to allow operational projects to compete with new projects when market prices rise.

Coordination between demand-side and supply-side CfDs is essential. This ensures consistency in subsidy allocation, avoids market distortions, and aligns renewable generation with industrial demand. Three coordination models are explored. At minimum, supply and demand-side CfDs should be coordinated on a policy level. Portfolio aggregation offers the most robust alignment but faces various regulatory hurdles which will prevent implementation in the short-term. An intermediate level of coordination can be achieved by one-on-one matching, where the price difference between a commercial agreement (e.g., PPA) is settled by the issuer.

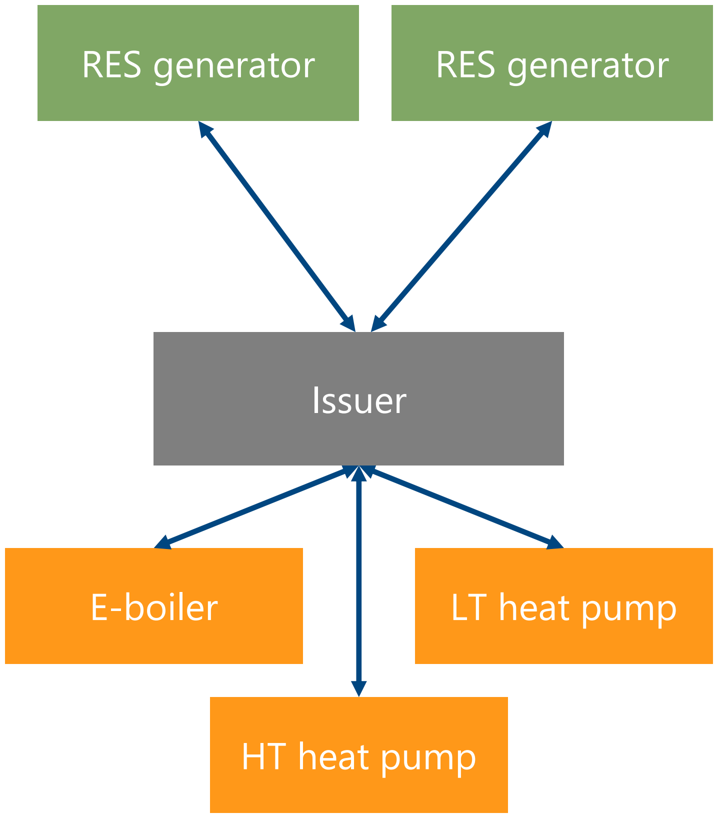
Fundamentals of a CfD auction model

CfD Mechanism: two-sided CfD for industrial electrification with policy coordination with supply-side CfDs

Design parameter	Design choice	Substantiation
Reference period	Monthly	A monthly reference period provides the best balance between operational incentives and cost certainty for industrial consumers.
Budget allocation	To follow market and technology assessment	Having applicants compete for a single, unfenced budget via competition on strike price offers a high level of competitiveness and favours projects with a low unprofitable gap. Conversely, this would decrease competitiveness of innovative solutions with a higher unprofitable gap.
Budget limits	▪ Minimum & maximum subsidisable reference price ▪ Minimum strike price	A minimum and maximum subsidisable reference price provides budget protection for the issuer while offering a parallel benefit to participants. A minimum strike price may be introduced to incentivise applicants to optimise their bids and increase competitiveness between projects.
Award mechanism	Competitive auction based on strike price	Competitive award based on objective criteria improves competition and transparency of the instrument. Core objective is to stabilise electricity price, strike-price based award is therefore the most suitable metric.
Contract duration	15 years	A contract duration of 15 years strikes a balance between providing sufficient long-term operational certainty and maintaining a manageable budget envelope.
Indexation	CPI or PPI based indexation	Pre-FID: inverse indexation as increasing capital costs ask for lower operational cost to sustain business case. Operational phase: positive indexation justified as reference installation would face similar cost increase.
PPA carve-out or step-in	Step-in mechanism as safety net	A carve-out mechanism results in risk of cross-subsidisation; a step-out mechanism distorts the balance between compensation and pay-back. A step-in mechanism (where operational projects compete with new projects) could be introduced as a safety net for industrial electrification.

Increased coordination between supply and demand via bilateral project matching

CfD Mechanism: four-sided PPA CfD between individual generation and demand-side projects



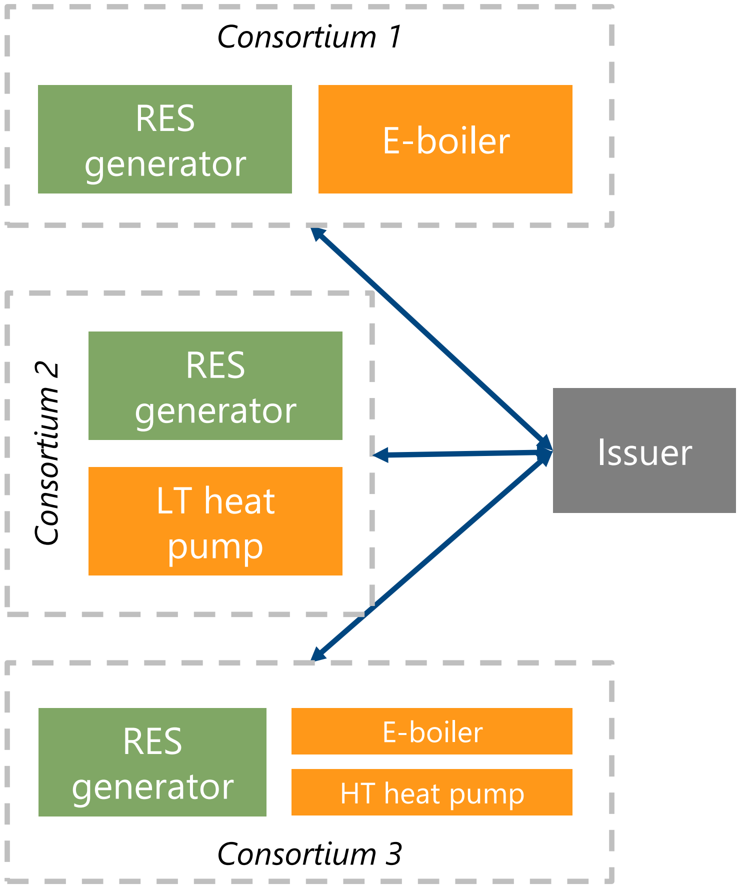
In this conceptual auction model, renewable generation and electrification projects apply for a CfD instrument separately. The **issuer collects and reviews the bids and takes an active role** in matching the supply and demand-side projects on an individual basis. These projects then enter a quasi-PPA where the issuer settles the difference between the two strike prices. Other commercial terms, such as imbalance settlement, guarantees of origin, and credit support can either be negotiated between the commercial parties involved, or **managed in a tripartite agreement** between the generator, consumer, and issuer.

Benefits of this mechanism is that the supply- and demand-side auction **mechanisms can be tailored to specific policy objectives** separately, though fundamental design choices will have to be coordinated. The reference period, for instance, must be the same for both mechanisms if the issuer is to settle precisely the difference between the generation and electrification strike price.

Disadvantages include the **high level of involvement by the issuer** (a government agency or public entity), which raises concerns about electricity market liberalisation. However, the APAE describes the tripartite agreement as a possible option to facilitate supply and demand of renewable electricity.

