Research Paper on

The Contracts for Difference

CAPACITIES FOR AN ENERGY TRANSITION

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SAGEN SOUTH AFRICAN-GERMAN ENERGY PROGRAMME

NORD POOL

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Contents

Abbreviations

CfD	Contract for Difference
CPA	Central Purchasing Agency
DAM	Day Ahead Market
FiT	Feed-in-Tariffs
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IPP	Independent power producer
PPA	Power Purchase Agreement
RES	Renewable Energy Sources
SAGEN	South African-German Energy Programme

1. Introduction

1.1 Background

The South African–German Energy Programme (SAGEN), funded by the German government and implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), was approached by Eskom Transmission to provide further technical assistance and capacity building for the implementation of reforms in the power sector. This research paper has been developed under the project "Capacities for an Energy Transition" as an input to the power sector reform process, where the use of Contract for Difference is part of the planned implementation of the Central Purchasing Agency (CPA). Separate documents outline the overall expected high-level market design for South-Africa and the functions of the CPA. It is beneficial for readers of this document to also read these papers, as they are interlinked and provide insight into key aspects of how the future electricity market in South Africa could work. This report was prepared by Hans-Arild Bredesen from Bredesen Consulting, acting as a sub-contractor to Nord Pool Consulting.

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1.2 Content

This research paper presents the underlying concepts and selected international examples of the use of a **Contract for Difference (CfD)** to support policy objectives, more specifically as:

a) a financial mechanism

b) a transitional measure

c) a support mechanism, or

d) a hedging tool.

CfDs have many use cases in electricity markets such as incentivising investment to new production, for example, Feed-in-Tariffs (FiT) or similar; curbing the exercise of market power, for example, Singapore vesting contracts; and as a support mechanism for market reform. A significant positive effect of CfDs is the increased liquidity in the underlying physical short-term market by switching bilateral physical arrangements into the market. CfDs are also used to control risk; hedge electricity prices, for example, when introducing a wholesale market; and to support existing generation capacity. CfDs could therefore have significant potential use in the South African context.

2. The basics of Contracts for Difference and financial energy markets

To understand the function of a Contract for Difference within an energy context, one must first make the distinction between a **physical energy market / contract** and a **financial energy market / contract.** In a physical energy market, such as a Day Ahead and intraday energy market, trading entails a commitment for the delivery and consumption of electricity. Generators enter bids for the volume of electricity they are willing to produce at a certain price and consumers enter bids as to how much they are willing to pay for a specified amount of electricity. A co-optimisation algorithm is then used to match generators and consumers, thereby determining a market price at which the electricity is sold. (For more details on these market mechanisms please see the Eskom Transmission research paper entitled "The South African Electricity Market").

In a financial energy market, parties do not have to hold or trade the underlying physical commodity itself (in this case electricity), but rather trade based on the changing value of the underlying commodity (the derivative) using the physical energy market as the reference point. A financial energy market thus functions in much the same way as a stock market. CfDs have a long history as a mechanism of trading in financial markets. A CfD is a financial derivative contract between two parties, where the parties settle based on the price difference between an agreed upon price (strike price) and the underlying market price in the reference market (reference price).

This type of contract can be implemented as an agreement between

- two market participants (on a bilateral basis as a substitute for a physical bilateral contract)
- a market participant and a central counterparty / marketplace, or
- two market participants via a central counterparty / marketplace.

A common setup in energy transitions and government subsidy schemes is a central counterparty such as a government agency or a government fund acting as the counterparty to the CfD. This allows the other party to the contract to reduce exposure to the volatility of energy prices in short-term physical market(s).

There are two categories of CfDs: **two-way** and **one-way** CfDs. A **two-way CfD** is a contract where the direction of payments within the CfD depends on whether the difference between the strike price and reference price is negative or positive. The effect is that in all circumstances, both the buyer and seller will pay or get paid the strike price. In practical terms, the parties to the CfD effectively agree on the strike price as the price to be paid

for the specified volume of the underlying entity within the contract. The effective outcome of CfDs is that after both the physical wholesale market and the CfD contract are settled, the combined amount both parties have paid / have been paid adds up to the strike price multiplied by the agreed volume. Such a mechanism creates security and stability in the form of a long-term fixed energy price for both parties, while increasing liquidity due to their participation in the short-term physical wholesale market. This is the most common implementation of CfDs and there are many examples of the implementation of financial derivative markets for electricity, where these contracts are offered as standardised products to trade.

