ELS ANALYSIS

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NAVIGATING SUPPORT SCHEMES - CONTRACTS FOR DIFFERENCE IN PERSPECTIVE

- A Report for the Swedish Wind Energy Association

*This report is carried out by **ELS Analysis** for **The Swedish Wind Energy Association**. ELS Analysis is an energy focused advisory and data modelling provider, offering analysis on global energy markets, policy developments, political risks and how they are interlinked.*

Support schemes for new low-carbon energy production are at the centre of the debate on how to speed-up investments into new power generation. Forecasts indicate strong growth in green electricity demand, yet current levels of investment into green energy sources seem insufficient.

The current investment environment is characterised by both policy and market uncertainties. For governments to meet their national energy and climate targets, they increasingly realise the risks need to be divided between state and market.

Contracts for Difference, CfDs, have proven to be an effective risk allocation tool and if well-designed it can contribute to the growth in new power production.

TABLE OF CONTENT

ABOUT ELS ANALYSIS

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- We cover all north-west European markets
- We are based in Stockholm and London
- Our team has regulatory, market and technical expertise in the energy and commodity spheres
- We provide user-friendly analytical tools through ELS Analytics' platform

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INTRODUCTION

On behalf of the Swedish Wind Energy Association, ELS Analysis has prepared a report explaining the role of Contracts for Difference, CfDs, in a broader policy and market environment. To understand the specific role of CfDs in supporting low-carbon energy production, CfDs are compared to other types of support schemes, such as investment-based support schemes but also other risk allocation tools within the group of revenue stabilisation schemes. An analysis of how different electricity-producing technologies can benefit from a CfD scheme is also provided, along with a discussion of the role of CfDs in the wider electricity market. The report also provides a broader understanding of which factors need to be considered when a government decides to introduce a CfD scheme, as well as what legal framework the EU is proposing to make CfDs the union's main principle for price support schemes.

The purpose of the report is to provide the Swedish Wind Energy Association with a supporting document to understand the role of CfDs, their impact on green investments, their correlation with other support schemes, their effect on the functionality of the market as well as the preconditions for implementing such a scheme in Sweden.

The report is structured into three chapters. The first chapter focuses on CfDs in the broader subsidy and risk-sharing perspective while the second chapter covers the specifics of different CfD schemes. The last and third chapter provides insights into how CfDs impact the wholesale electricity market and system stability. It also lists factors that are useful to take into consideration when introducing a CfD scheme in a market.

MAIN CONCLUSIONS

1. The call for governments to support build-out of new low-carbon energy production is increasing. The investment environment has, however, proven difficult lately and the market signals that the financial risk prevents investors from taking final investment decisions.

2. Support schemes have developed from fixed subsidy schemes to more market based risk management tools. Different technologies require different kind of support, depending on their different business models and characteristics.

3. For low-carbon energy production support schemes can be grouped into investment-based schemes and revenue stabilisation schemes. CfDs belongs to the latter group and have been increasingly used for renewable energy projects. Since renewable projects have a high upfront cost and a low operational cost, volatile electricity prices and uncertain revenue streams present the largest risks for investors.

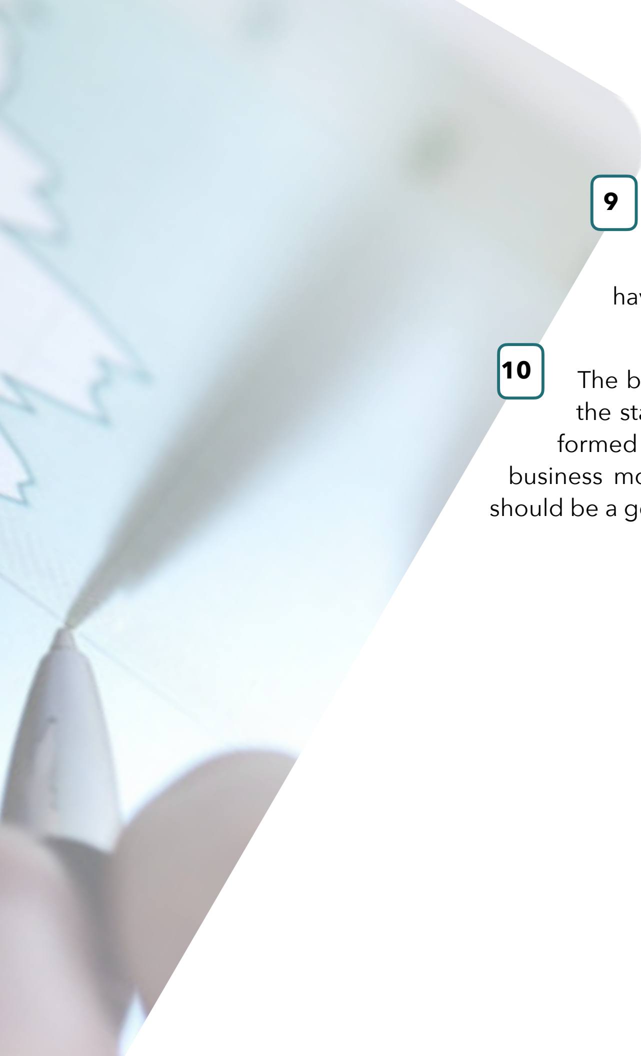
4. The need for risk-sharing does not mean that projects necessarily are unprofitable, but rather that investors need security regarding revenue stabilisation. A traditional CfD provides a price risk hedge by setting a fixed strike price for every unit of produced electricity. In a two-sided CfD, a state entity bears the downside risk, i.e. if the reference price (the market price) trades below the set strike price the “state” pays the electricity generator and if the reference price trades above the strike price, the generator pays the state the upside difference.

5 There are several design options that need to be considered when introducing a CfD scheme. It is very important to clarify the objectives behind the scheme and evaluate how it will interact with other national policy priorities and markets.

6 Funding the CfD scheme is one of the most difficult design options, since the choices reflect how much risk the state is willing to take. The government can decide to limit the budget to only the predicted technical cost of the project, or base its cost assumption on a net present value methodology and even inflation adjust the contract's strike price.

7 All these different design options are predicated on policy/political priorities, but also a deep knowledge of the market and specific project costs. It also requires the state to have the legal expertise and capability necessary to plan and execute a CfD scheme, either through an auction or an administrative allocation, and finally to enter into a contract with the electricity generator.

8 Concerns have been raised over price hedging long-term contracts' impact on the wholesale electricity market. When a large part of the market is shielded from price signals the effect could be that hedged generators do not adjust their production according to the needs of the market. Thus, price volatility increases through imbalances. This report acknowledges this fact, but does not necessarily conclude that this is the root of the problem, since the current marginal pricing system lacks sufficient incentives to prevent producers with low production costs to maximise their production even when they are un-hedged.



9 The EU favours double-sided CfDs among other price support schemes in the updated legal texts of the electricity reform package. However, compared to the initially proposed text on CfDs, making them mandatory, the union's CfD aims have been watered down, leaving member states with more flexibility.

10 The broader market signals show investments being directed into those markets where the state provides some level of risk sharing. The competitive landscape is increasingly formed around those governments providing the best designed CfD schemes. However, business models can vary a lot and investments can happen without CfDs. This conclusion should be a general understanding of the business and market environment.

CHAPTER 1: BACKGROUND - SUBSIDIES & RISK SHARING TOOLS

CFDS IN A BROADER SUBSIDY & RISK SHARING PERSPECTIVE

To enable large-scale buildouts of new low-carbon energy production, most governments around the world have realised that the state needs to play a more active and central role in both planning, executing, and evaluating the country's energy production expansion. This has to do, to a large extent, with providing the right legal and regulatory framework enabling market players to align their investments with national and/or regional energy and climate strategies and low-carbon production targets. Nevertheless, in some cases, it also involves sharing the financial risk and economic burden that some low-carbon technologies suffer during the early phases of expansion. Different technologies bring different kinds of investment risks. Thus there is not one subsidy scheme or one risk-sharing tool that suits all. This chapter will provide a broad understanding of the most common production-based subsidies and risk-sharing tools used by different governments worldwide and place CfDs in that broader composition of economic support schemes.

Subsidies sometimes tend to be viewed negatively in the energy debate due to several reasons. A prominent reason for subsidy skepticism is that any kind of state intervention risks distorting the market and its ability to stimulate investment into the most cost-effective energy production sources. Historically, subsidy schemes for low-carbon energy sources have proven expensive and inflexible, which at times has challenged the market's ability to balance itself and send short-, medium-, and long-term price signals. Another reason why subsidies are often criticised is that the majority of energy subsidies are related to fossil energy production and consumption. According to the International Monetary Fund, IMF, fossil fuel subsidies, including both explicit and implicit subsidies, reached $7 trillion globally in 2022. This was an increase from previous years, as a direct result of the energy crisis caused by Russia's renewed invasion of Ukraine.

Nevertheless, the definition of subsidies is very broad and ambiguous and subsidy schemes target different parts of the energy economy. The usual divide is between production and consumption, but it can also be directed to relevant infrastructure and services as well as indirectly through trade and consumption quotas. In the broader definition of a subsidy, it is not only that a subsidy is structured as direct funding in terms of cost relief, but it could also add a cost to an unfavourable alternative. See figure 1.1 for a general overview of different subsidy categories.

Since energy markets are highly politicised and subject to several political agendas and regulations it can be argued that energy markets struggle to achieve the ideal "perfectly competitive market" that economists often use as a benchmark to judge whether public intervention is justified or not.

During the past decade, subsidy schemes have gone through some significant developments and there is a clear movement away from fixed subsidies to more market-based risk-sharing instruments, where the state and the market share the risk. When introducing a subsidy or risk-sharing scheme it is important to clarify the objectives behind the scheme and evaluate how it will interact with other policy priorities. Those objectives can vary a lot from one country to another and are often closely connected to the country's national energy and climate strategy and targets. The objectives are often related to:

- Affordability, i.e providing affordable energy for low-income households
- Market disruptions, i.e market correction for unpriced externalities
- Enable "dynamic economies of scale", i.e induce technology learning and drive down the costs of new technologies
- Energy security, i.e reducing import dependence through stimulating national investments

Figure 1.1: Overview Subsidy Categories & Target Areas

Source: ELS Analysis, IRENA

INVESTMENT & REVENUE-BASED SUPPORT SCHEMES

For this report's focus on CfDs we now turn to the difference between investment-based and revenue-based support schemes for energy production, which are at the center of the discussion about support schemes for low-carbon energy production. As mentioned above, there are many different ways to stimulate investments in new production. This could be done indirectly, through state support for consumption that increases the acceptance of higher electricity prices, but also through, for example, state-funded infrastructure projects that lower the overall project cost. However, if looking at specific production-based support, it can be useful to divide them between investment and revenue-based schemes, since the two of them are more or less suitable for different low-carbon technologies.