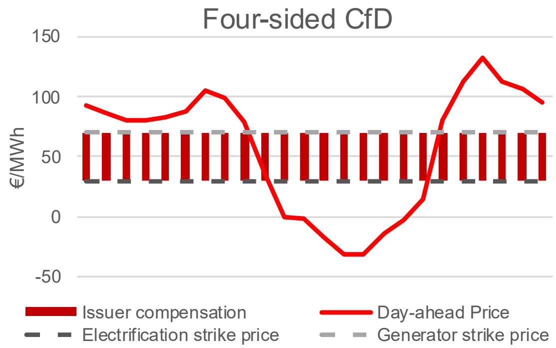
Increased competition via consortium-based CfDs

CfD Mechanism: four-sided CfD for consortia of supply and demand projects



In this conceptual auction model, applicants must form a **consortium of renewable electricity generation and industrial electrification projects**. The consortium then applies for two strike prices: a strike price to derisk the revenue potential of the generation asset(s) and a strike price to derisk the industrial electrification asset(s).

Award is then based on the difference between the two strike prices – a larger bandwidth representing a higher compensation requirement for the issuer.



The benefit of this approach is that the responsibility of **coordination between supply and demand projects is allocated with market participants**. Competition on the bandwidth between upper and lower strike price drives applicants to submit bids with the smallest gap between generation and generator strike prices.

Conversely, consortium formation and commercially sensitive negotiations between multiple stakeholders with diverging interests is **highly complex and could reduce the attractiveness of this CfD design**.

Conclusion: The initial assessment of CfD design variants shows that none fully meet all objectives – however, the 4-sided CfD appears most attractive for industry

- While the assessment depends heavily on the specific CfD design choices (reference period, award mechanism, and more), only the 4-sided CfD enables direct coordination with RES CfDs – potentially helping industry meet shareholder expectations for a fully decarbonized energy supply
- We strongly recommend to validate this initial assessment by quantifying effects. Please note that criteria are not equally important and importance may vary depending on perspective of stakeholder

Stakeholder Perspective / Objective of CfD	Criterium	CfD option: one-sided	two-sided	corridor	four-sided
Issuer "avoid risks for state budget, be in line with EU legislation and support network integration (if possible)"	Avoiding one-sided risk exposure (only to state)	★☆☆☆	★★★☆	★★★★	★★★☆
	Proportionality (avoid cross, over, under subsidization)	★☆☆☆	★★★★	★★☆☆	★★★★
	Maintain energy market incentives	★☆☆☆	★★☆☆	★★★☆	★★☆☆
	Compatibility to congestion management instruments	★☆☆☆	★★☆☆	★★☆☆	★★☆☆
	In line with EU guidelines for state aid	~	✓	✓	✓
Industry "Accelerate electrification of industry – and decarbonize this way"	Competitiveness (likelihood of being awarded with CfD)	★☆☆☆	★★★☆	★★☆☆	★★★☆
	Eligibility (non-discriminatory terms, level playing field)	★★★☆	★★★☆	★★★☆	★★★☆
	Investment security provided after being awarded	★★★★	★★☆☆	★★★☆	★★☆☆
RES investors "Support RES investments"	Additional ("more efficient") demand	★★★★	★★★☆	★★★☆	★★★☆
	Coordination with RES-CfDs	★☆☆☆	★☆☆☆	★★☆☆	★★★★

Favourable ★★★★
★★★☆
★★☆☆
★☆☆☆
Unfavourable ☆☆☆☆

*industrial participant / CfD buyer from consumer side

Table of content

Table of content

A suitable governance model for CfDs mirrors that of SDE++

Governmental organisations

Ministerie van Klimaat en Groene Groei

Policy leader & budget owner: Sets up the CfD scheme's regulations, targets, and funding in line with climate policy. Provides overall governance, ensures the CfD aligns with national climate goals, and reports to Parliament.

Ministerie van Financiën

Financial oversight: Secures and allocates the budget for CfD payouts (e.g. via the Climate Fund or ETS auction revenues) and guards against cost overruns. Ensures the scheme's affordability and approves major expenditures.

Rijksdienst voor Ondernemend Nederland

Executing agency: Implements the scheme on behalf of the ministries. RVO handles applications, evaluates and awards CfD contracts, and administers payments to companies, just as it operates the SDE++ subsidy program. Monitors project compliance and gathers performance data.

Planbureau voor de Leefomgeving

Technical advisor: Provides independent analysis and advice on subsidy levels and technology costs. PBL would calculate appropriate strike prices or support levels for the CfD (similar to advising SDE++ base amounts), and assess the scheme's climate impact, under mandate from KGG.

Other stakeholders

Authority for Consumers & Markets

Regulator: active regulatory role in CfDs to ensure the instrument doesn't counteract energy market efficiency.

TSOs & DSOs: confirm available grid capacity; validates compliance with flexibility requirements (in case applied as design parameter).

Industrial company: applies for CfD for electrification of existing process. Provides measurement data for settlement and compliance monitoring.

Investors: help finance the upfront capital for electrification projects. Input from financial institutions on bankability is vital in designing CfDs.

Discussion: barriers for industrial electrification

Barriers for industrial electrification

In this study, we address one of the barriers for investing in industrial electrification, being the uncertainty and volatility of electricity prices. However, there are other equally pressing barriers for investments.

Non-energy costs: industries in the Netherlands face substantially higher network charges, no reliefs or exemptions on taxes or levies for large industry, and, until recently, no indirect cost compensation. This puts the Netherlands at a competitive disadvantage with other European countries[1,2].

Grid congestion: a rapidly changing energy system that increasingly relies on variable renewable electricity, electrification of domestic and commercial heat, mobility, and long lead times for grid expansion projects have resulted in a heavily congested grid. Only a few regions in the Netherlands remain unaffected by the lack of available transport capacity for consumption and production of electricity[3]. As a result, companies are faced with large uncertainty, primarily about the ability to attain a new or expanded grid connection, but also about the effect on operational costs and revenues.

Connection queues: because of a congested electricity grid, transmission and distribution system operators can not award each application for new connection or transmission capacity. Industries are faced with long waiting times for new connections, severely affecting the ability to invest in electrification measures where this requires additional capacity.

CfD impact on grid congestion

The objective of the CfD is to accelerate industrial electrification in the Netherlands by providing price certainty at an investable level. Grid congestion (and the ability to obtain a grid connection/expansion) is one of the key barriers for industrial electrification. While not the primary objective of the mechanism, careful CfD design can contribute to congestion mitigation. We identify three options:

1. At minimum, the mechanism should be **compatible with congestion management products/mechanisms and alternative transport rights**. Like the Flex-E subsidy scheme, the CfD could require applicants to establish a capacity-limiting contract (capaciteitsbeperkend contract).
2. Introducing **flexibility requirements** for CfD applicants to ensure the respective asset has upward and/or downward capacity available to provide demand response services to the grid.
3. Adding **locational requirements or incentives** to steer electrification towards desired areas; for instance, making the subsidy only available in areas with high feed-in congestion. However, this comes at a cost of eligibility (level playing field) and could undermine the primary objective of the CfD mechanism.

A CfD instrument for industrial electrification can be designed to address aspects of the grid congestion challenges but is most effective if combined with other policy measures to reduce grid congestion.