By comparison, in a **one-way CfD** payments are one-directional and in the case of the reference price being higher than the strike price, no payments are made. This ensures a minimum price for the seller and allows it to keep its profit if the reference price is higher than the strike price. As an example, in a certain support scheme for renewable energy sources (RES), a generator benefits if the market price exceeds the strike price.

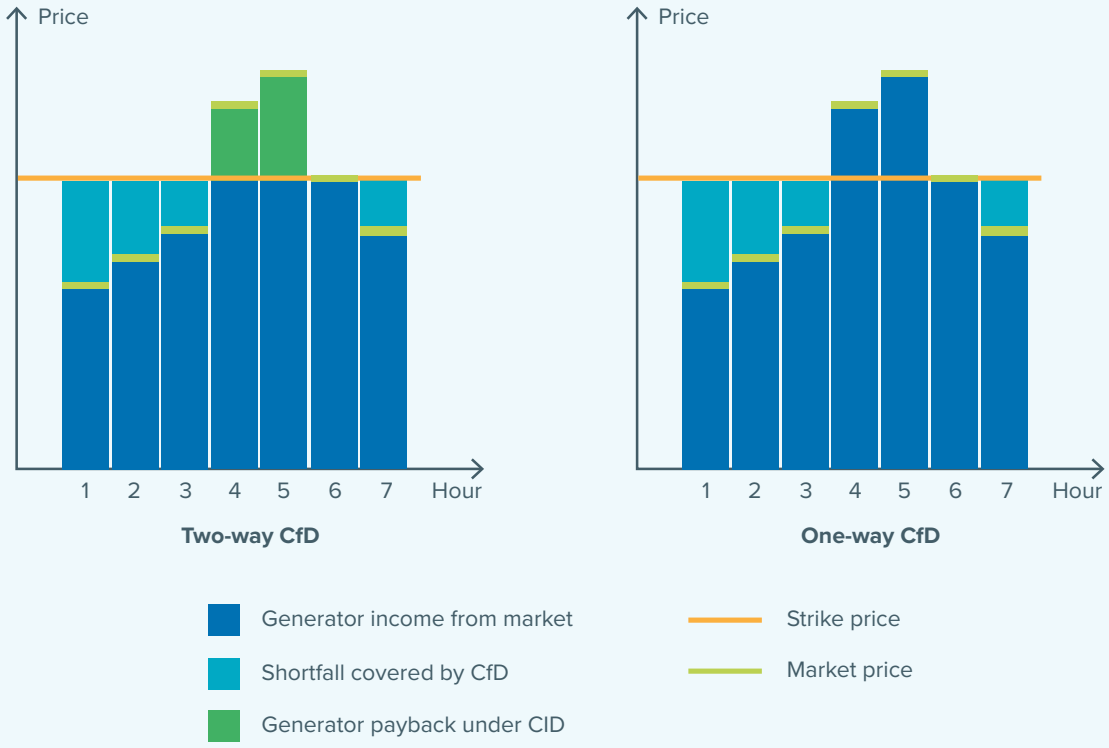

Figure 1. Example of payments under a CID

Figure 1 illustrates how the payments in these two types of CfDs will be facilitated from the point of view of a generation company. The left side diagram of the figure presents a scenario with a two-way CfD. In this scenario, if the market price is lower than the strike price

(hours 1–3 and 7), the generator receives income from the market (dark blue) according to the market price (lime green), and the CfD counterparty pays the generator for the difference between the strike price (yellow) and the market price (dark green). If the market price is above the strike price (hours 4 and 5), the generator must pay back the difference between the strike price and the market price. If the market closing price is equal to the strike price, no payments outside of the market are made (hour 6). Appendix 1 presents a practical numerical example of how the turnover from a two-way CfD would be calculated compared to a Power Purchase Agreement (PPA).

The right-hand-side diagram in Figure 1 presents a one-way CfD, where the difference to a two-way CfD is that when the market price exceeds the strike price, the generator gets to keep this difference between strike price and market price as extra revenue from the wholesale market. It should be noted that CfDs can be settled either at the same time resolution as the underlying market or less frequently and based on either hourly market prices or average prices. In the examples of Figure 1 the settlement is on hourly market prices.