By analysing project costs for different technologies, Capex and Opex look very different from one technology to the other and it can be helpful to understand these factors when evaluating which financial risk a particular project faces. A general view is that the higher upfront risk a project faces the more effective it is to introduce a Capex-related investment-based support scheme. However as will be discussed below, it is not the pure Capex percentage of the total project that determines the need for an investment-based support scheme, but rather Capex related to the volume produced under the plant's lifetime. If a project instead is more exposed to the market risk, i.e. securing a high enough revenue stream based on increasingly volatile power prices, a revenue-based risk-sharing scheme is more suitable. Both investment and revenue-based support schemes can be either carried out by an auction, which determines the level of support, or through an administrative allocation decision-making process. The underlying instrument is the same in both processes, but the important difference is that in an auction the final level of support is determined by market players, whereas in an administrative allocation process, the decision is the government's.

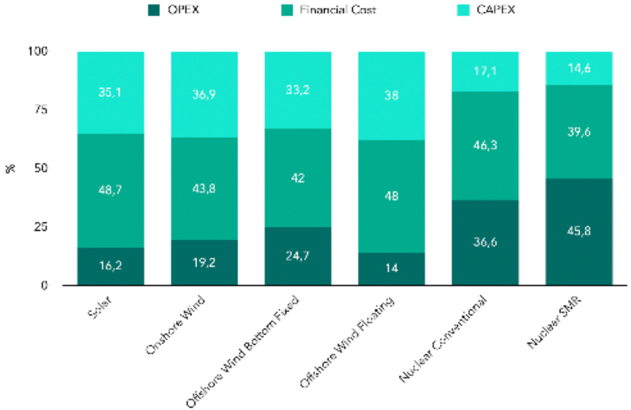
Capex, Opex & financing cost for low-carbon technologies

The following graphs show ELS Analysis' assessed division of Capex, Opex, and financing cost for a number of different low-carbon technologies based on ELS' modelled Levelised Cost of Energy, LCOE, for each technology. These assessments represent purely technical LCOEs and do not include any policy risk or other related costs like for instance cost-driving project delays. The below graphs show both LCOE-based assumptions for each technology, if they were to be built today, but also should they be built in 2030 when we assume much of the build-out will take place. ELS' cost outlook falls further in 2040 and 2050 for higher-cost technologies.

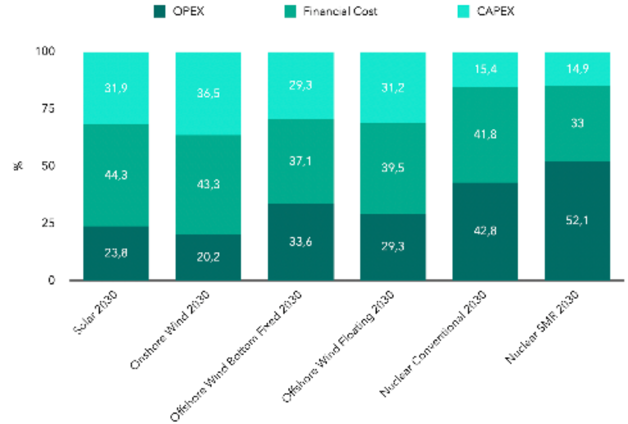
As mentioned above, the percentage of the Capex and Opex is only relevant if analysed in relation to the volume produced and the plant's lifetime. New nuclear and offshore wind, which today have the highest LCOE among the technologies included in the below graphs, will be compared in this section to illustrate how this can be understood from a financial risk point of view.

When looking at graphs 1.1 and 1.2, where just the different cost categories are shown in percentages, the share of Capex for a nuclear power plant is lower than for offshore wind because nuclear power plants produce higher volumes of electricity (MWh) over their lifetime than an offshore wind farm of the same capacity, so Opex takes a larger share of costs. However, as seen in graphs 1.3 and 1.4, in reality, nuclear has both a higher Capex and Opex, per MW of installed capacity, than offshore wind. This is because a high required rate of return, RRoR, causes the LCOE of nuclear power to rise much more than the LCOE of offshore wind. The reason is that nuclear power's upfront cost (the capital cost in €, which is realised early in the lifetime of a plant), is much higher relative to the net present volume of energy produced over the plant's lifetime (in MWh). By contrast, offshore wind's upfront costs are lower relative to the lifetime volume of energy produced. Additionally, since nuclear power operating costs are estimated higher, the profit margin of nuclear power (power sale revenues minus operating costs) is lower for nuclear power than offshore wind. Thus, nuclear power's ability to pay back its high upfront costs is more sensitive to high RRoRs than offshore wind, making the investment case for nuclear power more complex.

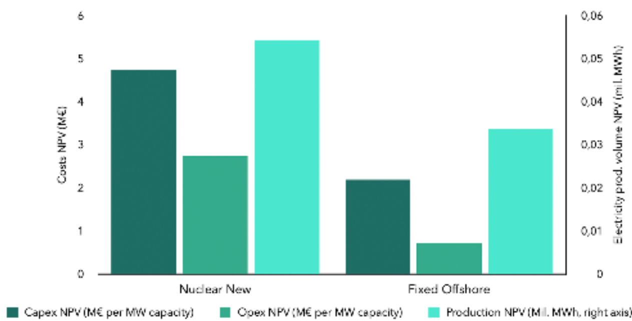
Graph 1.1: LCOE-based Cost Category Division - Current



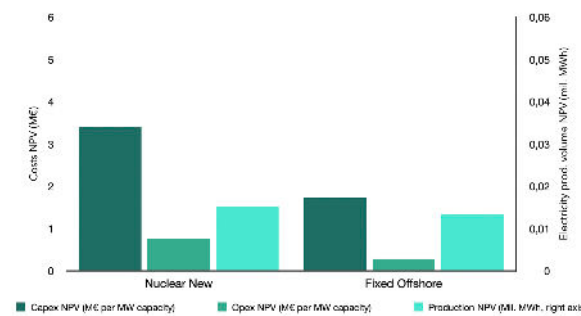
Graph 1.2: LCOE-based Cost Category Division - 2030



Graph 1.3: Comparison of Costs with Production Volumes when RRoR is 7% (all values are MW of installed capacity)



Graph 1.4: Comparison of Costs with Production Volumes when RRoR is 15% (all values are MW of installed capacity)



Source: ELS Analysis

Investment-based support schemes

The main characteristic of investment-based support schemes is that they provide support to the electricity generator early in the project phase. This is usually done through grants, loans, or tax incentives.

Loans & guarantees: Governments offer direct lending by state-owned financial institutions to reduce the cost of financing at low-carbon energy projects.

Accelerated depreciation: The low-carbon energy project is allowed to depreciate its assets at a rate that is higher than normal depreciation rates. The logic behind this is that according to accounting rules, depreciation can be withdrawn from profits and therefore reduce the taxes that the low-carbon energy company has to pay.

Investment subsidy: Governments take on some of the upfront investment cost early in the project phase. This is usually based on a calculated percentage of the total investment of the project or a fixed amount per MW capacity of the project.

Investment tax credits & other tax incentives: Similar to the investment subsidy but funded through different channels, in the form of a tax refund rather than an upfront payment.

Revenue-based support schemes

Revenue or price-based support schemes entail a payment per unit of electricity produced by the low-carbon energy producer. It is within this group that we have seen most developments in recent years and strong movement from more fixed support mechanisms to flexible and market-related mechanisms, dominated by different kinds of CfD schemes.

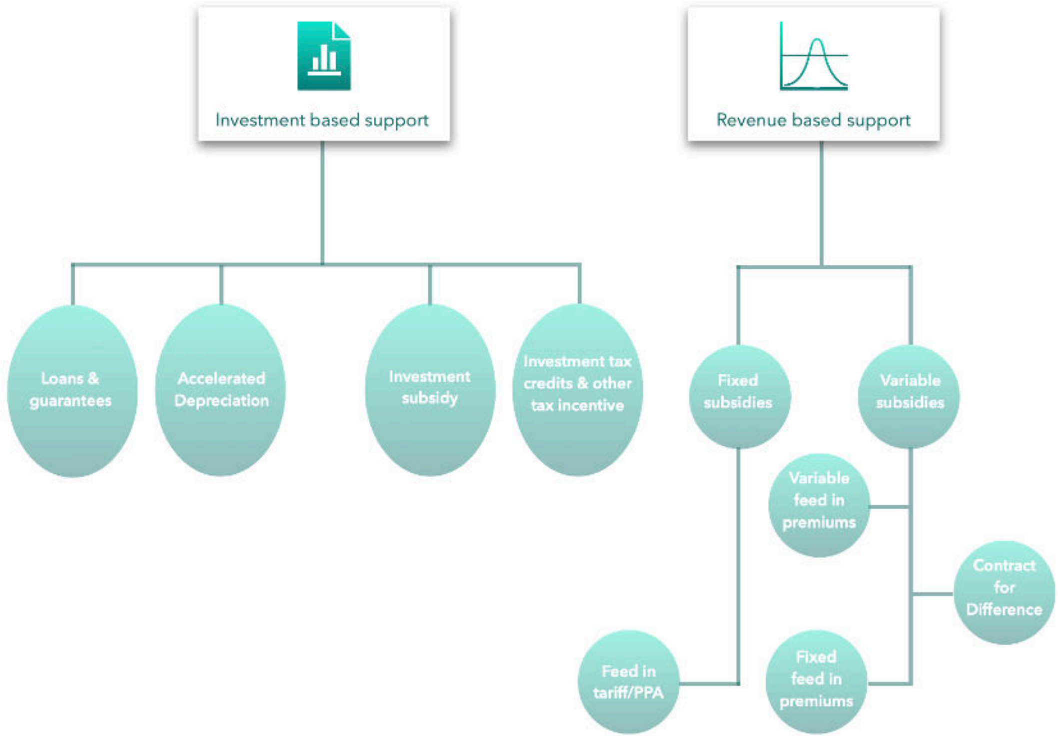
Feed-in-tariffs (FiT): The government mandates a fixed price, usually above the market price, to producers and this is secured through a long-term contract, typically from 15-20 years. FiTs have been used by many governments around the world and have been successful in enabling renewable energy production. However, the scheme has also been criticised for being very expansive and not a suitable tool in a liberalised electricity market environment, where market forces set the price.