[1] Electricity cost assessment for large industry in the Netherlands, Belgium, Germany and France: Final report | Rapport | Rijksoverheid.nl
[2] Komende jaren toch vergoeding voor hoge elektriciteitskosten industrie | RVO.nl
[3] Landelijke Capaciteitskaart

E-Bridge competence in energy Guidehouse

A detailed analysis of compatibility with congestion management products an mechanisms is not scope of this study – one-sided CfDs may be unfavourable

CfD impact on grid congestion

Congestions in the electricity grid can generally be categorised as either load-driven or infeed-driven.

In the case of **infeed-driven congestions, the introduction of additional electric load can help relieve congestions in the grid**, under certain conditions. This is particularly true when the congestion occurs within the distribution network or at the transformer interface with the extra-high voltage grid, and when the new load is connected at the same or a lower voltage level. The underlying reason lies in the predominantly radial structure of the distribution grid, which allows for redistribution of flows in such configurations. Industrial load additions, especially those resulting from CfDs for industry, are typically connected at medium, high, or extra-high voltage levels. Their potential to mitigate congestion is therefore highly dependent on the specific connection point within the grid architecture.

Conversely, **load-driven congestions are generally exacerbated by additional electric load**. However, exceptions exist in meshed grid structures, particularly at the extra-high voltage level, where additional load near regions with (regional) surplus infeed can alter power flows in a way that alleviates congestion.

Congestion management strategies encompass a range of mechanisms. These include time-dependent elements in network charges designed to incentivise behavioural change (e.g. time-of-use tariffs), capacity-limiting contracts (such as time-block-based or fully variable transmission rights), and market-based redispatch instruments like GOPACS. In the latter case, industrial customers with CfDs may attempt to incorporate the specific compensation structure into their bidding strategies. The feasibility of this depends on the design of the CfD auction and applies across all CfD variants. Nonetheless, this **adds complexity to participation in redispatch markets**.

Time-dependent incentives embedded in network charge structures may pose disadvantages for one-sided CfDs, particularly in industrial contexts. One-sided CfDs create strong incentives to increase load during periods of low electricity prices, which may conflict with time-dependent (temporarily high) network charges that incentivize load reduction. This incentive is weaker under other CfD types, as cost savings from low electricity prices may be reduced by paybacks to the issuer. This initial assessment warrants further validation through a dedicated study.

Capacity-limiting contracts may offer standardised tariff discounts, for example, based on the percentage of capacity accessed or as defined by the "tarievencode" from ACM. These limitations can be fixed in time or proportionally applied (e.g. 15% of the time). Such mechanisms may interfere with the market incentives of CfDs, especially those with longer reference periods, and could complicate bidding strategies. Conversely, CfD structures may reduce the appeal of capacity-limiting contracts for participants.

In conclusion, CfDs are compatible with congestion management approaches, but only to a limited extent. To ensure coherence between market mechanisms, CfD instruments should be designed to minimise conflicts with CM product incentives, particularly in situations where infeed congestion coincides with low electricity prices. We recommend that this interaction be studied in more detail to inform future policy design.

*The study does not aim to be exhaustive in terms of instruments considered

Discussion: settlement basis and effect on consumer energy prices

Production- or capabillity-based settlement

For generation-side CfDs, there is an ongoing debate about production- and capability-based settlement. A production-based settlement mechanism determines the compensation and pay-back based on actual operational behaviour. In a capability-based mechanism, the generator is not compensated for the realised production volume, but based on a reference volume of what they could have produced based on a benchmark equivalent renewable power plant. This to maintain sufficient market incentives in the operational behaviour. For onshore renewable generation, the Netherland have chosen for a production-based settlement rather than reference volume due to the variety and diversity of eligible projects[1].

Industrial electrification is characterised by a relatively limited technologies, but a broad variety of applications, a high level of process integration, and diverse exposure to market circumstances depending on industry segment. A capability-based settlement mechanism would need to represent this high level of diversity to ensure a competitive and attractive CfD instrument.

We conclude that an analogous **capability-based mechanism is unfavourable** for an industrial electrification CfD, as it is complex to establish an appropriate benchmark for asset compensation. Applications of industrial electrification measures vary too much in objectives, operational behaviour, and level of integration. A production-based settlement mechanism is more appropriate and requires implementation of metering and reporting requirements.

Effect on consumer energy prices

Contracts for Difference for industrial electrification can be a powerful catalyst for decarbonizing industry and can influence consumer energy prices in both the short and long-term. In the near term, an industrial CfD would provide heavy industry with a stable, low electricity price, overcoming key barriers like volatile markets and high grid charges[2]. This price stability is expected to unlock electrification investments by making electricity competitive with (or cheaper than) fossil fuels for industrial use.

However, simply boosting demand could raise electricity prices for others unless supply expands in parallel. Coordinated policy action is essential: as industrial demand rises, new renewable generation must be brought online through complementary support (e.g., supply-side CfDs)[3]. This prevents market imbalances and spreads the benefits of electrification across the economy. In the long run, if demand and supply grow together, consumers stand to gain significantly. A grid dominated by low-cost, zero-marginal-cost renewables will exert downward pressure on electricity prices.

In sum, a well-designed industrial CfD, coupled with robust renewables deployment, and measures to address other investment hurdles can lead to more stable and ultimately lower energy prices for society, while enabling critical emissions reductions. The transition must be managed carefully but the end-state is a cleaner, more affordable energy system for all.

[1] Voorbereidingen voor tweerichtingscontracten zon-PV en wind op land
[2] Unlocking industry electrification: an overview of EU policies and regulatory framework - Florence School of Regulation
[3] The changing dynamics of European electricity markets and the supply-demand mismatch risk

Discussion: Comparison between CfD and SDE++

Boundary condition	CfD	SDE++
Effectiveness	Dedicated mechanism has high potential to achieve objective of scaling up industrial electrification, though barriers like non-energy costs and congestion are not addressed.	Effective in supporting lowest cost carbon abatement technologies. Less effective in stimulating industrial electrification due to wide variety of applications and operational modes.
Proportionality	Support is only as much as needed to reach the strike price, with pay-backs to the state below that. This avoids windfall profits and over-subsidisation.	Pays participants based on product reference price, which can include electricity cost component, but has no mechanism to reclaim excess revenues in case reference price surges.
Market disruption	Insulates participants from electricity price signals. To mitigate lack of market exposure, designs use longer reference periods or partial exposure, so participants retain market incentive.	Electrification projects remain exposed to electricity market prices and will respond accordingly; long reference period (annual) retains market exposure for renewable electricity generation.
Eligibility	May be negatively affected by requirements or criteria to achieve secondary objectives (e.g., locational requirements).	Designed to be technology-neutral with a level playing field for all eligible options. This wide scope means different solutions compete for the same budget, hence, the introduction of fences.
Competitiveness	The competitiveness element of a CfD instruments is primarily affected by design parameters including budget allocation and award criteria.	Budget fences increases competitiveness within the categories. However, this may negatively affect competitiveness of low-cost measures as their budget availability is effectively reduced.
Attractiveness	Symmetrical protection in a two-sided CfD is highly attractive; further affected by budget allocation and award mechanism.	Provides limited protection against electricity market volatility and uncertainty for industrial electrification.
Direct decarbonisation	Award based on strike price results in indirect stimulation of direct decarbonisation; Award based on subsidy intensity results in direct stimulation of direct decarbonisation.	Applications compete within phases based on subsidy intensity (€/tCO_2), directly stimulating decarbonisation.
Indirect decarbonisation	Achieved via market integration (through extended reference periods), policy coordination, or with four-sided CfD.	SDE++ directly supports renewable electricity generation in various technology categories.