2.1 Contracts for Difference as regulated schemes

The length of CfD regulated schemes can vary greatly. Support schemes for renewable energy generally last from 10 to 20 years. In some cases, support schemes may be tied to regular (for example, biannual) reviews, where the regulator determines if the CfD is still appropriate based on new developments in the market. A CfD can cover a specified amount of energy produced or consumed, or all the energy the generator is able to produce. In transitory measures for market deregulation and energy transitions, the CfD might be tailored so that the energy contracted decreases annually to give the parties a smooth transition into a fully competitive market and pricing.

Depending on the purpose of the CfD, there are several ways the strike price can be set or agreed upon. A government can administratively determine a strike price based on benchmark values such as an estimated cost of new electricity generation and the price of carbon emissions. Arranging an auction to get the best competitive strike price is also common in schemes that are intended to incentivise new capacity. Alternatively, the parties to a bilateral CfD can agree on a price based on their expectation of future developments in the market price.

CfDs are an effective way to move trade from bilateral physical contracts onto a short-term wholesale physical market. Typically, when introducing CfD schemes to support market opening, some concerns are raised as to whether the contracted parties distort the market with the guaranteed price from the CfD (which might be seen to disincentivise bidding in a competitive way). Despite CfD covered generators being compensated for their production, there are several reasons why the incentive to bid competitively still exists.

Firstly, the CfD premium will cover only the shortfall between the market price and strike price. In other words, in a case where a CfD covered generator bids an artificially low price, they would get compensated based only on the overall market closing price and thus wouldn't gain from bidding artificially low (or high). Secondly, in competitive power markets the generators always aim to maximise their profits. Bidding on artificially high prices might result in the generator not being scheduled, missing any profit from that day. Thirdly, and most importantly, bidding at a considerably lower price level than what is justified, without a clear need to do so, amounts to market manipulation, which is prohibited in market rules.

2.2 Contracts for Difference as generic market products

The implementation of a financial electricity derivatives market is well-used and proven internationally. The main purpose of this is to allow buyers and sellers to hedge their price risk in the short-term physical market. In short-term physical wholesale markets, the goal is to produce marginal prices based on choosing the cheapest generation resources to meet the demand. Based on this, the short-term physical wholesale market normally produces a volatile short-term electricity price (reference price) which represents the underlying situation in the power system hour by hour. The benefit of a volatile reference price is that it creates incentives for investing in new production or transmission in areas with high prices or where access to cheap electricity is limited (often called a **price signal**). The downside of volatile prices is that they cause significant uncertainty and risk for market participants and investors in terms of their return on investment. An electricity derivate market can be introduced as a means to manage this price risk and provide hedging opportunities. This is typically implemented as an open marketplace with a central counterpart or as pure bilateral arrangements.

3. Potential applications of Contracts for Difference in a South African context

CfDs are used for various purposes, and the design parameters of the contracts can be tailored to suit policy needs. Table 1 presents various common applications of CfDs.

Table 1. Different applications of Contracts for Difference

Application	Explanation	Main benefit
Tool used by government in energy market liberalisation	When a wholesale electricity market is newly established, CfDs can be set up solely for the purpose of hedging the prices for an initial period for the generators and retailers who are not yet accustomed to the mechanics of the wholesale market. When imposed at the time of deregulation or transition, this is often referred to as **vesting contracts.**	Introducing participants to the market without exposing them to the full risk of volatile prices from the start, while retaining price signal from the market
Tool used by government to incentivise investment into desirable technologies	Emergent technologies are typically more expensive as the value chain is not yet fully developed. Many renewable energy support schemes around the world rely on CfDs or similar mechanisms to guarantee prices for newly installed renewable energy capacity.	Incentivising investment into desirable technologies and increasing market liquidity
Curbing the exercise of market power	A government can enforce mandatory CfD schemes on dominant market participants, to reduce their market power. Guaranteeing a price with a CfD, for a certain amount of production during scarce supply, will discourage a producer from misusing its market power, to withhold capacity.	Reducing incentives to use market power
Replacing physical bilateral contracts	A CfD can be used instead of a physical bilateral contract. Instead of paying an agreed upon price for an agreed upon volume of electricity, the parties to the contract sell and procure their electricity on the organised markets, with the CfD providing financial certainty.	Increasing market liquidity, introducing participants to the market without exposing them to the full risk of volatile prices from the start, revealing the marginal price of the system

4. Power Purchase Agreements / vesting contracts in South Africa

South Africa is currently aiming to create a new scheme where a CPA is established as a market support entity. The CPA will then be the counterpart to PPAs signed with Eskom Generation's power plants. This structure of the proposed PPAs is illustrated in Figure 2.

