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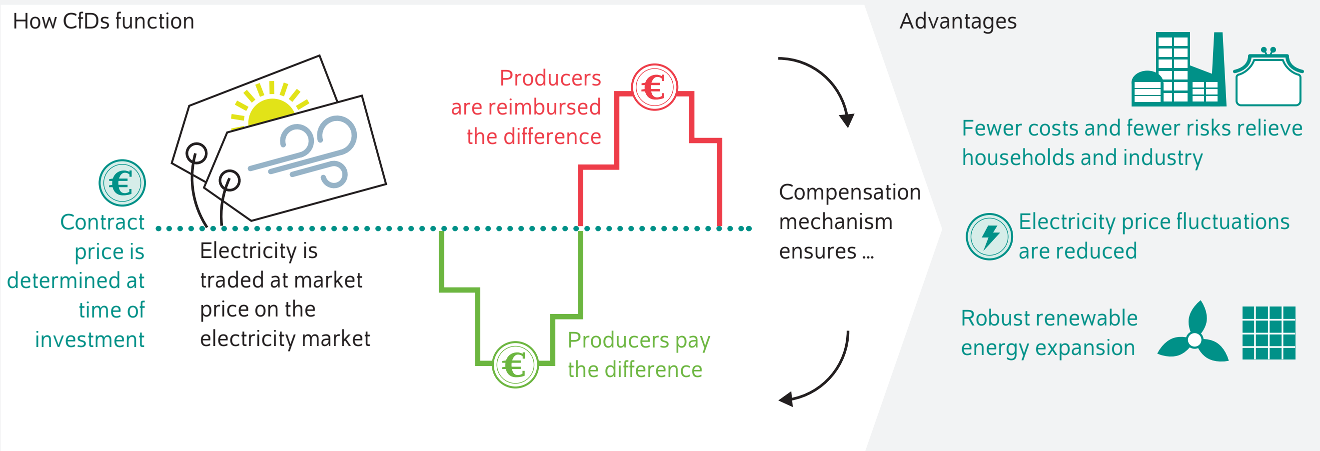
AT A GLANCE

Contracts for difference support the expansion of renewable energy sources while reducing electricity price risks

By Mats Kröger, Karsten Neuhoff, and Jörn C. Richstein

- The 2022 Easter Package, which reforms financial support for renewable energy sources, retains sliding market premiums as the sole remuneration mechanism
- DIW Berlin studies show that contracts for difference (CfDs) provide better protection against electricity price risks for producers and consumers of renewable energy
- CfDs also result in lower financing costs for renewable energy projects; electricity customers can thus reduce electricity generation costs by up to 30 percent
- By simplifying financing measures, additional projects can be realized and the risk of project cancellations reduced
- If supplemented by an advanced reference yield model and market value model, renewable energy expansion could be promoted in a targeted and system-friendly manner

Contracts for difference also provide consumers with better protection against electricity price risks



Source: Authors' depiction.

FROM THE AUTHORS

"Contracts for difference offer advantages that benefit electricity customers. For example, low financing costs reduce electricity generation costs by up to 30 percent. In addition, CfDs provide electricity customers with better protection against price risks."
— Karsten Neuhoff —

MEDIA

Audio Interview with Karsten Neuhoff (in German)
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Contracts for difference support the expansion of renewable energy sources while reducing electricity price risks

By Mats Kröger, Karsten Neuhoff, and Jörn C. Richstein

ABSTRACT

The German Federal Government passed the "Easter Package" in July 2022, which envisages a number of measures for the expansion of renewable energy sources. The package retains sliding market premiums as a remuneration mechanism, which protect electricity producers unilaterally, while contracts for difference (CfDs), which also protect electricity customers, are only used in the offshore wind sector. However, CfDs could lead to a reduction in financing costs and reduce electricity price risks for producers as well as households and companies. The decline in financing costs would strengthen the expansion of renewable energy sources. In this context, a simplified market value model and further developing the reference yield model could ensure a system-friendly expansion of renewable energy sources.

High natural gas prices have significantly contributed to the rapid increase in wholesale electricity prices, which has led to Europe-wide discourse on the future direction of the electricity market. Will the high generation costs of marginal gas power plants continue to determine the price of all electricity sales? In June 2022, the EU Commission announced a reform of the electricity market.[1] Greece, along with other EU countries, has proposed splitting the spot market in two (separated into highly dispatchable fossil generation and clean, mostly non-dispatchable clean resources) to prevent high fossil fuel prices from continuing to drive up electricity costs. Critics point to the complexity and possible inefficiency of the proposal.[2] However, even without splitting the spot market in two, electricity consumers could benefit monetarily from renewable energy sources were the sliding market premium replaced by contracts for difference (CfDs).