Discussion: co-existence with SDE++

Co-existence with SDE++

The SDE++ scheme and a proposed CfD instrument serve similar goals, but through different approaches. SDE++ is a subsidy targeting the *average cost gap*[1], whereas the CfD would *fix a maximum electricity price* for industry by compensating high prices and clawing back windfalls. Cumulation of state aid is possible under CEEAG provided that the total amount of aid for a project or an activity does not lead to overcompensation or exceed the maximum aid amount allowed under these guidelines. If aid under one measure is allowed to be cumulated with aid under other measures, then the governing authority must specify, for each measure, the method used for ensuring compliance with the conditions set out in this point[2].

Coexistence between SDE++ and a CfD is possible at a policy level, with SDE++ continuing to fund certain decarbonisation options and a new CfD addressing the shortcomings of SDE++ for electrification, but coordination is essential. In practice, **when a single project receives both SDE++ and CfD support for the same activity, there is a large risk of breaching EU rules** on proportionality and avoidance of overcompensation. An industrial company may apply to either scheme, but likely not stack them for the same electrification project as the instruments both cover electricity costs[3]. The conditions for any dual usage (in exceptional cases) would be that each instrument covers distinct costs or periods, and the combined aid remains within the verified funding gap, a scenario likely too complex to implement, hence the preference for an "either/or" choice per project.

Guidelines on State aid for climate, environmental protection and energy

> "Aid may be awarded concurrently under several aid schemes or cumulated with ad hoc or de minimis aid in relation to the same eligible costs, provided that the total amount of aid for a project or an activity does not lead to overcompensation or exceed the maximum aid amount allowed under these guidelines. If the Member State allows aid under one measure to be cumulated with aid under other measures, then it must specify, for each measure, the method used for ensuring compliance with the conditions set out in this point."

[1] Energy production, avoided CO_2 or energy purchasing costs are accounted for via the base- and correction amounts (basisbedrag and correctiebedrag)
[2] Communication from the Commission – Guidelines on State aid for climate, environmental protection and energy 2022
[3] CfD does this directly, SDE++ indirectly via base and correction amounts.

Table of content

We consulted with seven organisations on the merits of CfDs for industrial electrification

Organisations

ebn

ENERGIE NEDERLAND

NedZero

NVDE

KONINKLIJKE vemw

VNCI

VNO NCW

Guiding questions

Opening questions

1. What is the relevance of industrial electrification for your organisation[1]?
2. Do you share the view that SDE++ has fundamental challenges that withhold applications for industrial electrification?
3. What is your initial appraisal of introducing contracts for difference (CfDs) to stimulate new investments in industrial electrification?

Alternative instruments

4. Are you aware of other mechanisms (private or publicly funded) that can unlock industrial electrification?
5. With the objective to stabilise electricity costs, do you prefer a (commercial) power purchase agreement (PPA) or a (government backed) CfD?
6. How would a guarantee fund for PPAs affect your answer to the previous question?
7. How can a CfD for industrial electrification coexist with the current SDE++ set-up?

CfD variants

8. What are, in your view, the (dis)advantages of a corridor CfD over a two-sided CfD? Which do you prefer?
9. What are, in your view, the (dis)advantages of a four-sided CfD over a two-sided CfD? Which do you prefer?

Design parameters and governance

10. What are in your view the key design elements for a CfD mechanism to be effective and provide investment signals for electrification?
11. How can the CfD be designed to optimally arrange a match in supply and demand of renewable electricity (hour by hour, as well as long-term growth)?
12. How does the choice of a reference period affect the market readiness[2] of the CfD mechanism?
13. How does the choice of an award mechanism (strike price or subsidy intensity) affect the market readiness of the CfD mechanism?
14. Should the budget be allocated in technology or sector specific buckets to increase market readiness?
15. How do you see the role of various government agencies and financial institutions?

Market consultation summary: introduction

The consultation revealed strong support for CfDs as a tool to accelerate industrial electrification, provided they are well-designed and embedded in a broader policy mix. While preferences varied across organisations, there was alignment on the need for flexibility, transparency, and risk-sharing. The findings underscore the importance of tailoring CfD design to sectoral needs, ensuring coordination across the energy value chain, and maintaining a balance between simplicity and effectiveness.

Strategic Importance of Industrial Electrification
All organisations agreed that industrial electrification is an important decarbonisation option, if not the cornerstone of industrial decarbonisation, particularly in sectors with limited alternatives. Electrification technologies such as e-boilers, electric cracking, and hydrogen production were discussed, with varying views on their maturity and efficiency. While low-temperature applications are already viable, high-temperature processes remain a challenge. Grid congestion, electricity price volatility, and lack of infrastructure coordination were cited as major barriers to scaling up electrification. The “electrification” category of SDE++ is limited to low- and high-temperature heat and electrification of offshore production platforms; it was noted that indirect electrification (such as electrolytic hydrogen production, which has a dedicated category in SDE++) would also benefit from a CfD instrument.

Key Challenges and Limitations of Existing Instruments
When asked about the merit of a CfD to stimulate investments in industrial electrifications, respondents confirmed that electricity price stability is one of the key challenges, but others are equally or more pressing. Grid congestion and the ability to secure a grid connection (expansion) was named as a key issue for delayed electrification. Furthermore, non-energy costs (grid fees and taxes) provide a strong negative competitive element, especially for internationally operating companies.

The SDE++ scheme, while appreciated for supporting renewable energy, was widely seen as inadequate for industrial electrification. Its focus on production-based financial support and outdated or incompatible cost parameters limits its effectiveness. There is a consensus that new instruments are needed to address electricity demand-side risks and unlock investments, though grid tariffs and access to electricity transport remain as the most urgent barriers.

CfDs as a Promising Solution
CfDs were broadly endorsed as a promising mechanism to provide price certainty and reduce investment risk. Compared to commercial Power Purchase Agreements (PPAs), CfDs are seen as more transparent, politically palatable (due to their payback mechanism in case of a two-sided CfD), and better suited to stimulate market development. Many interviewees suggested that CfDs could complement or even catalyse the PPA market, especially if paired with a guarantee fund to reduce counterparty risk. Several organisations mentioned the concept of “green lead markets” as a fundamental mechanism to increase the value of renewable electricity and argued that CfDs could well complement such a mechanism. Some organisations also suggested a combination of CAPEX and OPEX support, like in the OWE scheme for hydrogen production.

Market consultation summary: CfD mechanisms

Two-sided CfD
The two-sided CfD, where the government compensates the difference between a fixed strike price and the market price in both directions, was recognised for its simplicity and familiarity. It offers strong price certainty, which is particularly attractive for capital-intensive investments. However, some participants noted that this model may reduce incentives for flexible operation and demand-side responsiveness, as it insulates users from market signals. While not dismissed outright, the two-sided CfD was seen by some as less suited to encouraging innovation in industrial demand profiles. Others considered it a solid baseline instrument, especially when complemented by additional mechanisms that promote system integration and flexibility.

Corridor CfD
The corridor CfD, where compensation is only provided within a predefined price band, was widely appreciated for maintaining market signals and encouraging flexible behaviour. It was seen as a promising way to balance risk-sharing with market discipline. However, concerns were raised about how financial institutions will likely interpret the upper strike price as a de facto price level, increasing the overall risk profile and, henceforth, financing conditions and costs. The effectiveness of this model was viewed as highly dependent on the design of the corridor and the auction mechanism.