Power Purchase Agreements (PPA): In non-liberalised electricity markets, a PPA can be signed by a power producer and a government-mandated agency/distribution company. A fixed price is set in the contract, often related to the cost of realising the project and not the market price.

Feed-in-premiums (FiP): FiP is a developed form of a FiT that is more related to market developments, where the power producer sells electricity in the market for the market price but is provided a "top-up" payment or a premium to the revenues secured on the market. FiP can either be fixed, i.e. the premium level is decided upon beforehand and stays the same for the contract's duration, or sliding, where the premium is equal to the gap between a fixed support level and the fluctuating electricity price.

Contract for Difference (CfD): CfD schemes differ a lot from one country to the other, which will be analysed in-depth in the following chapters. A CfD, in general terms, is a contract that enables the power producer to stabilise its revenues at a determined price level, a so-called "strike price", for the duration of the contract. Under a CfD the payment can be made by the power producer to the government-mandated agency/distributor and vice versa depending on how the market price moves relative to the strike price.

Figure 1.2: Different Investment & Revenue Based Support Schemes



Source: ELS Analysis

SUMMARY & CONCLUSIONS: SUBSIDIES & RISK SHARING TOOLS

The call for governments to support the build-out of new energy production is increasing. The market environment for financing high-cost technologies is difficult, whilst at the same time there is mounting political pressure to meet growing demand and reduce the escalation of emissions. The financial risk often hinders the market from making final investment decisions without any government guarantees or risk-sharing. Thus, the competitive landscape surrounding investments into high-cost technologies to a large extent depends on which role governments play and how much of the risk they are willing to take. Nevertheless, much can be said about subsidy schemes and the negative impact they can have on both markets and state budgets and it is therefore important to assess which subsidy or risk-sharing scheme is most suitable for the individual country.

In this chapter, we have broadly gone through the most common support schemes used by governments around the world. The key points from this overview are:

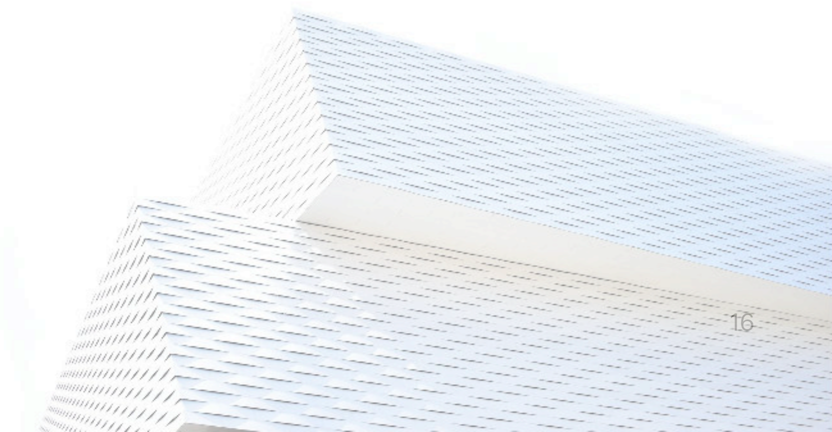
- If introducing a subsidy or risk-sharing scheme it is important to clarify the objectives behind the scheme and evaluate how it will interact with other policy priorities, such as technology-specific production targets/priorities; market conditions & outlooks; state budget conditions and structure.

- Enabling investment decisions for new production can be done indirectly through demand-side support as well as support for infrastructural and/or other related services.

- Investment and revenue-based support schemes target different types of the energy economy and different technologies demand different kinds of support and risk-sharing mechanisms.

- For those capital-intensive technologies that require significant upfront investments before entering operation, such as new nuclear, investment-based support structures are to a large extent required.

- For those technologies that are facing more of a market risk, i.e. where the risk lies in the revenue stream prognosis, such as high-cost renewable projects, more of a revenue risk-sharing instrument is required.



CHAPTER 2: EXPLAINING CONTRACTS FOR DIFFERENCE, CFDS

THE ROLE OF CONTRACTS FOR DIFFERENCE

As described in the previous chapter, when it comes to energy production, a contract for difference, CfD, is a revenue-based risk management tool that provides energy producers and investors with certainty over their future investments. There are different kinds of CfD structures and this initial part of the chapter will go through how CfDs are structured and work in general, but also the main characteristics of the different types of CfDs.

A CfD is a risk management tool that is used by governments and private entities in a range of different markets and the broader economy. Thus, CfDs are nothing unique for the energy sector, however, it has become a prevailing tool for governments around the world when it comes to enabling the deployment of renewable energy production.

In contrast to traditional subsidy schemes, described in previous chapters, a CfD should rather be viewed as a risk-sharing and risk-management tool in markets where alternative hedging opportunities are scarce. In general, this means that the contractual parties do not necessarily need to be a state entity and a private actor (eventhough that is usually the case for renewable CfDs), but a CfD can be a purely commercial agreement between for instance an independent electricity producer and a utility. However, a commercial long-term risk-sharing agreement is often structured as a physical Power Purchase Agreement, PPA, instead, since it usually also includes physical delivery obligations.

Even though CfDs and PPAs differ in some regards and don’t necessarily share the same motive, the one thing they have in common is that they determine a price level per unit of electricity produced, which helps the electricity producer to calculate a project's revenue stream over the contract’s duration.

Why have CfDs become a prevailing tool for renewable energy production?

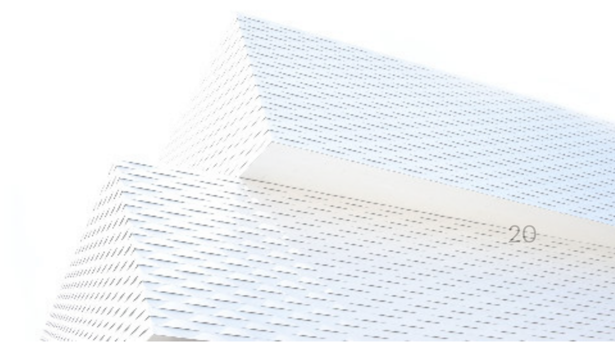
As been described, CfDs are nothing new. They are a hedging tool frequently used in the broader economy and especially in financial markets. In energy markets, however, they are mostly used by governments as a risk-sharing mechanism for producers and investors to mitigate financial risk ahead of investments into renewable energy production in particular. As will be described step-by-step below, in a low-carbon energy CfD, a state entity often takes the downside risk (strike price vs market price) while the electricity generator bears the upside risk (strike price vs market price). Thus, it is a revenue stabilisation tool and the reason why this has proven suitable for especially renewable energy producers is that:

1) Renewable energy projects have far higher initial capital costs than many fossil-fuel-based electricity production alternatives. However, their Operating and Maintenance cost (O&M) are much lower. This is primarily because, in contrast to electricity produced by natural gas, coal, and biomass, renewable energy does not require the purchase of fuel during its operating phase. Fuel purchases and generated revenue are closely related, however, with renewable energy, upfront fixed costs (i.e. Capex and financing cost) during the development and construction phase can reach over 80% (see graphs 1.1 and 1.2). In contrast, a renewable energy producer's O&M expenses are relatively low, which has less of an effect on the producer´s marginal production cost.

   Revenues from selling electricity in the market must cover a renewable energy producer's upfront costs during the operating phase. This carries the biggest risk for investors in renewable energy since they are reliant on the operating phase's profits, i.e. how much the renewable producer produces and how the market prices move. Moreover, the expenses, such as debt servicing and dividend payments to equity providers, carry additional risk because the cost of capital is subject to significant fluctuations based on the overall state of the economy. This is why the slowdown in renewable investments can be closely related to the increasing interest rates of the last couple of years.

2) Compared to other energy and commodity markets, liberalised electricity markets are subject to high degrees of price volatility, due to factors such as variable and inelastic demand, inflexible supply, and limited storage. Since fossil fuel generators have higher marginal production costs and only produce when it is profitable (the merit order), renewable energy producers are price takers because they have very low marginal production costs (which do not account for the upfront capital cost). As a result, renewable energy sources are frequently dispatched when they generate power. These factors taken together, i.e. the price volatility and therefore uncertain revenues and renewables being the price taker and therefore not in a position to determine their profitability level, make it incredibly difficult for renewable energy producers and investors to calculate the project's potential revenue stream and therefore remunerate the initial capital expenditure.

3) Electricity markets lack sufficient hedging tools for investors to handle the price and revenue risk described above. In many liquid energy and commodity markets, the market itself provides hedging opportunities, such as forward contracts in futures markets so that the described price risk can be handled. However, given the nature of electricity markets and the fact that they cannot store large part of the energy sources generating electricity, as well as given the non-elasticity, producing long-term price signals and financial products reflecting those has proven challenging. However, when large-scale batteries and for instance, hydrogen storage solutions are introduced this could very well change.



CFDS BETWEEN A STATE ENTITY AND AN ELECTRICITY GENERATOR

A CfD scheme can vary a lot and it is not unusual for governments to adjust and change their CfD structures between different auctions or allocation rounds. These changes are often related to the funding of the CfD scheme and developments in the market, which will be discussed later in this chapter. On a broader basis, CfD schemes are often divided between two different structures, so-called double- or one-sided CfDs. In general, in terms of varieties of CfDs, they come down to how much risk the government will and/or can take.