CfDs for renewable energy sources are a contractual instrument for which auctions are used to determine a long-term electricity price and the services to be procured. The contract conditions are then passed on to electricity customers and the difference to the wholesale price is paid, thereby stabilizing the price for producers and consumers alike. In contrast to the sliding market premium, this hedges producers against low electricity prices as well as consumers against high electricity prices (Box 1).

Utilizing CfDs would also contribute to achieving the 2030 expansion targets set by the German government. According to DIW Berlin's *Ampel-Monitor Energiewende*, which monitors the government's progress, annual photovoltaics installation must triple and onshore wind installation must quadruple to meet the targets.[3] While high electricity prices are making investments in renewable energy sources attractive, they remain risky, as price development in the medium and long

1 European Parliament, Sitting of 08-06-2022 (available online; accessed on August 11, 2022. This applies to all other online sources in this report unless stated otherwise).

2 Euractiv, *Greeks pitch new electricity market model as fight over market reform intensifies* (available online).

3 Wolf-Peter Schill, Alexander Roth, and Adeline Guéret, "Ampel-Monitor Energiewende Shows the Pace of the Energy Transition Must Be Accelerated Significantly," *DIW Weekly Report*, no. 26/27/28 (2022) (available online).

DOI: https://doi.org/10.18723/diw_dwr:2022-35-1

Box 1

Remuneration mechanisms for renewable energy sources

In Germany, financial support for renewable energy sources comes from Federal Network Agency auctions, in which financing for a certain volume of projects (in MW) is put out to tender. Operators market the electricity themselves and, if they are successful in the auctions, receive plant-specific financial support, which in principle may be structured in one of the following three ways:

Fixed market premium: Under a fixed market premium, projects receive a fixed premium on top of the electricity price regardless of the revenue generated. In Germany, it is paid for plants that were subsidized since 2020.

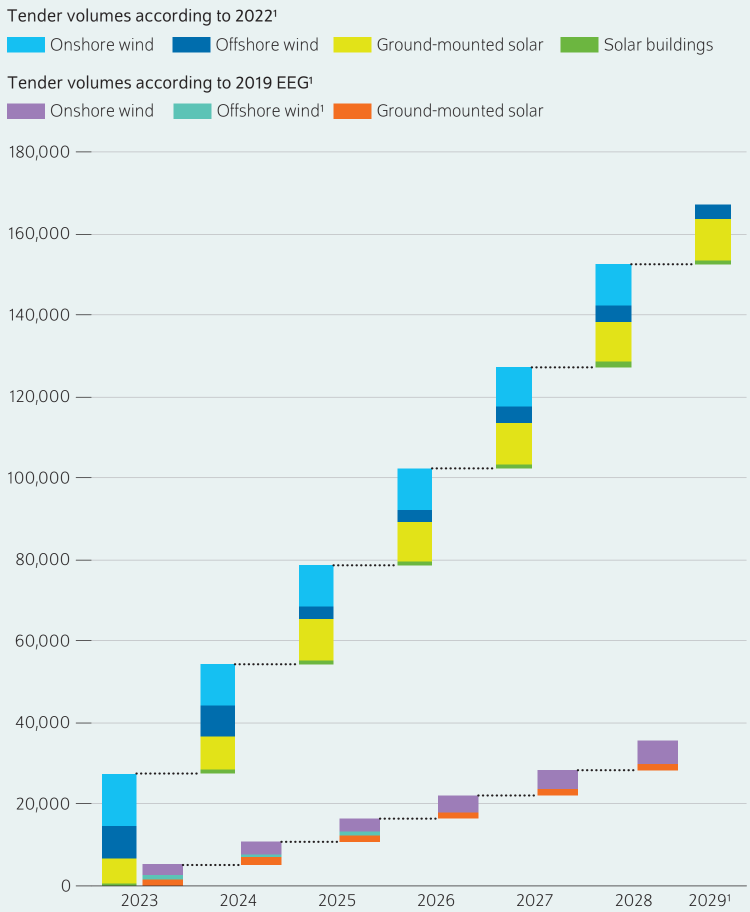
Sliding market premium: Under a sliding market premium, the subsidy is based on the contract price, which is determined by the auctions. Operators receive a compensation payment from the government up to the contract price if the electricity price is lower. If the electricity price is higher than the contract price, no additional financial support is paid. In Germany, the sliding market premium applies to plants that were subsidized after 2012.