Four-sided CfD
The four-sided CfD, linking producers and consumers through mirrored contracts with the government acting as intermediary, was described as elegant and potentially transformative. It was praised for its ability to align supply and demand incentives and reduce government exposure to price volatility. However, its complexity and administrative burden were recurring concerns. Some interviewees questioned whether the coordination required between multiple parties would outweigh the benefits. Others saw potential in combining this model with market-based instruments that stimulate demand for green electricity, provided the government's role remains clearly defined and manageable.

Strategic Considerations
Across the interviews, it was emphasised that the choice of CfD variant should be guided by the overarching policy objectives, whether to maximise CO_2 reduction, stimulate market development, or support specific technologies. There was also recognition that different variants might be appropriate for different sectors or project types.

Market consultation summary: CfD design

Key Design Parameters

Several design elements were identified as critical to CfD effectiveness:

- **Reference Periods**: Weekly or monthly periods were preferred to balance market responsiveness and operational feasibility. Hourly references were recognised as disincentivising flexibility, while an annual reference does not provide sufficient certainty in operational planning.
- **Contract Duration**: Industrial consumers generally prefer contract durations of 10 to 15 years, which aligns with their planning and investment horizons, though the appropriate duration may vary by technology.
- **Award Mechanism**: Competitive bidding based on subsidy intensity was widely supported over first-come-first-served models, as it promotes cost-effectiveness and transparency. There was no clear consensus favouring subsidy intensity over strike price as an award criterium.
- **Technology Differentiation**: Many were in favour of sector- or technology-specific "fences" to ensure fair competition and system value. For example, e-boilers and heat pumps serve different roles and should not compete directly.
- **Flexibility Requirements**: Some suggested including flexibility obligations (e.g. a commitment to provide x % of upward or downward operating flexibility) in CfDs to support grid stability, though implementation were seen as complex and potentially distorting the level playing field.

Governance and Implementation

There was consensus that the Ministry of Climate Policy and Green Growth (KGG) should lead CfD governance, supported by RVO for implementation and execution, and PBL for market research and reference calculations. The existing SDE++ ecosystem was seen as a strong foundation. Transparency, stakeholder feedback loops, and alignment with EU frameworks (e.g. CEEAG, CISAF) were deemed essential for legitimacy and effectiveness. It was suggested to consult financial institutions in the development of a CfD mechanism to ensure that the instrument provides sufficient investor certainty and bankability.

Complementary Instruments and Market Conditions

Several organisations proposed combining CfDs with other instruments:

- **CAPEX Subsidies**: Fixed investment support (e.g. as in the OWE scheme) was seen as essential to reduce upfront capital allocation risk.
- **Private or Green Lead Markets**: Suggested by multiple organisations as a way to pass costs to end-users in low-impact sectors, enabling broader market transformation.
- **Aggregator Models**: One organisation proposed an aggregator model (similar to H2Global) as a potential analogue for electricity. Here, the intermediary (government) agency takes an active role in developing supply and demand portfolios, though others saw this as disproportionate.

Table of content

Appendix: Country analysis

Country selection: Countries analysed were selected according to the following criteria:

- Country size and size of industry
- National decarbonization ambitions and targets
- Existing national support schemes for energy generation and consumption; track record, stability and duration schemes
- Geographic proximity and comparability to the Netherlands

Assessed countries and schemes:

Germany

United Kingdom

France

Belgium

Spain

Assessment: Support schemes have been assessed with the focus on implemented CfD schemes in the selected countries. Furthermore, specific support schemes for industry on electricity cost have been investigated:

Main features and criteria for CfD instruments:

- Type or mechanism
- Eligible technologies
- Strike price/guarantee price
- Reference market price (electricity market price which is used for CfD settlement)
- Contract duration of scheme
- Annual expenditure/cost dependent on market price
- Completed CfDs in number of contracts/contracted energy production megawatt-hours (MWh) per year
- Funding: Publicly or privately issued CfDs
- Maximum spending over maturity CfDs

Factsheet Germany (1/2)

Generation | **Consumption**

Description[1]

- Climate protection agreements also known as Carbon Contracts for Difference (CCfDs) as support scheme to decarbonize Germany's industrial sector and achieve climate neutrality by 2045
- CCfD's provide financial incentives to energy-intensive industries, encouraging the adoption of low-emission technologies by offsetting the additional costs associated with
- First auction round implemented in 2024; second auction round pending

Mechanism

- **CCfDs function as two-way contracts for difference**
- Competitive auction process; awarding based on funding cost efficiency and relative emission reduction of the submitted bids
- If cost of low-emission production > cost of existing reference technology → state pays difference
- If cost of low-emission production < cost of reference technology (higher CO_2 price) → companies pay back difference to state
- Yearly settlement of subsidy amount (based on reference price development)

Technologies

- Targeted technologies: greenhouse gas emission intensive industry sectors
  - steel, chemicals, cement, glass, ceramics, paper, pulp
- Supported technologies:
  - Electrification; Hydrogen, Biomass; process innovations/ new methods to reduce emissions, CCS/CCU in second round

Funding

- The government provides financial support and policy frameworks to de-risk investments in low-emission technologies
- Budgeted EUR 4 bln for first auction round
- Todal funds of EUR 2.8 bln. to be provided by government as result of first auction round (15 contracts)

[1] Source: German government

Factsheet Germany (2/2)

Key parameters

Strike price	**Basis contract price** (difference between new low emission technology and existing reference technology); sector dependent
Market reference price	**Effective CO_2 price; linked to EU ETS** but also company and sector dependent
Indexation	Annual adjustment via annual average electricity spot price: 70 % baseload; 30 % **renewable volume-weighted**
Duration	**15 years**
Funding volume	**EUR 2.8 bln** first auction round
Number of contracts /subsidized capacity	15 contracts awarded in first auction round (2024); total emission reduction up to 17 mil tones
Issuance private/ public	Issuance by German government

Summary of the latest tender results[1]

- **15 projects awarded of 17 bids received**
- 9 companies will use electricity to decarbonize their existing processes
- 4 companies will use hydrogen as new low emission technology
- 2 companies will biogas respectively biogas to decarbonize
- Projected **subsidy amount per project** over the contract duration ranges from **EUR 52 mil to EUR 564 mil.**

Requirements for participants

- Minimum CO_2 emission reduction 10 kt per year
- Minimum support volume per project: EUR 15 mil
- Maximum bid price: 600 EUR/$t_{CO2,Äq}$
- Minimum 90% CO_2 reduction vs. reference technology in the last year of support
- Term begins with operational start construction and commissioning within 3 years