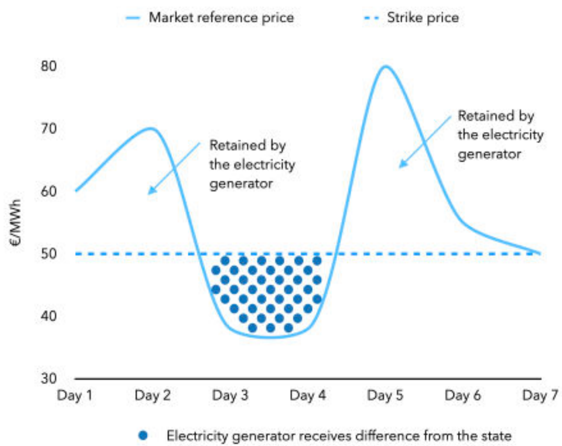
One-sided CfD:

Payments under a one-sided CfD are made only in one direction, meaning if the reference price is higher than the strike price, no payments from the electricity generator are made to the state. If the reference price instead is traded below the strike price the electricity generator is compensated by the state for the difference, see Figure 2.1.

Two-sided CfD:

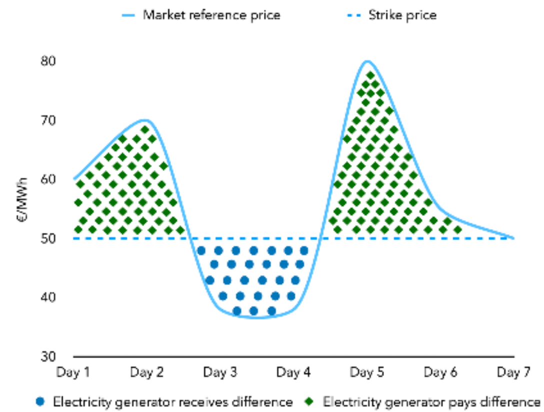
In contrast to the one-sided CfD the state entity and electricity share the risk in a two-sided CfD. The strike price is still fixed in the contract and refers to the reference price. However, in a two-sided CfD, the electricity generator pays the state entity the difference between the strike price and the reference price if the reference price is traded above the strike price. Similar to a one-sided CfD the state entity compensates the electricity generator for the difference between the strike price and reference price if the reference price is traded below the strike price, see Figure 2.2.

Figure 2.1: One-sides CfD



Source: ELS Analysis

Figure 2.2: Two-sides CfD

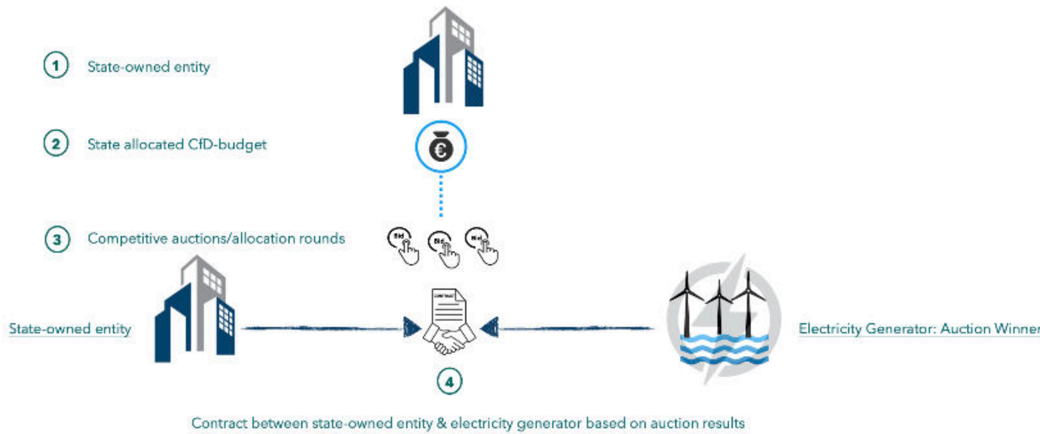


Source: ELS Analysis

Explanation of a two-sided CfD between a state entity & an electricity generator (numbers in figures correspond with numbers in text)

The most commonly used CfD schemes for renewable energy projects are two-sided CfDs between a state entity and a renewable electricity generator. However, two-sided CfDs can very well be used for other energy technologies as well, such as electrolysers, batteries, nuclear, etc. Worth noting is that CfDs do not indicate that the technology necessarily is uneconomical, but rather that, the fixed upfront cost presents a risk, whilst the revenue stream is highly uncertain. After all, in a two-sided CfD, the state can also earn money from the arrangement.

Figure 2.3: General structure of a two-sided CfD



Source: ELS Analysis

1. **State-owned entity:** Introducing a CfD scheme is decided by the government, where often a state entity or a state-owned company such as a grid operator is appointed to carry out the process of granting a CfD contract to a project. The state-owned entity is furthermore the counterpart in signing the CfD agreement with an electricity generator.
2. **State-allocated CfD budget:** Deciding on a budget for a CfD scheme looks very different in different countries and how the budget is funded also differs a lot. This will be discussed in a separate section below. However, the budget is related to the project's Levelised Cost of Energy, LCOE, if it is a technology-specific set-up, and based on this an administrative strike price, ASP, or a reference price, sets the upper limit for the forthcoming CfD auction/allocation round.

3. **Competitive auctions/allocation rounds:** In most cases, CfDs are awarded through technology-specific competitive auctions. As mentioned above CfDs can be awarded through administrative processes, but auctions offer the competitive advantage of identifying the markets' view on an appropriate CfD-level. For those electricity generators that have qualified to participate in the auction, a bidding procedure begins that can be designed in different ways, but that usually grants the lowest bid the winning CfD contract, translating it into the strike price. Worth noting is that we have seen a tendency in the market among bidders to bid well below the ASP, or reference price, and sometimes even submit zero bids to win the auction. This so-called race-to-the-bottom behaviour in auctions has raised concerns about projects not being realised because the bidding strategies fail to correspond with the risk-sharing level required by the generator, who instead only aims at winning the auction and gaining access to the project site.
4. **Contract between state-owned entity & electricity generator based on auction results:** Based on the strike price determined in the auction a CfD contract is signed between the state entity and the auction-winning electricity generator. The contract duration can vary but is usually between 15-20 years for a renewable energy production project, but can be up to 35 years for a nuclear plant.

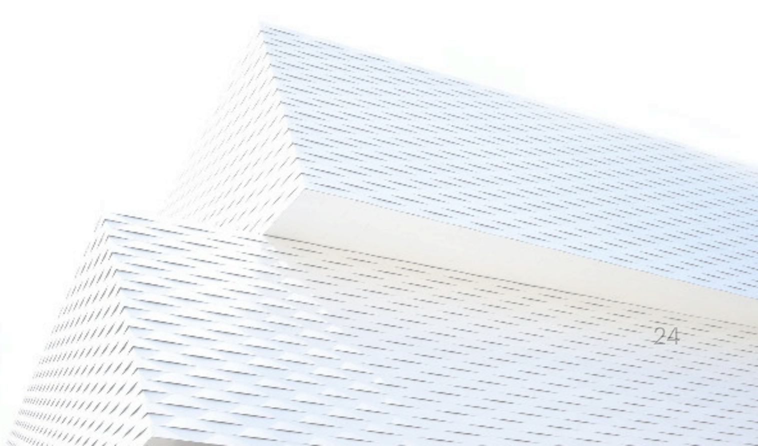
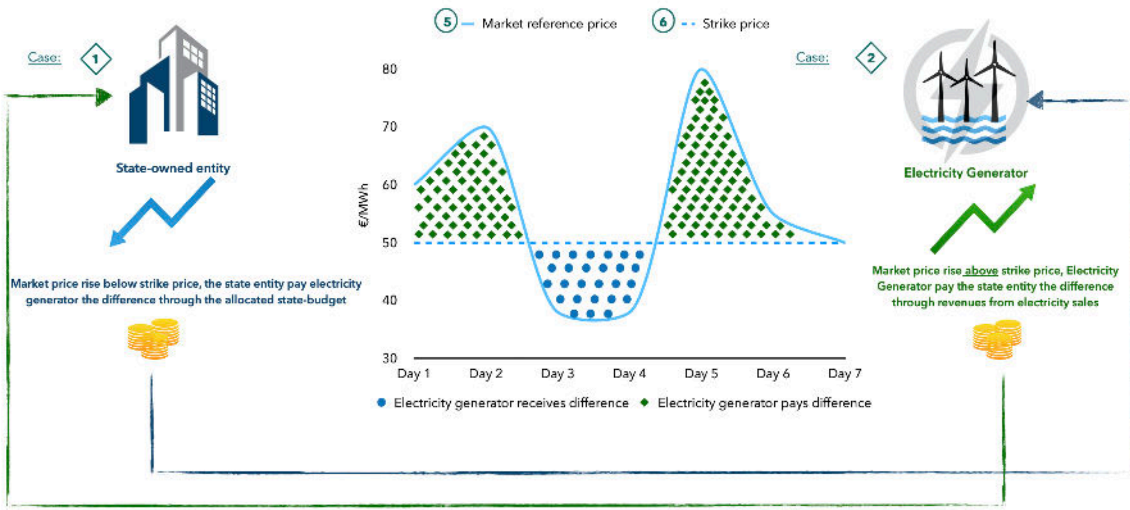


Figure 2.4: CfDs during the operational phase



Source: ELS Analysis

5. Market reference price: In a CfD scheme the reference price constitutes the variable rate and it is the difference between the market price and the strike price that determines how much the electricity generator should pay to the government entity (see Figure 2.4, case 2) or receive from the government (see Figure 2.4, case 1). The reference price is a measure of the average price of electricity. However, since electricity is traded in different ways and over different periods, there are several options available when determining how to set the reference price in a CfD scheme.

When deciding on how to determine the average reference price there are a few principles that need to be considered. Firstly, the reference price should reflect the price that a generator could reasonably expect to achieve through trading in the market. Thus, it becomes very important to have a technology-specific approach when deciding methodology. Secondly, the signals from which the reference price is drawn must be sufficiently liquid to have confidence that it is a robust representation of market prices. Thirdly, the reference price should avoid undue interference with price signals that incentivise efficient operation. In practice this means that the reference price can be based on different averaging periods, but also the method used for calculating them. The averaging period can be everything from hourly, daily, and monthly to annual electricity prices, and the method for determining the reference price can be based on for instance simple or volume-weighted, or base or peak.

The choice of design has to a large extent to do with which type of technology the scheme targets. In the UK for instance, for baseload CfDs, the reference price is set six-monthly, which is the market price for the forward six-monthly season baseload contract, as quoted during the sixth month prior to delivery. Whereas for renewable CfDs, the reference price is set hourly, which is the weighted average of the settlement prices for the two day-ahead auctions, run by the power exchanges, for the relevant hour.