Contracts for difference: CfDs expand on the principle of the sliding market premium. Companies still receive a compensation payment if the electricity price is lower than the contract price. However, they also need to pay back electricity market revenues when the electricity price is higher than the contract price. While CfDs are not used in Germany, a similar model has been in use in Great Britain since 2014. (Re-)payments are allocated to retail companies via the state-owned Low Carbon Contracts Company. This is in principle similar to the German renewable levy (EEG-Umlage), but can turn negative in times of high prices.

Figure 1

Change in tender volumes due to the Renewable Energy Sources Act (EEG) reform

In megawatts



1 No tender volumes for offshore wind were defined for 2026 to 2028 in the 2019 EEG. In the 2022 EEG, no tender volumes were defined for 2029.

Sources: EEG 2019, EEG 2021

As a result of the Easter Package measures, tender volumes for wind and solar energy multiplied.

term is uncertain and projects take many years to realize. At the same time, under the sliding market premium, financial support loses its risk-reducing effect when electricity prices are high and renewable costs are declining. CfDs, in contrast, avoid these risks for project developers and simultaneously stabilize energy prices for consumers by hedging producers against declining electricity prices and avoiding windfall gains when electricity prices are high. Thus, they enable simple and cost-effective financing for the necessary acceleration of the renewable energy expansion. At the same time, the risk that projects that have been accepted in auctions are not being implemented due to short-term price fluctuations is avoided. Furthermore, the tenders can be designed in a way that ensures project developers have sufficient incentives for selecting a system-friendly location and orientation for their projects. Providing such incentives is important for an efficient renewable energy transition.

Using DIW Berlin studies, this paper discusses the opportunities offered by the CfD model and how CfDs can contribute to solving the problems of the current renewable energy support scheme.

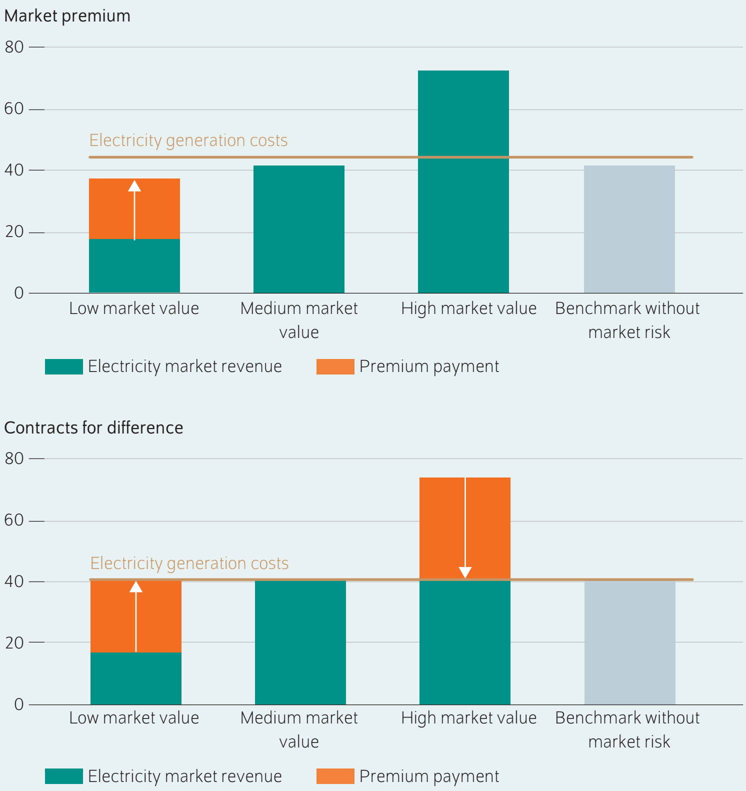
Easter Package does not utilize CfD opportunities

The Easter Package is meant to significantly increase the pace of the renewable energy expansion. The measures and legislative changes included in the package have, among other things, significantly increased the tender volume for renewable energy sources in all segments (see Figure 1). To

Figure 2

Difference between revenue and power generation costs for CfDs and the sliding market premium

In euros per megawatt hour



Sources: Nils May, Karsten Neuhoff, and Jörn Richstein, "Affordable electricity supply via contracts for difference for renewable energy," *DIW Weekly Report*, no. 28 (2018): 251–259 (available online).