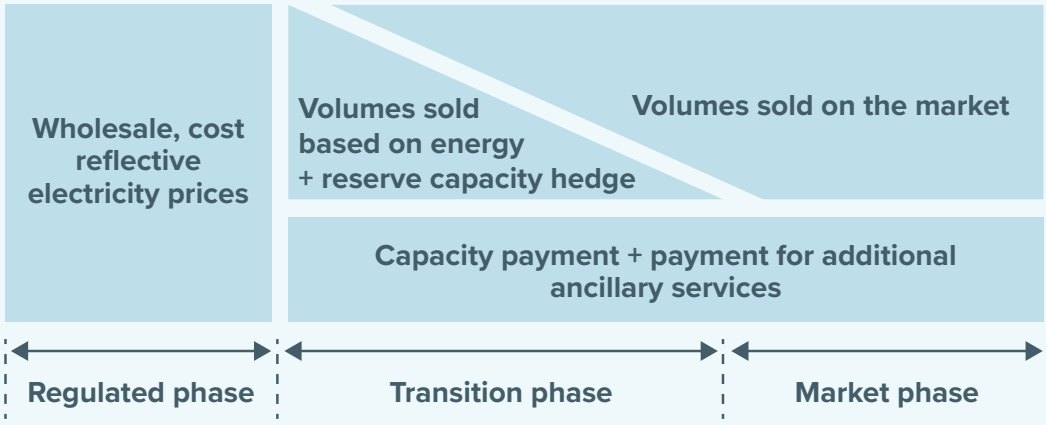

Figure 2. South African Power Purchase Agreement / vesting contract scheme

One main difference to the other international examples provided here is that this scheme has a physical part through capacity payments. The PPAs (vesting contracts) consist of three integral parts:

1. **Capacity payment**. This part will be applicable to the PPA holder for the lifetime of the plant. Based on the contract specifics, the contracted power station is paid for available capacity for each hour of the month. The available capacity is then declared in the Day Ahead Market (DAM). The CPA will pay for the declared available capacity at an availability rate that is calculated based on predetermined formula, and takes into account capital recovery, annual fixed maintenance recovery, annual fixed operating cost and effective availability. Penalty rates will apply when the contracted power station does not have a metered availability equal to their declared availability.

2. **Ancillary services capacity payment**. This part will cover ancillary services such as starting a unit without external grid support (black starting), continuing to power an area without external grid support (islanding) and voltage regulation. Ancillary service terms in the contract may not apply for the full life of plant. Some of the payments may apply to technical adjustments or investments made to the plant and would incorporate a longer term pay-back (for example, islanding and black starting) whereas others could be more dynamic and have an initial capacity component that terminates before the contract expiry.

3. **Energy hedge.** Generally, the energy production is expected in the long run to be compensated in the DAM. However, in the medium term it is expected that specified volumes will be hedged against an average energy rate applicable in the year. This energy rate should cover the fuel costs of the generator as well as variable operations and management costs. The volumes associated with the hedge shall reduce annually, allowing for gradual exposure for the power stations to market prices. Participation in the market, as well as the price that is offered into the market, are requirements of the PPA. These prices should reflect the average energy rate for the year, allowing for a cone of 15% deviation to accommodate short-term changes in incremental cost.

For more information, please read the Eskom Transmission research paper entitled “The Role of the Central Purchasing Agency”.