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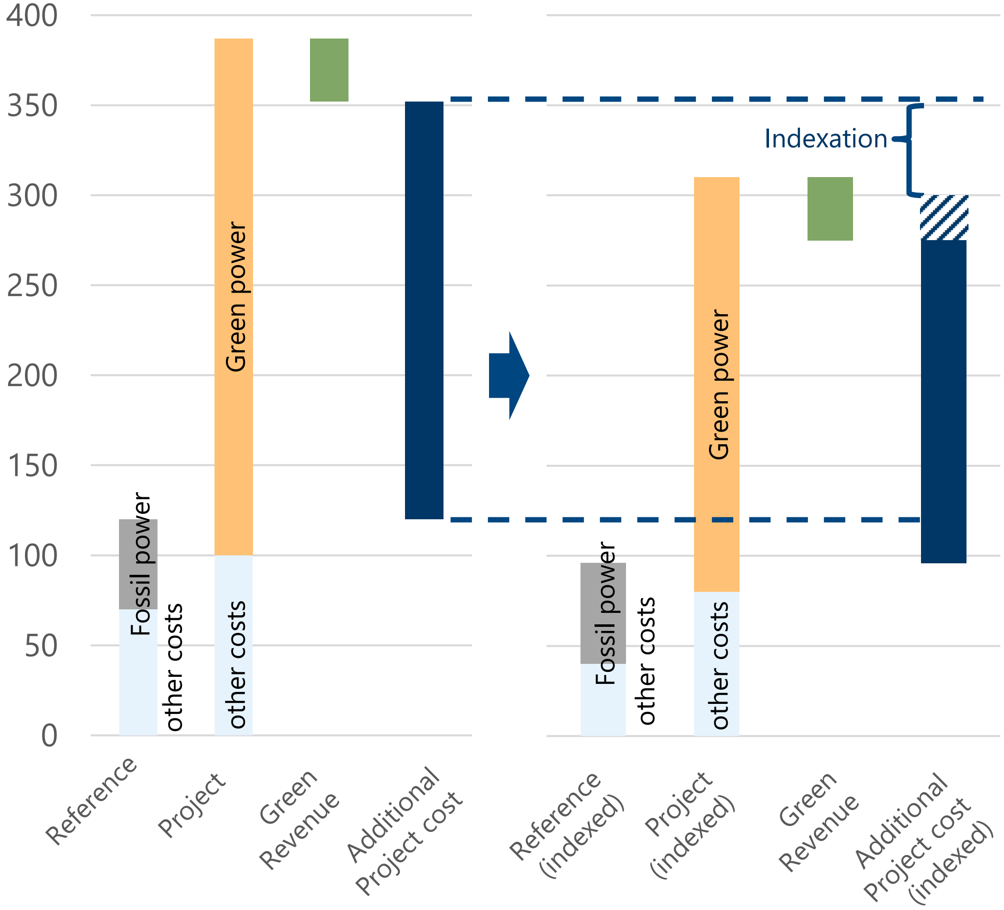
[1] Source: Tender results

Indexation as part of the Carbon Contracts for Difference (CCfDs)



- The project's additional costs, which form the basis for subsequent payments, result from comparing the reference system to the project costs, minus any green revenue (see left side of the graphic)
- **Indexation** incorporates **adjustment** of both reference and project costs to reflect actual market prices (**updated annually**)
  - ➢ modifying additional project costs and resulting payments
- Depending on the technology, **price indices** are applied; these are **specified** in the **rulebook** of each respective auction round
- The **real electricity price (index)** is calculated based on **hourly market prices** and **renewable generation shares**, and is then used to determine payment amounts:

$$p_{elect}^{real} = 0{,}7 * \frac{\sum_{t=1}^{8760} p_t}{8760} + 0{,}3 * \frac{\sum_{t=1}^{8670} p_t * (E_{PV,t} + E_{Won,t} + E_{Wof,t})}{\sum_{t=1}^{8760} (E_{PV,t} + E_{Won,t} + E_{Wof,t})}$$

- The index consists of two components:
  - I. 70% - Baseload component reflecting constant consumption - **unweighted**
  - II. 30% - Renewables component capturing costs under flexible, renewable-based generation (PV, onshore, offshore) – **weighted by prognosed renewable share in each hour**
- Source power price indexation: SMARD.de (BNetzA)

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[1]Source ; [2]Source ; [3]Source

Additional support schemes and conclusions

Additional support schemes:

- **Indirect cost compensation** Companies of energy-intensive sectors like i. a. production of various metals, hydrogen, chemicals, wood and paper (see Annex I of the EU Guidelines for full list) are applicable to a compensation on the CO2 component of the electricity price. (Source)
- **Individual network charges** for energy intensive consumer according to § 19 (2) StromNEV.
- **Relief on levies** according to § 31 EnFG: Relief on CHP- and offshore-levy.
- **EEG support scheme for renewable generation:** Feed in tariff support scheme for renewable generation i.e. onshore wind, solar, biogas, biomass; mechanism via competitive auction design; 20 year guaranteed premium paid EUR/MWh; No premium paid of market value of technology exceeds premium cap (>100 kW). Premium fixed in "pay as bid" design. EEG scheme is currently under review and will be renewed and amended in alignment with EU directive from 01.01.2027.

Conclusions:

- German CCfD's targeting industrial decarbonisation. Next to electrification also the use of hydrogen and other clean gases is supported. Focus in no easy abatement sector where CO_2 price signal is insufficient.
- CCfD's design with dynamic strike price with claw back potential avoiding over subsidy.
- Complex auction and evaluation process; high uncertainty in accessing actual CO_2 abatement cost; difficult to benchmark divers technologies.
- Entry barrier and complexity has left out SME companies and industry.
- Risk of overlap with other schemes EU ETS and CBAM if not harmonized.

Factsheet United Kingdom (1/2)

Generation | Consumption

Description

- Central CfD support scheme for large-scale, low-carbon electricity since **2014**
- **Legal basis:** Electricity Market Reform (Energy Act 2013)
- Applies across Great Britain; **administered** by:
  - **Low Carbon Contracts Company** (LCCC)[1]
  - **National Grid ESO**
  - **Ofgem** (regulator)
- Currently **under review** (Review of Electricity Market Arrangements)

Mechanism

- **Two-sided** contracts between **generators** and **LCCC**
- If market price **<** strike price → LCCC pays difference to generator
- If market price **>** strike price → Generator pays back surplus to LCCC
- CfDs **awarded** via **reverse auctions** (lowest bids win)

- Features include:
  - Technology-specific **budget caps**
  - Administrative **strike prices**
  - Non-delivery **penalties**

Technologies

- On-/Offshore Wind (+ Remote Island Wind and Floating Offshore)
- Solar
- Biomass
- Nuclear
- Geothermal
- Other (Energy from Waste, Tidal stream, etc.)

Funding

- Funded via a **supplier levy**, not directly government expenditure
- Levy **costs** are **included** in **consumer electricity bills**
- LCCC handles:
  - Payments to generators (when prices are low)
  - Refunds from generators (when prices are high)
- System structured to maintain **budget neutrality**

[1] Private limited company owned by the **Secretary of State for Energy Security and Net Zero**

[1] Source

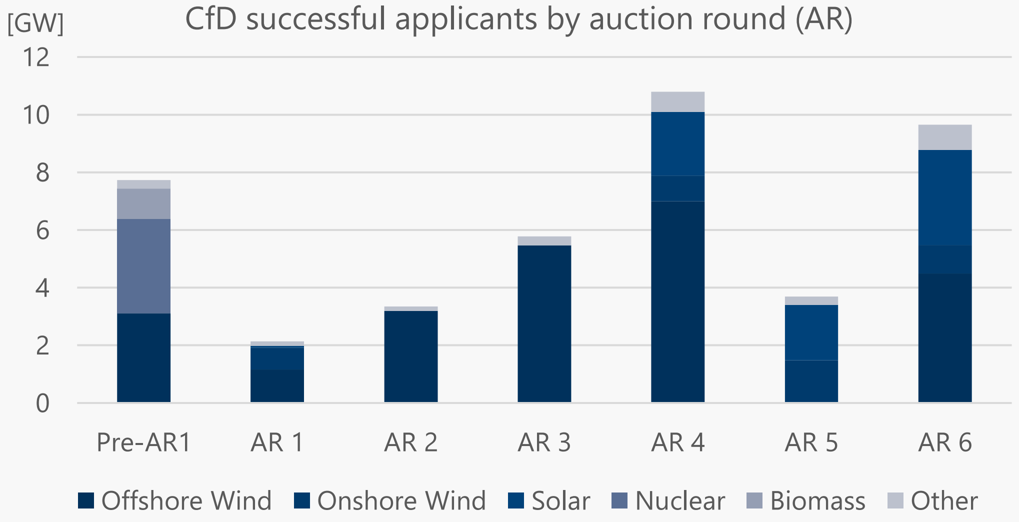
Factsheet United Kingdom (2/2)