CfDs result in a larger share of secure revenue, thereby reducing financing costs.

that end, approval procedures will be simplified by classifying development as "of overriding public interest," and more land will be made available for onshore wind by setting a goal of developing two percent of Germany's land area by 2032.[4] Further measures include facilitating the expansion of solar installations on highways and above fields and the abolition of the EEG surcharge.[5] However, the Easter Package continues the remuneration of renewable energy generation via tenders and the sliding market premium. In terms of renewable energy remuneration, the package plans to reform financial support for small solar plants (<1 megawatt; MW) and intends to phase out financial support for renewable energy sources once the coal phase-out is completed in 2038.[6]

Originally, the Easter Package proposal included the authorization for the government to introduce CfDs for offshore wind as well as the option of introducing new remuneration mechanisms for other renewable energy technologies, but both measures were ultimately removed. Following committee deliberations, the use of CfDs was restricted to offshore wind turbines in central pre-screened areas.[7] However, the increased use of CfDs remains an important policy option to be used as an instrument for price stabilization, as contracts for consumers are limited to two years for market competition reasons. Contractual risks and effects on creditworthiness also limit the availability of long-term contracts in electricity markets.[8]

Maintaining the sliding market premium makes the renewable energy transition more expensive

Under the current renewable energy support scheme, almost all wind installations and about one-third of solar energy expansion are financed by the sliding market premium (Box 1). The sliding market premium provides a one-sided hedging of risks in favor of the electricity producers, as they can retain revenues if the electricity price is higher than the contract price.

In the past, the (expected) electricity prices have been well below the cost of subsidized wind and solar installations. In the competitive tenders, this led to bids barely accounting for possible revenue beyond the market premium; this case only occurred in the few hours with exceptionally high prices.[9] When technology costs are falling and electricity prices rising, electricity market revenue from periods of high prices are priced into the bids until they fall to zero. This is also the case for the fixed market premium in competitive tenders.

Thus, the instruments lose their risk-reducing effect and electricity price risks arise for producers and consumers. For producers, this leads to an increase in financing costs, as secure revenue from the market premium is increasingly replaced by uncertain revenue from the electricity market, which limits the ability to raise low-cost debt capital to finance projects. In the extreme case of a zero bid under the sliding market premium (where producers rely solely on high electricity market prices), financing costs and thus the costs for wind and solar electricity generation would increase by up to 30 percent compared to the current standard financing conditions, as a DIW Berlin study shows.[10]

Support for wind and solar energy is necessary in addition to carbon pricing because of rising financing costs in their

4 Gleiss Lutz, *Das Osterpaket – Eine Übersicht zur aktuellen energiepolitischen Gesetzesnovelle* (2022) (in German; available online).

5 Handelsblatt, "Bundestag beschließt Booster für erneuerbare Energie – und kippt Ökostrom–Ziel für 2035," July 7, 2022 (in German; available online).

6 Gleiss Lutz, *Das Osterpaket.*

7 Deutschlandfunk, *Wie die Bundesregierung den Offshore-Ausbau beschleunigen will* (2022) (in German; available online).

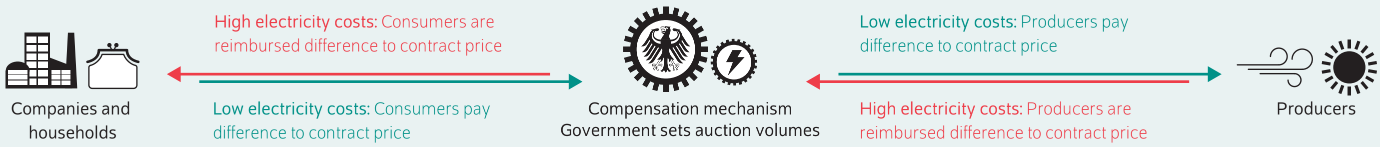
8 Maere d'Aertrycke Gauthier, Andreas Ehrenmann, and Yves Smeer, "Investment with Incomplete Markets for Risk: The Need for Long-Term Contracts," *Energy Policy* 105 (2017): 571–583; Jacob Mays, David P. Morton, and Richard P. O'Neill, "Asymmetric Risk and Fuel Neutrality in Electricity Capacity Markets," *Nature Energy* 4, no. 11 (2019): 948–956.

9 Karsten Neuhoff, Nils May, and Jörn C. Richstein, "Financing renewables in the age of falling technology costs," *Resource and Energy Economics* (forthcoming).

10 Neuhoff, May, and Richstein, "Financing renewables in the age of falling technology costs."

Figure 3

Contracts for difference



Source: Authors' depiction.

CfDs hedge consumers against high electricity prices indirectly through possible reimbursements.

absence (due to a lack of risk hedging) and insufficient incentives for meeting expansion targets.[11] Private power purchasing agreements (PPAs) are insufficient on their own for meeting the expansion targets because few companies are in a position to enter into long-term PPAs. Energy-intensive companies and utility companies face reduced creditworthiness when entering into PPAs due to the threat of payment obligations in the event of low wholesale electricity prices that are not covered by long-term purchase agreements for their products.[12] This is why only a fraction of the renewable energy expansion can be hedged by PPAs.[13]

CfDs reduce the financing costs of the energy transition

In contrast, CfDs would provide symmetric hedging for both consumers and producers. If CfDs were used, revenue above the contract price would be siphoned off and passed on to reduce energy costs, unlike under the sliding market premium (Figure 2). Such a repayment could take place via a reverse levy on electricity bills, and depend on the consumed electricity, or alternatives (household size, or previous years' consumption).