6. Strike price: the strike price represents either the lowest bid in a competitive auction, or the set price by the government that is awarded to the winning electricity generator(s) in an administrative allocation process. Important to stress is that the strike price is not necessarily the same as the ASP or reference price, as has been explained above, but can rather be well below the ASP cap.

FUNDING CONTRACTS FOR DIFFERENCE

One of the more difficult and sometimes most controversial parts of designing a CfD scheme is for the government to decide and agree on a CfD budget. Separate budgets are set for each allocation round and both the structure and size can differ a lot. Governments can take very different positions and include different factors when setting up a CfD budget. Thus, the underlying components are important to understand when assessing the risk allocation.

Several different design-options need to be considered when deciding on a CfD budget, some of which are directly impacting the determination of the ASP and some that are more related to the expected size of the budget. This report has divided these design options into three parts, see Figure 2.5:

1) Contract conditions between the state entity and the electricity generator
2) Methodology for setting an ASP/reference price
3) Strike price conditions

The CfD-scheme can be funded through either the state budget, i.e. through taxes, or electricity bill levies. In Europe, the most common way to fund support schemes for low-carbon energy production is through a levy on consumer bills. However, many countries have identified sectors that are exempt from this, such as in many cases, energy-intensive industries. Other exempted categories can be low-income households or other vulnerable end-consumers. Only five countries in Europe are financing their support schemes through general taxation.

Figure 2:5 Factors to consider when setting a CfD budget

Various contract conditions

Contract between a state entity & electricity generator

Design options:

1. Fixed duration, i.e the contract is valid for 10-20 years
2. Volume based contract
3. Mixed, i.e a combination of fixed and volume based

Various methodologies for setting a CfD-budget

The state decides on a CfD-budget & how it will be funded often through determining an ASP/reference price

Design options:

ASP structure:

1. Technology-specific
2. Technology - neutral

Objectives for setting ASPs

1. Cost assumption
   1.1 LCOE-based
   1.2 Net present value-based
   1.3 Supply-curve based ASP development
   1.4 Grid cost included
2. Support in times of negative reference (market) prices
3. No support in times of negative reference (market) prices

Strike price awarded to the successful project

Winner(s) awarded contract with a set strike price which works alongside the reference price

Design options:

1. Strike price set through auctions
2. Strike price set through administrative allocation
3. Reference price (market price) averaging period:
   3.1 Hourly
   3.2 Daily
   3.3 Monthly
   3.4 Annually
4. Reference price (market price) averaging method:
   4.1 Technology-specific
   4.2 Simple or volume weighted
   4.3 Base or peak
5. Strike price indexation
   5.1 None
   5.2 Inflation-adjusted

Source: ELS Analysis

1. **Contract conditions between the state entity and the electricity generator:**
One of the main factors to take into consideration when it comes to specifying the contract conditions, is the contract's duration. In most renewable CfDs the contract duration is 10-20 years, for nuclear the contract can run up to 35 years.

As discussed above, the average reference price (the underlying variable rate) can be based on everything from hourly to yearly averages and the next step is to connect the reference price to the asset's production. Here, the terms of the contract can relate the payments to volumes produced, which is calculated by taking the strike price minus (for instance) the day-ahead price, multiplied by the volume produced. Alternatively, the contract can state a fixed amount or a combination of volume and fixed base production. With a fixed term, it means that there is a cap on how much the electricity generator can receive under the CfD contract. Thus the contract can determine that only parts of the generator's production will be covered through a predetermined production profile. For the electricity generator, the risk increases the further away from the actual output the CfD is settled.

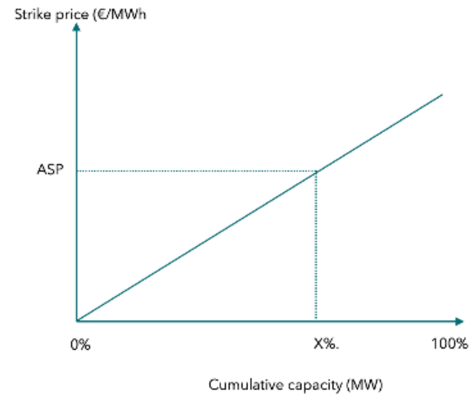
2. **Methodology for setting an ASP/reference price:**
Deciding on the structure and objectives for an ASP or reference price constitutes the foundation of the CfD budget. Introducing technology-specific structures has become the norm and makes a lot of sense since different technologies face very different project costs and revenue stabilisation requirements.

Setting an ASP/reference price starts with calculating the specific project's Levelised Cost of Energy, LCOE. The ASP/reference price is based on the project's LCOE, i.e. Opex, Capex, and financing cost, but the ASP/reference price can be based on more factors deemed relevant for the project's overall economics. Methodologies used for this can vary a lot and have a significant impact on the overall CfD budget. A basic LCOE calculation is based on purely the technical cost of the project and might not take into consideration the net present value of the project. The UK, for instance, bases its ASP on a net present value methodology, but such an approach requires significant analysis and deep market know-how. Thus, a calculation like this includes data gathering to estimate the project's lifetime cash flow to sum the net present value of total expected costs and revenues in each year. To appreciate the expected revenues the state entity responsible for determining the ASP/reference price must have the ability and capability to forecast electricity prices for the project's lifetime, or the CfD's contract duration.

The British authorities are also using a supply-curve-based ASP calculation, which broadly means that in the latest reported methodologies for the country's allocation round, the supply curve is created using a generic approach by varying Capex costs. The supply curve is created per technology and the range of viable strike prices has been estimated by assuming that pre-development, construction, and infrastructure costs increase linearly from the first project to the last project in the supply curve, where the low point on the supply curve assumes that low pre-development, construction and infrastructure costs apply to this particular project. Operating costs and all other costs and non-strike price revenue assumptions are assumed to be constant across the length of the supply curve.

An important factor when evaluating the overall project cost is the grid cost. This is especially the case for offshore wind, where the grid connection constitutes a significant part of the project cost and in case this cost is borne by the state this has an impact on setting the ASP/reference price.

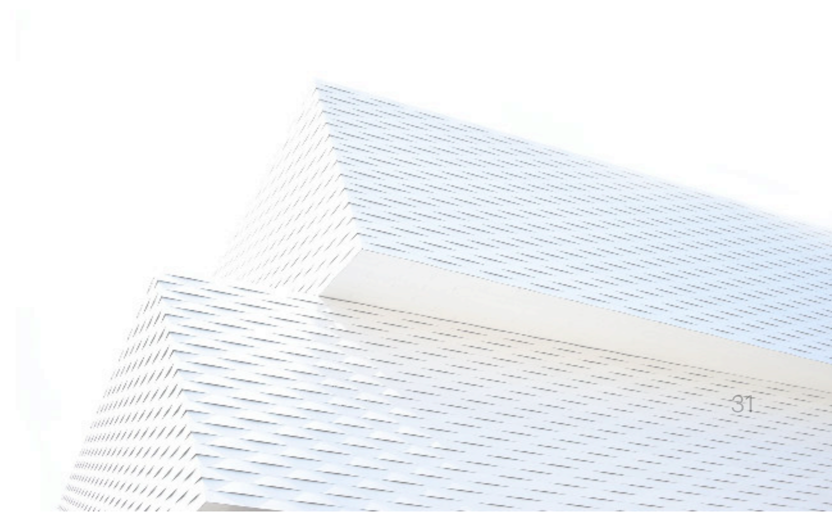
ASP & Supply Curve



Source: ELS Analysis, UK Department for Energy Security & Net Zero

3. Strike price conditions:

The methodology for setting a strike price, either by an administrative process or through competitive auctions, and the market reference price, has been discussed elsewhere in this report. However, there is a growing debate about whether governments should inflation-adjust the strike price or not. Skeptics hold that inflation risks are always present and something that an electricity generator should be able to account for itself. However, the cost of capital has increased significantly in the last couple of years and has proven to be one of the main obstacles to FIDs being taken among many low-carbon energy producers. In the UK the government has introduced inflation-adjusted strike prices to keep the strike price relevant to market developments.



EU:S POSITION ON CFDS

After a long negotiation period for EU's energy and climate legal packages, we are now entering a time of adoption and implementation of these packages in national laws and strategies. Comparing current legal texts with revised documents, a general conclusion is that the EU is aiming to provide stronger regulatory frameworks for member states to reach both union-wide and national energy and climate targets. One of the elements that has been identified by EU institutions as important for enabling the uptake of low-carbon energy production is introducing CfDs. Although it is clear that EU aims to harmonise both the union's permitting procedures as well as its support structures, the final legal outcome around CfDs leaves room for member states to adjust and implement support schemes according to national interests.

Current EU legal texts do not include any wordings regarding CfDs, but when the reform of the electricity market was launched by the European Commission in March 2023, a proposal to make two-sided CfDs mandatory was introduced in the Electricity Market Design (EMD). The reform package amends the electricity regulation from 2019 and electricity directives from 2018-2019, as well as the regulation on the protection against market manipulation in the wholesale energy market (REMIT).

The proposal presented by the Commission in March 2023, as well as the Council's agreement on a general approach for the electricity market reform in October 2023, went quite far in making two-sided CfDs mandatory for all member states if support schemes were to be introduced for new low-carbon energy production. The wording was such that any other support schemes that member states sought to introduce, such as investment-based support schemes, could only be introduced if two-sided CfDs were also introduced. Since CfDs are to be regulated in an EU regulation and not through a directive, meaning the rules will be directly applicable and transferred into national law, the market, and especially renewable energy producers, viewed the general approach as good news.

Thus, it meant that support schemes in the union would be more or less standardised and if countries would introduce investment-based support schemes, for example for nuclear, this would mean that governments would also have to introduce double-sided CfDs. For renewable energy producers, this would mean that the price risk (discussed above) would decrease in those European markets that implement any kind of support schemes for energy production.