Key parameters

Strike price	Technology-specific, set in sealed bids during allocation rounds
Market reference price	**For baseload technologies:** Baseload Market Reference Price (BMRP), based on seasonal forward market prices (from LEBA)[2] **For intermittent technologies:** Intermittent Market Reference Price (IMRP), calculated hourly using day-ahead prices from exchanges like EPEX SPOT and N2EX[3]
Indexation	Annual adjustment of strike price according to **CPI**
Duration	**15 years**
Funding volume	Budget set per allocation round by government (e.g. AR6 2024: £227 million)
Number of contracts /subsidized capacity	The amount varies per auction, with total subsidised capacity currently around **43 GW**
Issuance private/ public	Public: Contracts signed between generators and LCC

Summary of the latest tender results

- **Offshore wind** strike price fell from **£120/MWh** (AR1) to **< £40/MWh** (AR4)
- **AR6 offshore wind** prices rose to **~£57/MWh** (still < £75/MWh admin strike price)
- **Onshore wind: 48% drop** from AR1 to AR4; moderate rise in AR5–6
- **Solar: 30% drop** from AR1 to AR4; remained below initial levels despite recent increases



1) Source

2 such as biomass with CHP
3 such as solar or wind

Additional support schemes and conclusions

Additional support schemes:

- **Climate Change Agreements (CCAs):** Voluntary agreements allow energy intensive business users to receive a **discount from the CCL[1] up to 90%** of the levy (Source, Source) – for more detailed information see CCA study 2018.
- **Energy Intensive Industries (EII) scheme:** provides UK manufacturers in high-energy sectors (like steel, glass, and chemicals) with up to 100 % exemption from electricity policy costs, including those funding the CfD, RO[2], FiT[3], and Capacity Market. From April 2025, eligible businesses can also claim up to 60 % compensation for network charges (Source, Source).

Conclusions:

- The CfD scheme has been very effective in driving down the cost of capital, however limits generators' market exposure, meaning renewable assets are not exposed to price signals.
- Current design not for technologies that increase flexibility; e.g. flexible generation, storage, interconnectors and DSR (demand-side reduction). This resulted in a lack of investment.
- Reforms are under considerations:
  - Implementation of strike price range to increase exposure to market prices
  - Choosing different reference period for CfD settlement i.e. weekly or monthly instead of daily to increase market exposure and incentives for asset operators
  - Revenue cap and floor - guarantees minimum revenue (floor) while limiting excessive profits through a revenue maximum (cap).

1. Climate Change Levy
2. Renewable Obligation
3. Small-scale Feed-in Tariffs

Factsheet France (1/2)

Generation / **Consumption**

Description

- Since 2016, a two-sided CfD scheme applies on different types of RES, that was updated in 2021. The duration lies between **12 to 20 years** dependent on the technology.
  - Small wind parks with max 3 MW per plant and maximum number of 6 can get support without a tender
  - Larger plants are obligated to apply via competitive tenders with the awarded offer forming the reference price
  - Legal basis: **Code de'l énergie**
- A scheme for Hydrogen was launched in **2024** (Source).

Mechanism

- Payment in form of a monthly variable premium, the payment is conducted by EDF which gets a refund from the state (Source)
- Default mechanism:
  - If Market price **<** reference price → State pays difference
  - If Market price **>** reference price → Producer pays back difference
- The reference price is determined in the tender offer of the beneficiary ('pay as bid'), tender is conducted by CRE
- In times of negative prices, the market premium is not paid

Technologies

- Following technologies can benefit from CfDs
  - Solar (> 500 kW) [1]
  - Wind Onshore (> 3 MW or >6 plants) & Wind Offshore [1]
  - Biogas (> 500 kW) [1]
  - Electrolysers (5-100 MW) [2]
  - Planned: Nuclear (Source)

Funding

- Until 2021 the financing of the schemes was conducted through the Energy Transition Fond, which was fed by taxes on fossil fuel consumption (TICC, TICPE, TICGN). (Source)
- Today the financing is conducted via the state budget, the costs are therefore not directly passed on to the consumers. (Source)

[1] Source 1, [2] Source 2

Factsheet France (2/2)

Key parameters

	Generation	Electrolysers
Strike price	Determined in beneficiary's tender offer ('pay as bid')	Determined in beneficiary's tender offer ('pay as bid')
Market reference price	Day-ahead hourly market price of the power exchange	Special calculation – see link for details
Indexation	Annual via **L factor** (30 % OPEX)	Annual adjustment to real electricity costs
Duration	12-20 years depending on the technology	15 years for electrolysers
Funding volume	30.5 bln EUR for Solar, Onshore Wind, Hydro[1)]	4 bln EUR for electrolysers (for the first 1GW)[1)]
Number of contracts /subsidized capacity	34 GW of Solar, Onshore Wind, Hydro[2)]	200 MW across up to 12 projects of electrolysers[3)]
Issuance private/ public	Issuance by French government	Issuance by French government

Summary of the latest tender results (generation)

- 9th Onshore Wind tender in February 2025 (Source):
  - Tender of 925 MW
  - 67 projects with combined capacity of 1167,15 MW applied
  - 51 projects with capacity of **930,05 MW** were awarded with an average price of **87,61 EUR/MWh**
- In the latest solar tender from February 2025 no large-scale PV was awarded (Source).
- The latest wind offshore tender was finished in December 2024 with two projects of 250 MW each being awarded (Source).

Results of the first CfD round for electrolyser **(consumption)** projects are not yet published.

1) Source 2) Source 1, 3) Source 2

Additional support schemes and conclusions

Additional support schemes*:

- **Indirect cost compensation**: Companies of energy-intensive sectors like i. a. production of various metals, hydrogen, chemicals, wood and paper (see Annex I of the EU Guidelines for full list) are eligible to a compensation on the CO2 component of the electricity price. (Source)
- **Tax reduction**: Energy intensive companies are applicable for electricity tax reductions according to L312-65.
- **ARENH scheme:** In France 100 TWh of energy from nuclear power plants can be obtained at a fixed price of 42 EUR/MWh. The amount available for a specific consumer is dependent on the consumption during specific ARENH hours during the year. The scheme expires at the end of 2025. (Source)

Conclusions:

- France utilizes CfD schemes to support a variety of renewable generation technologies but also consumers like electrolysers.
- France is planning to further extend CfD utilization to support nuclear generation as a successor to the ARENH scheme.
- However, there are currently no CfD schemes in place that support industrial consumers.