Introducing CfDs would maintain investors' revenue certainty, which has been common in the past, as well as the accompanying low financing costs for renewable energy. One DIW Berlin study has already shown that the annual savings for electricity customers through lower financing costs via CfDs compared to the sliding market premium would amount to 800 million euros per year when applied to the expansion targets of the last federal government (before the Easter Package). Compared to the scenario without any financial support, it would be 3.4 billion euros.[14] Additional advantages via the hedging of price risks and avoidance of scarcity rents will be discussed in the following sections.

Furthermore, CfDs can strengthen renewable energy expansion by ensuring a predictable payment stream for producers. This simplifies financing conditions and gives project developers the necessary security to invest in the long-term development of new projects and to realize a larger number of projects with existing equity capital. At the same time, risk reduction in the context of high electricity price volatility leads to high realization rates. In this case, the probability decreases that projects for which developers have speculated on a positive electricity price development will be discontinued when electricity prices actually fall.

CfDs protect customers against fluctuations in electricity prices

Introducing CfDs would hedge risks for all electricity customers, both private households and companies, and reduce their bills in times of high electricity prices (Figure 3). If previous investments in renewable energy sources had been remunerated via CfDs instead of sliding market premiums, electricity costs would have been 1.7 billion euros lower in 2021. With CfDs, high electricity prices would have led to significant reimbursements for electricity customers.[15] Given the persistently high electricity prices, this would have reduced electricity bills by five billion from January to July 2022 alone without burdening the state budget, as is happening with the current relief measures (fuel discount, energy relief payout).[16] Assuming current future electricity prices (mid-August 2022), additional cost savings from August to December 2022 would have amounted to around 15 billion euros. In Great Britain, where CfDs were introduced in 2014, the high prices in the final quarter of 2021 resulted in reimbursements to utility companies and consumers for the first time. From now up to the end of winter 2023/2024, reimbursements of up to 1.5 billion euros are expected.[17] Despite these reimbursements, investments in offshore wind tenders remained high

11 DIW Econ und Greenpeace, *Grenzen einer CO_2-Bepreisung Dekarbonisierungsmaßnahmen jenseits eines CO_2-Preises* (2019) (in German; available online).

12 Standard & Poor's, *Key Credit Factors For The Regulated Utilities Industry* (2017).

13 Nils May and Karsten Neuhoff, "Financing Power: Impacts of Energy Policies in Changing Regulatory Environments," *The Energy Journal* 42, no. 4 (2021) (available online).

14 Neuhoff, May, and Richstein, "Financing renewables in the age of falling technology costs."

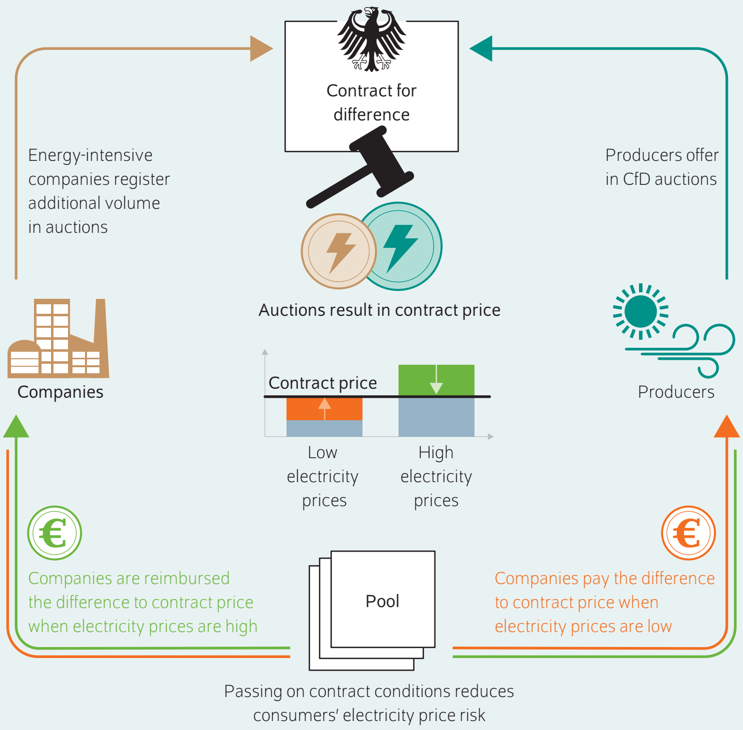
15 Jörn C. Richstein, Frederik Lettow, and Karsten Neuhoff, "Marktprämie beschert Betreibern erneuerbarer Energien Zusatzgewinne – Differenzverträge würden VerbraucherInnen entlasten," *DIW aktuell*, no. 77 (in German; available online).