December 2023 provisional political agreement - CfD rules watered-down

In December 2023, the Council and the European Parliament reached a provisional political agreement on the reform, and for the reform to become EU law, the rules need to be formally approved by both the Council and the European Parliament. In this new version, several revisions and additions have been included in the parts regarding CfDs. The most noteworthy changes regard the flexibility that is given to member states in the new version:

Mandatory two-way CfDs ***or equivalent schemes with the same effects:***

In the latest updated EMD, the wording regarding making two-way CfDs mandatory for member states, if they wish to introduce a support scheme for new low-carbon energy production, was broadened to also include "or equivalent schemes with the same effect". It is not defined what an equivalent scheme with the same effect could be, but one could assume that it would include for instance a sliding feed-in-premium, which is one of the well-known instruments that is most similar to a CfD. However, it will be important to get the details around this and understand exactly what these additional options to a CfD incorporate.

The EMD states that each and all support schemes will be evaluated according to state-aid rules, but in order to do so, the rules and definitions of what constitutes equivalent schemes need to be clear. If this definition ends up being very broad, ELS concludes that the initial aim to make two-sided CfDs the norm within the union has been heavily watered down. Further, if the idea is to leave this assessment to state-aid examinations, this also risks creating long and uncertain processes, which goes against the idea of harmonising the system.

Direct price support schemes vs other support schemes (*bold italic* means add-ons in the latest version of EMD):

> *(35) "Where Member States decide to support publicly financed investments* ***by*** *"direct price support schemes" in* ***new*** *low carbon, non-fossil fuel electricity* ***generation-facilities*** *to achieve the Union's decarbonisation objectives, those schemes should be structured by way of two-way contracts for difference* ***or equivalent schemes with the same effects*** *such as to include, in addition to a revenue guarantee, an upward limitation of the market revenues of the generation assets concerned"* EMD

Further:

> *(41) … "**The obligation to use two-way contracts for difference or equivalent schemes with the same effects does not apply to support schemes not directly linked to electricity generation, such as storage, and which do not use direct price support, such as investment aid in the form of upfront grants, tax measures or green certificates amongst others…"*** EMD

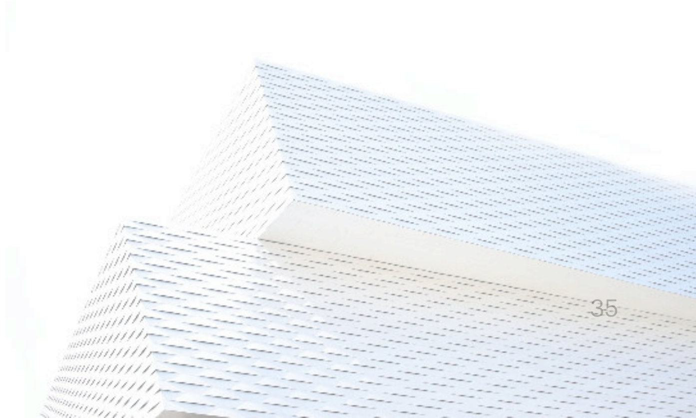
Based on these additions, once again, the initial text regarding mandatory CfDs has been heavily watered-down and been reduced to being more or less an EU-advocated principle, while opportunities are left for member states to use a range of different support schemes other than CfDs. The imperative part of CfDs, according to above additions, only relate to when a member state is introducing direct price support schemes and not when a state would like to introduce an investment-based scheme. In the latter case, it is not conditional to an introduction of a two-sided CfD scheme as well.

As the text was initially formulated, there was no separation between direct price support schemes and investment-based schemes, which meant that if a member state would like to introduce an investment-based support scheme it could do so as long as it also introduced a CfD scheme. This meant that the EU, through these CfD mandatory requirements, put some pressure on Member States to support the whole range of new energy production technologies.

CfDs applicable for some existing power generation facilities:

An important issue during last year’s negotiations has been whether or not CfDs should be used for existing electricity generation. The final version states that Member States should be able to decide to grant support schemes in the form of two-way CfDs or equivalent schemes with the same effects also for new investments aimed at substantially re-powering existing power generation facilities, substantially increasing their capacity, or prolonging their lifetime. This has been an important issue for France during the negotiation since they want to use this opportunity to support investments in their existing nuclear fleet.

The EMD also acknowledges that a transitional period is needed to ensure legal certainty and predictability, which means that the new rules regarding direct price support schemes should start being mandatory three years after the Regulation enters into force. Furthermore, the transitional period should be five years for offshore hybrid assets connected to two or more bidding zones due to the complexity of such projects.



SUMMARY & CONCLUSIONS: DEEP DIVE INTO CFDS

CfDs have become a prevailing tool among governments to support the uptake of new renewable energy productions. If the CfD scheme is well designed, it has proven to be an effective instrument to provide energy producers and investors with certainty over their future investments. In contrast to traditional subsidy schemes, a CfD should rather be viewed as a risk-sharing and risk-management tool in markets, such as the electricity market, where alternative hedging opportunities are scarce. CfD schemes can look very different in different countries and from one allocation round to another and the choice in design is dependent on how much risk the government is ultimately willing or able to take.

In this chapter, we offer an in-depth understanding of how traditional CfDs for low-carbon energy production often are structured and which purpose they serve in the uptake of energy production. Key points from this chapter are the following:

- A CfD is a risk-sharing tool through a financial long-term contract between, typically, a state entity and a low-carbon electricity generator.

- The main function of a CfD is that through different methods (either through competitive auctions or through an administrative process) determine a fixed price, namely a strike price, which is the agreed price that the electricity generator will receive for each unit of electricity produced. The difference between the agreed fixed strike price and the fluctuating market price (reference price) is what determines how much either one of the parties in the CfD contract should pay the other.

- Two-sided CfDs are the most commonly used structure, but one-sided CfDs also exist. In contrast to a one-sided CfD, the state entity carries the downside risk in a two-sided CfD (strike price vs market price) and the electricity generator carries the upside risk (strike price vs market price).

- CfDs have become an important and suitable tool especially for renewable energy producers to secure their revenue stream and therefore base their investment decision on. For a renewable energy producer their high upfront cost needs to be recovered during the operational phase and by revenues from selling electricity in the market. The risk lies in the fact that the market outlook is very uncertain and the price volatility is very high.

- State-based CfDs have become very important in electricity markets since the market itself cannot provide long-term price hedging tools. Given the nature of electricity markets and the fact that they can't store a large part of the energy sources generating electricity as well as the non-elasticity, producing long-term price signals and financial products has proven challenging.

- CfD schemes can be designed in many different ways and the risk-sharing level between the state and electricity generator can look very different. Deciding on a method for how to finance a CfD budget and calculate the project cost has proven difficult for governments.

- CfDs can be funded through either the state budget or through a levy on electricity bills. Those countries that have chosen to use state funding are also those countries that have struggled to maintain their support schemes because it has proven expensive and too high a burden on the state budget. Important to note, however, is that if financing the CfD budget goes through a levy on the electricity bill, the revenues from when the electricity price is trading above the strike price (i.e when the electricity generator pays the state entity the difference) should be directed to consumers and not to the state.

- The EU has seen the advantages of CfDs and is promoting the use of them in all member states. However, as analysed in this chapter, the mandatory nature of CfDs in the electricity reform design has been largely water-downed. This is by giving member states a lot of room to introduce similar support mechanisms within the scope of direct price support schemes, but also by opening up for investment-based support schemes as an alternative to CfDs.

- From a market and investment perspective, it is clear that for many renewable energy producers, there is no route to market without any risk-sharing tools in today's market. The high cost of capital alongside uncertain market and price outlooks, makes investment decisions very difficult. Thus competition over attracting investments has developed among those markets where governments provide this kind of support and capital increasingly flows to those markets which reduces risks that the market on its own can't handle.

- The need for risk-sharing should not be viewed as projects being uneconomical, but rather that investors need security regarding revenue stabilisation.

- It is worth noting that CfDs or other risk-sharing tools are not strictly necessary for individual investment decisions since different electricity generators have different business models, which makes them more or less exposed to revenue risk. However, in general terms and related to the need for large scale build-out of new electricity production, well designed CfD schemes are desired by the market.

CHAPTER 3: INTRODUCING CFDS & THEIR IMPACT ON THE MARKET

CFD'S IMPACT ON THE ELECTRICITY MARKET

Concerns have been raised about the impact that CfDs or other price-hedging long-term contracts have on the market function and system stability. Several issues have been voiced regarding revenue distribution and its impact on consumers, but this chapter will focus on the criticism leveled at the potential consequences arising when a significant part of the market (through fixed prices in long-term contracts) is shielded from short- to medium-term price signals in the wholesale electricity market. At the core of this issue lies the criticism that if you have producers who only take into consideration the fixed price in their long-term contract, they will not consider market price movements and therefore not adjust their production accordingly. This is in itself harmful to the market and to the system stability.

This criticism is not new and it is understandable. This issue has been raised in regards to all long-term contracts that contain a pre-decided set price. Thus, commercial PPA contracts also create the same effect. Still, long-term contracts (both financial and physical) exist in most energy and commodity markets without distorting the market's liquidity, but rather preserving the market balance. It might therefore be useful to broaden this discussion and recognise that it is not necessarily long-term contracts with fixed prices in themselves that are the main problem. Instead, it might be the broader market rules and structures, contained in the electricity market design, that create imbalances in the system and amplify market volatility.

Volume-based CfDs

With a CfD that provides the electricity generator a fixed price for each unit of electricity it produces and where the state bears the downside risk, there is no incentive for the producer to either increase output at times of high prices (since they will pay the difference between the strike price and the higher market price to the state entity) or decrease output in times of low or negative prices, since they will be compensated by the state for the difference between the strike price and the low market price. This results in the electricity generator maximizing its production all the time, notwithstanding if the market is scarce or abundant. Thus this harms the market, both in terms of system stability, but also in terms of high price volatility. The latter, meanwhile, strengthens the demand for CfDs, since it is increasingly difficult for investors to calculate the revenue stream when prices are unpredictable and when prices at times go negative.

As will be discussed below, adjustments to contract structures can be made to prohibit and minimize these effects, but the question is whether it is the long-term price hedging contracts that solely are responsible for this behavior or if it is also a broader market design issue. Some market experts argue that it is the marginal pricing system itself that is no longer fit for purpose when we move away from fossil-based electricity to a more renewable energy-dependent systems and markets. As described above, the business model for renewable energy producers looks very different from fossil fuel generators in terms of operational cost. For a fossil fuel generator, the fuel cost during the operation is linked directly to the price of the electricity generated, while for a renewable generator, there are no input costs. Thus, since the upfront capital cost for a renewable energy producer is not included in the current marginal pricing system, the renewable energy producer will always be called on to the market if capacity is available and will therefore contribute to high price volatility.