Factsheet Belgium (1/2)

Generation | Consumption

Description

- New **two-sided** CfD introduced in **2023**[1], replacing earlier one-sided LCOE[2]-based model for offshore wind
- **Legal basis**: Royal Decrees (23 & 26 May 2023); Electricity Act amendment pending
- **Existing projects** now **repay above LCOE + EUR 20/MWh**
- **New projects** in Princess Elisabeth Zone (3.15-3.5 GW capacity) operate under **auction-based two-sided CfDs**

Mechanism

- Two-sided **based on Available Active Power (AAP)**
- Default mechanism:
  - If Day-Ahead price **<** strike price → State pays difference
  - If Day-Ahead price **>** strike price → Producer pays back difference
- **Optional** mechanism for electricity sold via **long-term PPAs:**
  - Reference price = **PPA price + EUR 3/MWh**
  - **Limited** to **50 %** of AAP volume
- Monthly cash settlements between producers and the Belgian State

Technologies

The technologies subsidized under the CfD model in Belgium focus **exclusively** on **offshore wind** energy

Funding

- Market-based CfD scheme (payments tied to market vs. strike price gap)
- **EUR 682 million**[3] in approved state aid supports project construction & operation
  - Amount does **not fully fund CfD obligations**
- Long-term financing model and consumer cost impact **not yet disclosed**

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[1] Source: Auction rules

[2] Levelized Cost of Energy

[3] Source: State aid approval

Factsheet Belgium (2/2)

Key parameters

Strike price	Determined via competitive tender; capped at **EUR 95/MWh**[1] (according to latest information)
Market reference price	Day-ahead hourly market price of the power exchange (for CfD default mechanism) or PPA price + EUR 3/MWh (for optional volumes)
Indexation	**30 %** of strike price **indexed annually** to the **Consumer Price Index** (CPI) (after FID[2])
Duration	**20 years** or **80.000** full load hours
Funding volume	**EUR 682 million** in approved state aid for construction and operation (not full CfD volume)
Number of contracts /subsidized capacity	First tender (700 MW) launched in 2024; results pending. Total zone: **3.15-3.5 GW** planned
Issuance private/ public	Public: CfD signed between generator and Belgian State

Summary of the latest tender results

- First concession award in **2025**
- Government-commissioned **ex-ante study provides:**
  - Indicative pricing values
  - Policy recommendations
- **Target:** 3.5 GW offshore capacity via 3 CfD-backed concessions
- **Turbine size:** 14-18 MW
- **Investment cost**: EUR 2.43-2.59 million per MW (2024)
- **O&M costs:** EUR 58-69k per MW annually
- **Expected production:** 3.600 MWh/MW/year (→ 41% capacity factor)

CfD pricing insights:[1]

- **Expected bid** (with full 2-sided CfD)**:** EUR 83/MWh (2025)
- Cap-based design affects bid levels:
  - Absolute cap (EUR) would raise bids by EUR 1.8-5.9/MWh
  - Energy cap (e.g. 72 GWh/MW) with minor impact (only EUR 0.2-1.0/MWh)

[1] Source: Strike price and CfD insights

[2] Final Investment Decision

Additional support schemes and conclusions

Additional support schemes:

- **Indirect cost compensation**: Companies of energy-intensive sectors like i.e. production of various metals, hydrogen, chemicals, wood and paper (see Annex I of the EU Guidelines for full list) are eligible for a compensation on the CO2 component of the electricity price. (Source Flanders, Source Wallonia)
- **Capacity market:** Remuneration mechanism via competitive bidding process for producers, storage operators, and demand-side response; Capacity > 1 MW; first auction 2021; first delivery period 2025/26; contract periods 1 to 15 years asset dependent.

Conclusions:

- Two sided CfD including cap ensures pay back to state when market prices exceed strike price, achieving budget and funding control.
- CfD guarantees fixed strike price over 20 years proving revenue security to developers.
- CfD remove price signals for wind farm operators, this can distort short-term power market behaviours.
- Variable premiums require continuous monitoring of market prices and imbalance tariffs, increasing administrative overhead.
- Ongoing adjustments (e.g., the 2024 Royal Decree) and EU oversight create uncertainty for long-term project planning.

Factsheet Spain (1/2)

Generation | Consumption

Description[1]

- In November 2020, Spain introduced a new support scheme for RES-E via sliding feed-in premiums (CfDs)
  - allocated through technology-neutral auctions
- Legal basis: Royal Decree 960/2020
- Neither a minimum nor a maximum size is set in the auction
- Tenders can be based on installed capacity, the amount of electricity generated or a combination of both
  - minimum capacities per project; based on the amount of energy awarded + technology-dependent full load hours

Mechanism[3]

- The price received in each negotiation period, will be the awarded price corrected by a symmetrical incentives of market participation
  - Producer's price (**PR**) = Awarded price (**AP**) + Adjustment factor (**AF**) × (Market price (**MP**) – **AP**)
- **Adjustment Factor (AF):** a 0-50 % share of remuneration linked to market prices to incentivize production during high-price hours.
- CfD-like scheme:
  - If MP < PR → Payment obligation on the market
  - If MP > PR→ Payment obligation from the generator

Technologies[1,2]

- Hybrid design with technology-neutral and technology-specific reserved capacities
  - Wind on-/offshore
  - Solar
  - Hydropower, geothermal
  - Biogas, biomass
  - Additional technologies can also be authorized under specific conditions

Funding

- Financed via **electricity market mechanisms**
- **OMIE** settles the difference between market and auction price (CfD), passing costs to suppliers
- **Suppliers embed these costs in retail prices**, indirectly passing them on to consumers (Source)

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[1]Source; [2]Source; [3]Source

Factsheet Spain (2/2)

Key parameters

Strike price	Determined via competitive tender
Market reference price	Day-ahead hourly market price is considered for all technologies
Indexation	No indexation (Source, Source)
Duration	12 years
Funding volume	-
Number of contracts /subsidized capacity	4 auction rounds between 2021 and 2022[1] Total awarded capacity: 6380,5 MW
Issuance private/ public	**Public** (via state-run REER auctions by MITECO)

Summary of the latest tender results

- Early auctions (2021) were **highly competitive**, with full allocation and low strike prices (~25-30 EUR/MWh)
- Later rounds (2022) saw **weak participation**, low awarded volumes and higher bid prices due to market conditions and increase project cost for investors (45.5 MW onshore wind capacity awarded to two projects (39-45 EUR/MWh) (Source)
- Auction maximum price (cap) was not disclosed for 2022 but analysis suggest levels around 47 EUR/MWh

Summary of tenders:

Round	Planned capacity	Awarded capacity
1st 26 Jan 2021	3.000 MW	3.034 MW (Source)
2nd 19 Oct 2021	3.300 MW	3.124 MW (Source)
3rd 25 Oct 2022	520 MW	177 MW (Source)
4th 22 Nov 2022	3.300 MW	45,5 MW (Source)

1) Source

Additional support schemes and conclusions

Additional support schemes*:

- **Energy intensive Consumer Regime** (Source): Approved in March 2023, offers levy reductions of 75-85 % on electricity charges for firms in 114 high-energy sectors (Source), provided they invest in energy efficiency, emissions reduction, or renewable sourcing.
  - Total funding volume (2023-2028): 396 mil. EUR (Source)
- **CO_2 cost compensation scheme:** Established by RD 309/2022 (Source), provides up to EUR 2.9 billion in total funding through 2030 to support energy-intensive industries. It offsets indirect CO_2 costs from electricity prices and aims to maintain industrial competitiveness and prevent carbon leakage.
- **Capacity mechanism**: Spain plans to introduce capacity remuneration mechanisms for firm capacity providers (e.g., gas power plants and battery storages).

Conclusions:

- RES support scheme was halted in late 2022 due to lack of investor interest driven by increase in capital and project cost and low price caps of the auction.
- No specific industry scheme is currently in place that supports the industry on electrification.

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