16 Stefan Bach and Erich Wittenberg, "Entlastungspakete fangen nur einen Teil der höheren Energiekosten auf," *DIW Wochenbericht*, no. 17 (2022): 243-251 (in German; available online).

17 Energy & Climate Intelligence Unit, *New analysis, wind power "bonus" could cut bills by £25 this winter, and £45 next winter* (2022) (available online).

Figure 4

Passing on CfD conditions to companies



Sources: Concept according to Karsten Neuhoff, Jörn Richstein, and Mats Kröger, "Erneuerbaren-CfD-Pool für Industriestrom" (2022) (in German; available online).

Passing on CfD conditions simultaneously hedges energy-intensive companies and electricity producers.

in Great Britain.[18] This emphasizes the appeal of CfDs even when faced with high electricity prices and uncertain future price developments. This risk hedging is also relevant from a social standpoint, since both the costs of promoting renewable energy sources[19] and the current energy price increases[20] lead to a relatively heavier burden on lower income groups.

Passing on the terms of the CfDs to companies could result in further benefits for energy-intensive companies (Figure 4). Under such a model, companies can register their demand in the auctions. For this additional volume, a contract would be defined between the industrial buyers and the "pool" of producers, whose payments would be guaranteed by the federal government. The companies' payments are determined using the hourly generation profile and reference price of the installations in the pool, which are subsidized by a CfD.[21] Thus, the companies benefit from long-term, hedged electricity prices and, at the same time, can meet their internal climate targets through the certified procurement of green electricity.

Due to the government's high creditworthiness, the disadvantages of PPA financing costs are avoided. By standardizing the conditions and allowing for small-scale contracts, more companies can participate compared to private PPAs. However, as in the case of private PPAs, the state budget does not incur any costs from the compensation payments even if the conditions are passed on, since it only acts as a clearing house between the companies' compensation payments. A wide range of companies is able to participate because they are able to withdraw from the contract under certain conditions, for example if production is discontinued (exit option). Costs or revenue for the government can arise depending on how electricity prices develop if companies use this exit option.[22] Finally, defining the pooled portfolio of all CfDs as a standardized product could further develop the electricity forward markets by facilitating the establishment of complementary products relative to the standardized forward product to hedge profile risks. This can secure revenue streams from flexibility options and generate the necessary investments to develop this flexibility.

CfD design supports targeted and system-friendly expansion of renewable energy sources

A sustainable remuneration system should also provide incentives for expanding renewable energy sources in a system-friendly manner. System-friendly installations are installations that generate more electricity during times when less electricity is available overall. In contrast, the volatile generation profile of wind and solar energy poses challenges to the power grid, especially when plants produce at the same time due to similar siting and technology choices.

A more even production distribution can be achieved by further developing the reference yield model (Box 2). The increased tender volumes up to 2030 can only be achieved if less windy sites are also used for onshore wind expansion. The Easter Package recognizes this by defining state-specific targets of 1.8 to 2.2 percent of Germany's land area to be designated for wind energy. This goal can be supported by further developing the reference yield model. This is because the correction factors effectively increase the maximum allowable bids for low wind sites. At the same time, the threshold of 60 percent of the reference yield, below which there is no longer an increase to the adjustment, reduces the attractiveness of sites below the threshold. If states do not meet the two percent target, lowering the lower threshold or changing

18 Renewables Now, *All Round 4 CfDs signed in UK, Hornsea 3 included* (2022) (available online).

19 Karsten Neuhoff et al., "Distributional effects of energy transition: impacts of renewable electricity support in Germany," *Economics of Energy & Environmental Policy* 2 (2013): 41–52.

20 Mats Kröger, Maximilian Longmuir, Karsten Neuhoff, and Franziska Schütze, "The Costs of Natural Gas Dependency: Price Shocks, Inequality, and Public Policy," *DIW Discussion Paper* no. 2010 (available online).

21 Karsten Neuhoff, Mats Kröger, and Jörn Richstein, "Erneuerbaren-CfD-Pool für Industriestrom," (2022) (in German; available online).

22 The possibilities of such a double-sided CfD are to be assessed soon in a Federal Ministry for Economic Affairs and Climate Action tender, which is based on the DIW Berlin concept, see Tagesspiegel Background, "BMWK untersucht Industriestrompreis-Optionen," 2022 (in German; available online).