5. Case studies

5.1 CfD support schemes for renewable energy: UK and Finland

The main mechanism of the UK government for renewable energy support is a CfD support scheme that is targeted at supporting low carbon energy project implementation. The UK CfD is a contract between a low carbon electricity generator and the government-owned Low Carbon Contracts Company (LCCC) and is a textbook example of a renewable energy support scheme. The UK CfD requires the generators to sell their energy to the wholesale market and offers a guaranteed price for 15 years. The strike price is determined in an auction where the prospective generators bid their strike price and compete for the contracts. The UK CfD is a two-way contract, therefore when the market price exceeds the strike price, the generator is required to pay back the difference. CfDs are awarded under the scheme in auctions, held in periodical allocation rounds, where a number of projects that fit in a pre-determined budget are accepted. Four allocation rounds have been completed to date, with the latest ending in July 2022. Prior to the fourth round, the scheme had supported projects of differing low-carbon technologies totalling to 15,5 GW. The budget for the CfD scheme is funded by payments from electricity suppliers under a CfD Supplier Obligation Levy. The levy is two-way in the same sense as a CfD: if the reference price is higher than the strike price, Low Carbon Contracts Company returns payments to suppliers.

The Finnish CfD based Feed-in-Tariff (FiT) support scheme represents a slightly different approach to support renewable energy sources development. The Finnish scheme was introduced in 2011 and the issuing of new contracts stopped in 2017 when the limit of 2 500 MW of new wind power projects was reached. The main differences to the UK CfD are twofold. Firstly, instead of an auction, the strike price was administratively set to 83,5 EUR / MWh for all eligible producers. Secondly, the contract is a one-way type CfD – if the reference price exceeds the strike price, the generator does not pay back the difference. Within the Finnish FiT, the producers are paid the difference between the strike price and the three-month average market price according to the electricity produced. Energy Authority, the Finnish National Regulatory Authority acts as the counterpart to the CfD. The contract length is 12 years. The support scheme targeted wind power plants, biogas plants and wood-based fuel plants that fulfilled certain criteria and was offered to new projects up to a certain capacity threshold. There is a floor condition to the strike price, where, if the market price remains under 30 EUR / MWh during the three months settlement period, the strike price for that period is reduced by 30 EUR to 53,5 EUR / MWh.

5.2 CfDs as tools in market liberalization: Bulgaria

Bulgaria is currently undergoing energy market liberalisation and in a 2016 report the World Bank recommended CfDs as one of the tools to target specific parts of the electricity sector to introduce the transition. The main aim of the recommended CfDs is to increase the liquidity of the Bulgarian Day Ahead wholesale market by integrating independent power producers into the market. The recommendation includes replacing long-term PPAs, off-taker agreements, and fixed feed-in tariffs with CfDs that force the producers to trade in the organised markets, while respecting their earlier contract terms. A stepwise rollout is recommended, so that the CfDs would be imposed on different producer groups gradually. The Bulgarian Electricity Security Service fund would act as the counterparty to the CfDs. The report also proposes that CfDs could act as a support mechanism for liberalising the regulated sector.

5.3 Vesting contracts for curbing the exercise of market power: Singapore

The National Electricity Market of Singapore has had a vesting contract scheme in place since 2004 that applies to both the generation and retail segments. The eligible power producers are guaranteed a price (vested) for a percentage of their production, and on the retail side the vesting contracts cover the non-contestable load (meaning not part of the market) and part of the contestable load (part of the market). The vesting contract is a two-way CfD issued by the governing body, the Energy Market Authority, covering a specified quantity of electricity. The quantity allocated follows a calendar that sets a different hedge proportion or hedge quantity based on the day of the week and the time of day, to vest more electricity during peak consumption. The purpose of the Singapore vesting contract scheme is to curb the exercise of market power, more specifically to incentivise the dominant producers to not artificially increase prices by withholding capacity. The Energy Market Authority revises the scheme biannually and determines the vesting level and strike price (vesting price) based on comprehensive reviews. The vesting price is tied to an administratively calculated Long Run Marginal Cost of the most efficient generation technology that at the time of the review covered at least 25% of the electricity consumption. The national market support service company, SP Services, is the counterpart to the CfDs. The dominant producers see the scheme as financial support to maintain existing capacity, but the governing body maintains that the purpose is to reduce market power and are gradually reducing the vesting level.

6. Conclusion

In conclusion, CfDs are an extensively used financial tool in which both parties to the contract agree on a price or a minimum price for a specified volume of the underlying asset (in this case electricity). The fact that one does not have to physically own the underlying asset means that the parties can trade on the short-term physical energy market, while benefiting from the long-term price stability created by the contract. These contracts can therefore be used to create desirable market conditions such as increased liquidity on the short-term physical energy market and investment in new capacity when price signals are insufficient to meet system needs.