Based on the above, a fair question to raise is whether or not the market would suffer from the same effects with or without CfDs, given that marginal pricing in the electricity market seems rather ineffective in making low-operational cost producers adjust their production according to market imbalances. I.e even those renewable producers who are not price-hedged have limited incentives to, for instance, curtail their production in the case of market oversupply, as long as not all suppliers act in the same way. Thus, it only takes some of the producers to not curtail for the price to drop and consequentially any producer free-riding on many producers curtailing would likely capture the best immediate returns. Long-term price hedging contracts are a tool for renewable producers to mitigate this risk, so from that perspective, the risk is just as similar for them as for any other producer in the market, which proves that today's market structure makes it difficult for them to prevent sharp price drops or spikes from happening.

DEVELOPING TRADITIONAL CFDS

Even though CfD schemes can vary a lot, traditional CfD designs are often structured in a way that link the strike price in the contract to a specific asset's production volume. Because the price stabilisation tool is connected to each unit of electricity produced, the electricity generator will relate its production profile and bidding behavior in accordance with the strike price and pay less attention to movements in the wholesale electricity market. This has led to a discussion on how to develop these contracts in a way where they would both serve the purpose of a hedging tool for electricity generators and still contribute to market and system stability. In this part of the report, the idea of introducing a new version of CfDs will be touched upon, called financial wind CfDs. This idea was presented by the Leibniz Information Centre for Economics and gives a good understanding of the underlying concerns of traditional CfDs as well as proposing a solution. Nevertheless, there are other similar theories and proposals available that touch upon the same topic and this report only aims to identify some of the possible weaknesses in traditional CfDs and briefly discuss them. Thus it is outside this report´s scope to go into detail and cover the broader academic discussions around this topic.

The authors behind the working paper "Financial Wind CfDs", identify three main problems with traditional CfDs, and with a traditional CfD, they refer to a CfD that is production-based and related to a specific asset. In detail, this means that the contract has/is:

- A strike price that is fixed
- An underlying benchmark that gives the hourly day-ahead price
- Linked to a specific physical asset
- A payment obligation that is calculated for every hour of production

The three main problems are:

- Produce & forget

  A traditional CfD incentivises the generator to maximise its production. Since the generator receives revenues for all hours it produces, it has no incentive to increase production during periods of high prices (when the market is constrained). Nor is the generator incentivised to reduce output and/or plan maintenance when prices are low/negative (when the market is oversupplied) or even to invest in power plants that yield prices above average because all hours of production equal the strike price.

- Market distortion

  In a traditional CfD, the underlying price gives the hourly day-ahead price and the generator is aware of the fixed hourly CfD payment level once the auction has cleared. An opportunity cost will be factored into the pricing process in the same way as any other variable cost component. This will have implications for the following market stages: the intraday and balancing markets. Thus, the distortion on intraday and balancing markets becomes a real problem since inflated intraday prices are assumed to spill over to day-ahead and forward prices in arbitrage trading. In both high and low hourly price scenarios, the day-ahead prices become more extreme when intraday distortion and day-ahead arbitrage are combined.

- Unhedged volume risk

  Traditional CfDs' inability to fully achieve their objective of hedging revenue for renewable power facilities is another problem. This is because they expose generators to the volume risk (i.e. wind availability). When it comes to traditional CfDs, a low-wind year results in particularly low incomes, since above-average prices are no longer able to offset the decreased volume.

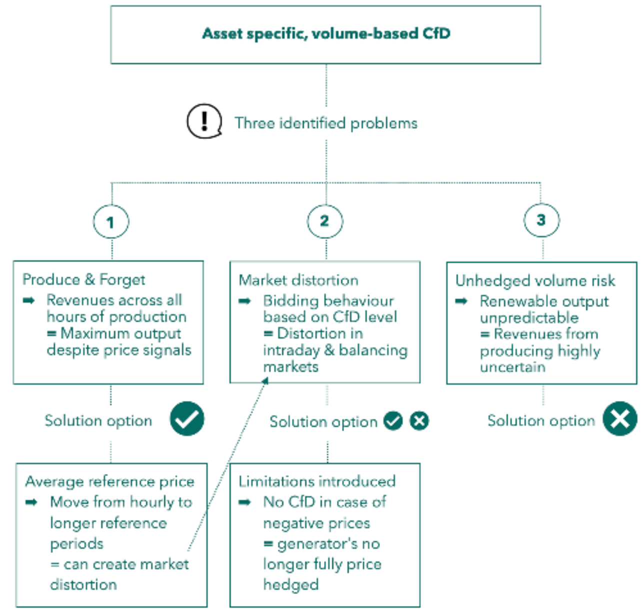
Some of the above issues can and are already adjusted in several traditional CfD designs.

One of the ways to handle the issue of produce-and-forget in a traditional CfD scheme is to move away from hourly day-ahead prices towards longer-term average reference prices. This can be monthly but also yearly if the aim is to capture seasonality changes as well. Intra-period price variations are no longer dampened for the generator and rekindle incentives by basing the CfD payout on extended reference periods. As a result, to recoup the highest charges, dispatch and maintenance incentives are optimized during these times, and design decisions are made during investment to produce during the most expensive hours of the reference period.

However, extended reference periods give rise to new issues. The distortion of bids on the day-ahead market is the most significant issue. This is because the CfD payment is largely independent of the day-ahead price and is known (or a reasonable estimate can be made) at the day-ahead stage. As a result, to maximize the CfD payment, generators optimize their bidding behavior.

To handle this, some CfD schemes do not provide any payments when prices go negative and some CfD paybacks are limited to just below the spot price. However, this also means that generators are no longer fully hedged against the price level.

Figure 3.1 Traditional CfD - identified problems



Source: ELS Analysis

Most of the problems described can be related to the fact that the CfD is directly connected to the asset's production and several options have been introduced to tackle this issue. Among them is the financial Wind CfD approach, but many other designs aim to tackle the same problems. Important to stress is also that the issues with CfDs are not only related to renewable generations but the same problems occur for any low-carbon generation enrolled in a traditional CfD contract.

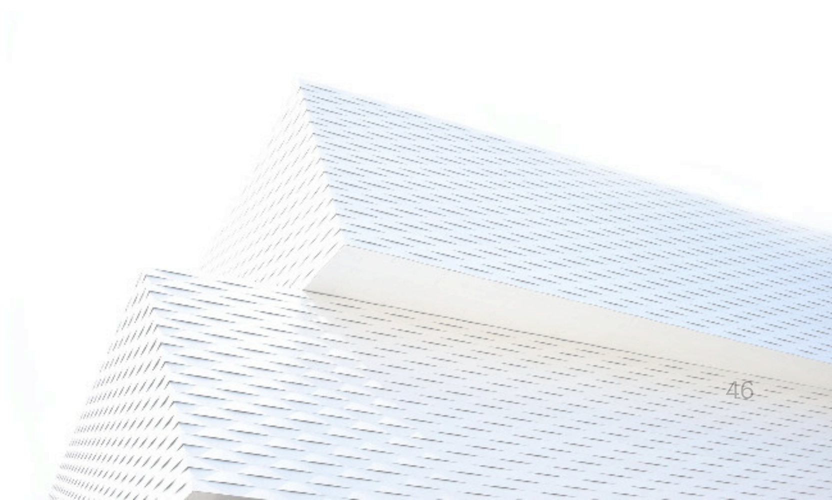
Without going into details regarding the specifics of a financial Wind CfD design, the approach provided in the design is to tackle the above-identified issues through providing a financial, instead of an asset-dependent structure. Thus payments are made regardless of the generator's production. Furthermore, it suggests not only hedging price risk but also volume risk. The tool is primarily meant to achieve two main goals:

1) Hedging revenue risk (both price and volume risk)
2) Full price structure exposure (for efficient dispatch, investment, and repowering incentives)

This is accomplished by giving the wind farm a set monthly payment from the government while the government receives the wind farm's monthly spot market revenue in return. However, these revenues are not actual revenues from a specific asset, but the revenues of a reference wind farm.

Advocates of a financial Wind CfD argue that compared to traditional CfDs, this type of hedge has the primary benefit of not influencing decisions about investments and utilizations. Low overall system costs are maintained via effective plant investment and operation incentives. The contract's asset-independent payments allow for undistorted asset dispatch, investment and repowering based on market signals.

Although, the proposed contract does not come without risks and disadvantages. The suggested contract design adds a new basis risk while removing the volume risk. This new risk is related to the fact that the contract is based on a reference turbine profile rather than the actual asset, the payment obligation can therefore deviate from the actual revenues. This can cause the generator to earn less or more than anticipated income. Those in favor of a financial wind CfD argue that the removed volume risk in the contract design outweighs this new basis risk since it will result in lower financing costs for renewables. The main advantage of this structure is, moreover, that the generator most likely will operate its plant according to price signals in the wholesale electricity market since the CfD payments are independent of the asset's production, and independent payment flows do not distort the market.



INTRODUCING CFDS IN SWEDEN

A growing discussion on introducing support schemes for low-carbon energy production is currently taking place in Sweden. The Swedish electricity demand outlook is set to double by 2045, yet little investment in new electricity generation is taking place. This is due to several reasons, such as slow grid expansions, slow, uncertain, and difficult permitting procedures, unpredictable and relatively low electricity prices, as well as an ambiguous political environment that provides insufficient certainty to investors. Introducing a revenue stabilization scheme, such as a CfD structure, can reduce the uncertainty and manage the market risk for most low-carbon energy producers. However, CfDs are part of a broader energy strategy and need to be well-designed to serve their strategic purpose.

This part of the report will put the previous chapter in a Swedish context, thus much of what will be stated as important strategic decisions, priorities, and required competencies to introduce a national CfD-scheme has already been examined in chapters one and two. Several steps need to be examined, analysed, and assessed before introducing any kind of support scheme and it requires significant expertise among decision-makers to understand both the technological aspects of building out new energy production, as well as market knowledge and understanding of the investment environment that different finance actors face. A key question is moreover, how much risk is the state willing to take and how large means can it bring to the table, in order to realise the large-scale build-out of new production? Support schemes, especially those that are more fixed and not based on a risk-sharing structure, can turn very expensive for the government since investing in new large-scale energy production brings a lot of uncertainties that initially can be difficult to assess.