Box 2

Reference yield model

The reference yield model is a bonus-malus system in the auction system for onshore wind energy. Its aim is to create incentives for an even geographical distribution of installations. For this purpose, the wind yield at the planned site is calculated for each turbine and divided by the number of full-load hours that the same turbine would achieve at the reference site with a wind speed of 6.45 m/s at a height of 100 meters. The quotient of the two gives the quality factor. Using the quality factor, a correction factor is calculated, by which the auction bid is divided (Table). The contract price, which determines the amount of financial support, is in turn multiplied by the correction factor after the auction ends so that installations at low wind locations can receive more financial support. The reference yield model thus increases the attractiveness of low wind sites in the auction, while simultaneously leading to a reduction in yields at sites with a high number of full-load hours during the operating phase. Therefore, competitive auctions result in a geographic shift of turbines because more turbines are awarded in low wind locations (Figure).

Table

Quality factors and correction factors[1]

Quality factors in percent of the reference yield, maximum bid allowed by quality factor for the May 2022 auction

Quality factor	60	70	80	90	100	110	120	130	140	150
Correction factor	1.35	1.29	1.16	1.07	1	0.94	0.89	0.85	0.81	0.79
Max. allowed bid	7.94	7.59	6.82	6.29	5.88	5.53	5.23	5	4.76	4.65

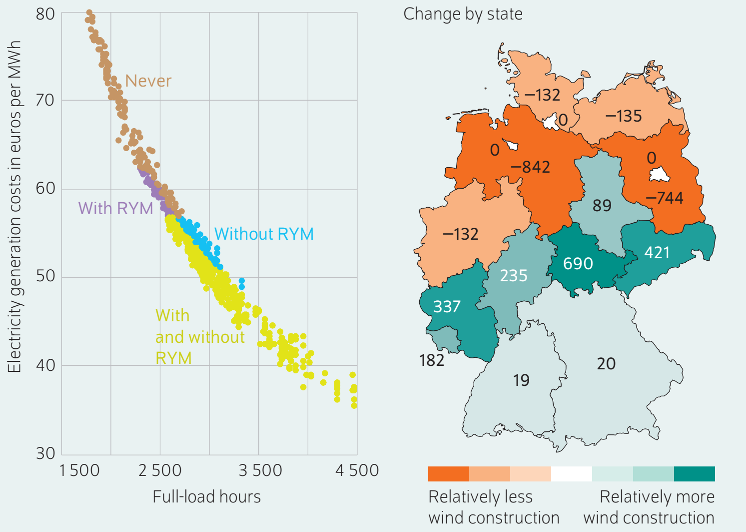
1 Table based on EEG 2021; was adjusted in EEG 2022 and extended to quality factor 50.

Source: Authors' calculations based on the 2022 EEG and the Federal Network Agency.

Figure

Subsidized installations and geographic distribution by state, with and without the reference yield model

Costs in euros per MWh, distribution in MW



Source: Mats Kröger, Karsten Neuhoff, and Jörn C. Richstein, "Discriminatory Auction Design for Renewable Energy," *DIW Discussion Paper*, no. 2013 (2022).

The reference yield model results in more projects being located at lower wind sites and plants being shifted to the south.

the correction factors could make more land with low wind speeds attractive.

Moreover, the reference yield model leads to a significant reduction in consumer costs for wind energy (Figure 5). Correcting bids reduces producer surpluses that operators or land owners can earn at sites with high full-load hours.[23] A DIW Berlin Discussion Paper shows that the reference yield model leads to a significant reduction in consumer costs when CfDs are introduced. In a simulation of future tenders up to 2030, the reference yield model reduces costs to consumers from renewable energy sources by about 25 billion euros, or 13 percent, assuming financing costs remain the same.[24]

With respect to incentives for system-friendly technology choices, the existing support scheme provides insufficient incentives for investment in system-friendly equipment, such as wind turbines with a greater share of generation at lower wind speeds.[25] Similarly, for solar energy, there is a fundamentally strong incentive to orient solar panels to the south. Due to these insufficient incentives, turbine shutdowns occur during periods of high production volumes, while renewable energy sources do not fully realize their

23 A high producer surplus from plant operators leads to windfall profits, such as land surpluses. Cf. Peter Haan and Martin Simmler, "Wind electricity subsidies — A windfall for landowners? Evidence from a feed-in tariff in Germany," *Journal of Public Economics*, vol. 159 (2018): 16–32.