7. Further reading

Contracts for Difference (n.d.) *What is the Contracts for Difference Scheme?* Available at: https://www.cfdallocationround.uk/about

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The World Bank (2016) Bulgaria Power Sector: Making the Transition to Financial Recovery and Market Liberalization Summary Report: Reimbursable Technical Assistance. Available at: https://www.me.government.bg/files/useruploads/files/wb_ras_i__summary_report_en.pdf

Appendix I: A practical example of a Contract for Difference

In this practical example, we compare the turnover of an Independent Power Producer under a PPA and a CfD for 24 hours. In the example, both the PPA contract price and the strike price of the CfD are 52€ / MWh and cover a volume of electricity of 7 MW. The Day Ahead Market (DAM) price fluctuates during the day. The price difference between the strike price and the DAM price is calculated as follows

While the turnover is calculated as

$$\textit{Price difference} = \textit{Strike price} - \textit{DAM price}$$

While turnover is calculated as

$$\textit{Turnover} = \textit{Price} \times \textit{volume} \times \textit{time}$$

$$€ = \frac{€}{MWh} \times MW \times h$$

Table 2 indicates the resultant turnover for the DAM, CfD and PPA.

Table 2. Sample prices for a Power Purchase Agreement versus Contract for Difference

Hour	Strike price	DAM price	Price Difference	Volume	Turnover in DAM	CfD Transfer	Turnover with CfD	Turnover with PPA
Units	€ / MWh	€ / MWh	€ / MWh	MW	€	€	€	€
1	52	26,87	25,13	7	188,09	175,91	364	364
2	52	26,97	25,03	7	188,79	175,21	364	364
3	52	26,8	25,2	7	187,6	176,4	364	364
4	52	26,17	25,83	7	183,19	180,81	364	364
5	52	27,3	24,7	7	191,1	172,9	364	364
6	52	28,22	23,78	7	197,54	166,46	364	364
7	52	38,75	13,25	7	271,25	92,75	364	364
8	52	51,31	0,69	7	359,17	4,83	364	364
9	52	54,05	-2,05	7	378,35	-14,35	364	364
10	52	50,24	1,76	7	351,68	12,32	364	364
11	52	45,2	6,8	7	316,4	47,6	364	364
12	52	46,01	5,99	7	322,07	41,93	364	364
Hour	Strike price	DAM price	Price Difference	Volume	Turnover in DAM	CfD Transfer	Turnover with CfD	Turnover with PPA

Units	€ / MWh	€ / MWh	€ / MWh	MW	€	€	€	€
13	52	41,47	10,53	7	290,29	73,71	364	364
14	52	42,9	9,1	7	300,3	63,7	364	364
15	52	44,9	7,1	7	314,3	49,7	364	364
16	52	49,72	2,28	7	348,04	15,96	364	364
17	52	60,07	-8,07	7	420,49	-56,49	364	364
18	52	71,45	-19,45	7	500,15	-136,15	364	364
19	52	67,87	-15,87	7	475,09	-111,09	364	364
20	52	52,85	-0,85	7	369,95	-5,95	364	364
21	52	42,5	9,5	7	297,5	66,5	364	364
22	52	37,62	14,38	7	263,34	100,66	364	364
23	52	32,95	19,05	7	230,65	133,35	364	364
24	52	29,24	22,76	7	204,68	159,32	364	364

The money transfer required by the CfD is calculated based on the price difference.

- When the DAM price is below the strike price, the independent power producer (IPP) gets paid less in the DAM compared to the PPA. Thus, the CfD pays the difference needed to cover the shortfall.
- When the DAM price is above the strike price, the IPP gets paid more in the DAM compared to the PPA. Thus, the IPP has pay to back to the CfD counterpart the difference to compensate this.

The CfD transfer is calculated as *CfD transfer = Price difference × volume × time*

The total net turnover will be the sum of the revenue received from the DAM and the money transfer carried out with the CfD counterparties.

Turnover with PPA = Turnover in DAM + CfD transfer

The conclusion to this example is that for all hours the total turnover of the CfD is exactly the same as the turnover of the PPA.