The below table lists the main factors that need to be assessed before introducing a CfD scheme and before deciding on what design to adopt.

Figure 3.2 List of key factors when introducing a CfD scheme

- National strategy for energy production expansion
  - Planning –> Technology specific targets
  - Executing –> Competitive auctions or administrative allocation processes
- Policy priorities
  - Determine the objectives of the CfD scheme
    - How does it interact with other national policy priorities?
    - Is it compatible with EU objectives?
    - Has it a competitive advantage over competing markets' objectives?
- Technology-specific or Technology-neutral approach
  - Determine which support scheme is more suitable by understanding the pre-conditions for different technologies
    - Ensure the effectiveness of design options
    - Avoid over-subsidising
    - Avoid exhausting the state budget or transferring a too-high cost to consumers
- Introducing a state entity as the planner, organiser, and partner
  - Market knowledge
    - Data collection capacity
    - Price forecast competence/knowledge
    - Investment knowledge and expertise
    - Technical expertise to understand project costs
    - Legal expertise
- Deciding on a budget
  - Financed through the state-budget
  - Financed through a levy on consumer bill

  - Determine contract conditions
  - Determine reference price conditions
  - Determine strike price conditions

Source: ELS Analysis

National strategy for energy production expansion

In many European countries governments have agreed in parliament on not only overarching national climate and emission reduction targets (which they are obliged to do by EU law), but also on specific energy production expansion targets. These are often divided between different technologies. These targets are then frequently adjusted according to market developments, but they serve an important purpose by offering certainty to the market that the government has anchored a long-term plan through a parliamentary majority and that governments will be held responsible for achieving these targets. Thus, markets that secure a long-term plan often also introduce a roadmap, a regulatory framework, and an investment environment enabling production growth.

When it comes to introducing a CfD scheme, the above-described political foundation is important for deciding on how CfD contracts should be awarded. In an auction-based system, it is even more important to have a long-term well-established political strategy since auction regimes require quite substantial regulatory changes to be implemented, but also demand a stronger involvement from state entities to plan, carry out, as well as evaluate the auctions. When it comes to renewable CfDs, they are often awarded through auctions as auction designs come with many benefits since they represent an interplay between state and market. The CfD level therefore reflects both sides.

CfDs can also be awarded through bilateral administrative allocation processes, where the state entity decides on a CfD level and awards it to the market player of choice. This process takes away the whole competitive nature of potentially pushing the strike price down and is not very common when awarding renewable energy projects with CfDs.

Policy priorities

Assessing and prioritising national objectives is touched upon in chapter one and requires some serious analysis before introducing any kind of support scheme since the cost of these schemes eventually will impact the overall national economy and the economy of electricity consumers. As described in Chapter Two it is not only the national objectives and related rules that will need to be taken into consideration for a European country, but it is also EU laws and principles. As analysed in the report's ***EU's position on CfDs***, the latest version of the electricity reform package gives a lot of flexibility for Member States to introduce national-adjusted support schemes. However, any support scheme will have to go through state-aid assessments, which gives the EU considerable leverage over how member states decide to support new low-carbon energy production.

An additional issue that bears importance for Sweden and any other country that has an ambitious electrification target, rising demand, and the need to stimulate investments into new low-carbon energy production is to understand competing markets' objectives. The competition between different markets for green investments is tough and those markets that both offer good market conditions and low political risk from an investment perspective are those markets that attract capital. For Sweden, it is important to understand that even neighboring countries are offering quite significant support schemes to support the uptake in both demand and production, which makes it highly relevant for Swedish authorities to assess the risk of investments not coming to or even staying in Sweden for the long run.

Technology-specific or Technology-neutral approach

Despite strong political signals, Sweden does not have any binding technology-specific production targets. Nevertheless, when designing a CfD scheme or any other support scheme, it is very important to have a technology-specific approach so that the support scheme is designed and customised for the specific elements that different technologies require. The main reason for this, from a government point of view, is to ensure that the project is not over-subsidised and exhausts the budget and/or transfers too-high costs to consumers. As described in the above chapters, different technologies require different kinds of support and risk-sharing mechanisms depending on the Capex, Opex, financing cost, and the project's lifetime.

Introducing a state entity as the planner, organiser, and partner

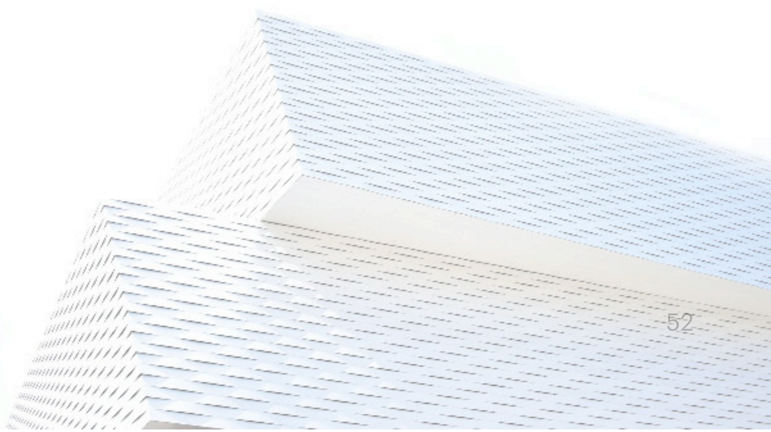
A CfD scheme requires a lot of market knowledge and expertise from the state entity responsible for carrying it out. As analysed in Chapter two, methods used for setting up a CfD scheme can vary a lot. However, all of them are based on a significant amount of data collection so that the reference price can correspond with both conditions and outlooks, current and future investment environments, technology expertise, and understanding of project cost as well as legal expertise, since the state entity will enter into a legal agreement with the electricity generator. Thus it is a rather big undertaking for the selected state entity to both ensure the capability to carry this out and also assess the capacity to do so.

Deciding on a budget

A whole section in Chapter two has been dedicated to analysing the difficult and sometimes controversial task of deciding on a budget for the CfD scheme. As a starting point, the government must decide on how to finance the budget, either through the state budget, i.e. through general taxation, or a levy on the electricity bill. The European experience has shown that those countries that have financed the CfD budget through the state budget have struggled with maintaining their support levels over time. The advantages of financing it through a levy on the electricity bill are that it increases transparency and reflects long-run cost in electricity bills, which also sends signals for energy efficiency investments. However, the refund must be also channeled through to the end consumers' bills, when CfDs generate revenue for the government.

With regards to determining conditions for both the reference price and strike price, this comes down to how much support or what risk allocation level the government thinks is appropriate and where the balance is between making sure that the scheme is fit for purpose and the state avoids overcompensating.

Concerning contract conditions some identified problems with traditional CfDs are raised in this chapter. When introducing a CfD-scheme it will be important to counter these risks and include other relevant objectives of the electricity market, and especially assess the risks with having a large part of the market covered by CfDs and potentially being part-shielded from market signals.



SUMMARY & CONCLUSIONS: IMPLEMENTING CFDS

This final chapter looks at the implementation of CfDs and relates the above chapters' theoretical analysis with steps that need to be considered when introducing and designing a CfD scheme. CfDs are appreciated by investors and are viewed by many governments as an effective tool to enable investments into new production, but they also raise some concerns. Thus, discussions regarding how to design future CfDs have intensified, in what will be an important debate to follow for policy-makers aiming to introduce CfD schemes.

Key points from this chapter are the following:

- The main conclusion is that implementing a CfD scheme demands a high capacity, capability, and expertise from the state entity or entities selected to be the planner, executor, and contract partner in the CfD scheme.

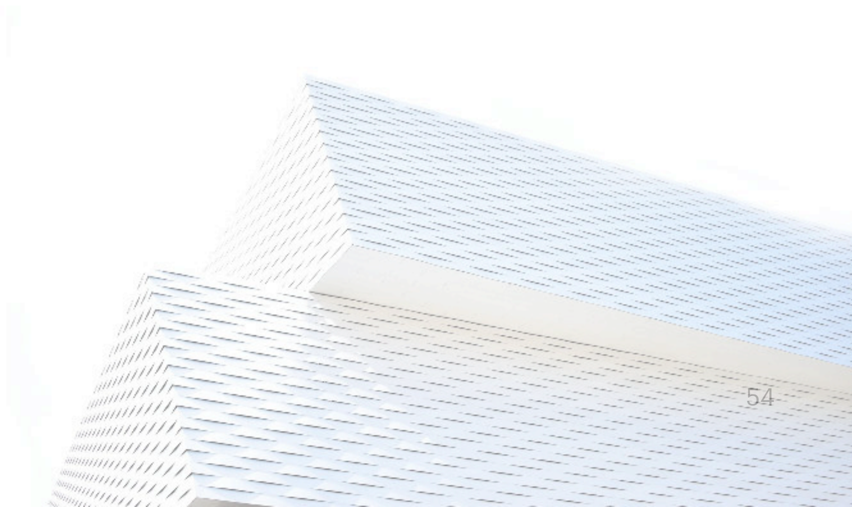
- Concerns have been raised regarding the impact CfDs or other price hedging long-term contracts have on the market's functionality and system stability. When increasing parts of the market are shielded from short- to medium-term price signals they risk distorting short-term markets such as intraday, day-ahead, and balancing markets, fostering a produce-and-forget mentality.

- Even though this criticism is valid this report raises the questions of whether or not this issue would completely be avoided if long-term price hedging tools were removed, or if there are other rules or structures in the electricity market that need to be adjusted to prevent this kind of bidding behavior.

- Since today's marginal pricing system tends not to include renewable energy projects' upfront cost, their marginal production cost is more or less zero, making them dispatchable every time there is capacity available. It thus creates a situation where renewable producers contribute to a high level of price volatility with or without a price hedge.

- New approaches to how future CfD can be designed have been presented lately and the main objective of most of them is to separate the CfD payment from the specific asset's production so that it is exposed to price signals and base its production profile/ behavior and investments accordingly.

- The final part of this chapter looks at Sweden and factors that need to be accounted for if a CfD scheme is to be introduced. The list of factors that need to be taken into consideration is based on the report's chapter one and two descriptions of risks and benefits with different CfD design options.



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