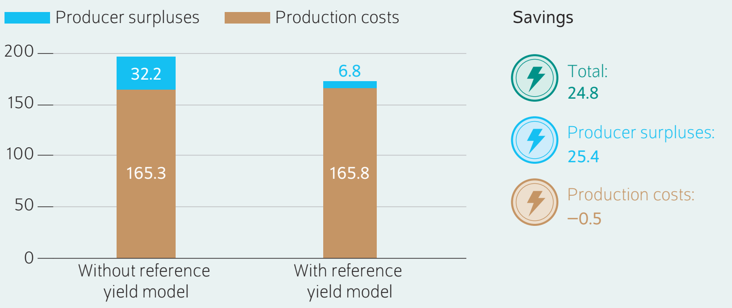
24 Mats Kröger, Karsten Neuhoff, and Jörn C. Richstein, "Discriminatory Auction Design for Renewable Energy," *DIW Discussion Paper* no. 2013 (available online).

25 Nils May, "The impact of wind power support schemes on technology choices," *Energy Economics* 65 (2017): 343–354.

Figure 5

Consumer savings due to the reference yield model for tenders, 2023 to 2030

Cash value in billions of euros



Source: Mats Kröger, Karsten Neuhoff, and Jörn C. Richstein, "Discriminatory Auction Design for Renewable Energy," *DIW Discussion Paper*, no. 2013 (2022).

The reference yield model significantly reduces producer surpluses while only slightly increasing production costs.

potential market value during times of low wind and in the morning and evening hours.

Different mechanisms for supporting system friendliness could be considered when introducing CfDs. One possibility would be continuing the existing system of monthly reference periods. In this system, producers are compensated based on the difference between the average price of the previous month and the contract price, which results from the auctions. Plants whose production deviates from the average generation curve thus receive higher compensation, as they produce more during hours with a low renewable energy supply and high electricity prices. This additional revenue from system friendliness, which results from increased production during high-price hours, will increase in the coming years as renewable energy sources account for a larger share of overall electricity production. However, the influence of the monthly reference period on the investment decision is limited by the fact that the associated revenues are still assessed as uncertain at the time of investment and lie in the future; therefore, they are strongly discounted.[26] Thus, insufficient incentives for system-friendly investments exist. An additional disadvantage of the monthly reference period are the associated revenue, and thus also financing, risks. This is because the revenues of individual producers can be significantly below the contract price if there is a high negative correlation between price and production volume.

Therefore, an alternative would be to use hourly reference periods, where a separate difference payment is determined for each hour and the payments are totaled at the end of the month. Since every kilowatt-hour of electricity produced is now remunerated at the contract price, revenue risks from the future expansion of renewable energy sources or electricity grids and the further development of the electricity market design are avoided, thus reducing both financing and electricity generation costs. At the same time, partial incentives for system-friendly investment decisions are also avoided, creating the need for appropriate mechanisms to be used instead to ensure full incentives for system-friendly investment decisions.

A market value model would be suitable for providing appropriate incentives to construct low wind turbines. Analogous to the reference yield model, the production of a wind turbine is determined relative to a reference yield. For this purpose, an electricity price profile is specified for which the market value of the turbine to be erected is compared with the expected market value of a standard turbine at the same location. Thus, a payment adjustment is determined that reflects system friendliness and is considered in the tender process.[27] In the case of smaller solar installations, the incentive to increase the east-west orientation of the panels could also be strengthened by introducing a flat rate adjustment that is determined for all panels based on their orientation.

Conclusion: Utilize advantages of the symmetric distribution of the electricity price risk

The expansion of renewable energy sources and the simultaneous support of price stability on the electricity market will be a central energy policy challenge for the German government and the electricity market regulators in the coming years. CfDs for renewable energy sources support this goal by hedging electricity producers and consumers alike against price fluctuations while simultaneously strengthening the expansion of renewable energy sources. Furthermore, the CfDs could be designed in a way to achieve other energy and climate policy goals: First, passing on the pooled CfDs could lead to simultaneous hedging of both industry and renewable energy producers and reduce financing costs. Second, by further developing the reference yield model, additional land could be developed and windfall profits from high producer surpluses at windy sites could be reduced without completely eliminating incentives for efficient site selection. Third, introducing a simplified market value model could increase the system friendliness of the renewable energy expansion. Thus, we recommend that the government change the renewable tenders to contracts for difference as soon as possible.

26 Karsten Neuhoff et al., "Von der einseitigen zur symmetrischen gleitenden Marktprämie," (2018) (in German; available online).

27 Karsten Neuhoff, Nils May, and Jörn Richstein, "Incentives for the Long-Term Integration of Renewable Energies: A Plea for a Market Value Model," *DIW Weekly Report*, no. 46/47 (2017): 929–938.

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