

The Analysis of the Novel Renewable Energy Sources Support Schemes – Case of Slovenia

Jernej Jožic
Jernej Zupancic
Matej Pecjak
Faculty of Electrical Engineering
University of Ljubljana
Ljubljana, Slovenia
Jernej.Jozic@fe.uni-lj.si

Edin Lakic, PhD
Institute for Innovation and Development of University of
Ljubljana
Ljubljana, Slovenia
Edin.Lakic@iri.uni-lj.si

Abstract – This paper investigates novel support schemes for the accelerated and efficient integration of renewable energy sources (RES), with a focus on Contract for Difference (CfD) and Power Purchase Agreements (PPAs) as key mechanisms. Using data from Slovenia, detailed economic analysis was conducted to evaluate the performance of mature technologies, such as photovoltaic (PV) systems, and Battery Energy Storage Systems (BESS). The analysis considers these technologies both independently and in scenarios where CfD and PPA coexist. The analysis reveals that two-way CfD mechanisms are more suitable for mature RES technologies, while one-way CfD mechanisms align better with BESS installations. PPA, despite yielding slightly lower revenues than CfD, presents a lower-risk alternative, making it attractive in specific market conditions as explained in the paper. Four variations of CfD and PPA interactions were analysed, emphasizing the need for flexible switching mechanisms based on market price fluctuations. Among these, the scenario with a predefined minimum mandatory production under the CfD scheme emerges as the most transparent and economically viable solution. The results underscore the potential of combined CfD/PPA schemes to reduce investor risk and promote the faster deployment of RES technologies. Furthermore, the integration of BESS is highlighted as critical in regions with weak power network infrastructure, demonstrating a robust economic case for its deployment. Although payback period calculations for BESS were not performed due to rapid technological advancements and price reductions, the analysis indicates a strong economic case for BESS deployment.

Index Terms – Contract for Difference, Economic Analysis, Power Purchase Agreement, Renewable Energy Sources, Support Schemes

I. INTRODUCTION

The green energy transition of the European Union (EU), which aims to achieve climate neutrality by 2050, necessitates the rapid deployment of renewable energy sources (RES) across the region. Photovoltaics (PV) and wind energy remain the dominating technologies within this transition. In recent years, the economic viability of PV and wind energy has improved significantly, while newer innovative technologies, such as bioenergy and battery energy storage systems (BESS) have lagged behind in both development and implementation. To facilitate the future advancement of the latter technologies,

the EU encourages its member states to promote them through updated initiatives tailored for investors.

At the EU level, various support schemes and mechanisms have been established over the years to expedite the deployment of RES [1]. In May 2024, the European electricity market design reform was introduced in the document

Regulation (EU) 2024/1747 [2]. The implementation of Contract for Difference (CfD) and Power Purchase Agreements (PPAs) has been recognised as an effective incentive to bolster the further development and deployment of various RES technologies. A technical analysis of CfDs is presented in [3], alongside an exploration of the PPA mechanism, which describes the coexistence of both CfDs and PPAs while highlighting the unique challenges that may arise from their collective market introduction. In [4], ENTSO-E analysed various mechanisms for the coexistence of PPA and CfD, demonstrating the potential economic benefits of their synchronous implementation in the market. Authors in [5] provide an in-depth investigation on PPAs which includes clear instructions on contract templates.

The purpose of this paper is to support decision-makers in determining and implementing innovative and effective support schemes. By addressing the economic and technological challenges of integrating RES technologies, the paper contributes to their future development and installations, while aiding in the broader transition to a sustainable energy future.

This study focuses on a comprehensive economic analysis of CfD and PPA mechanisms using data specific to Slovenia. It is crucial to identify all key parameters associated with each support scheme, including potential distortions in the mechanisms, which are among the central focuses of this paper. Notably, [6] provides an economic perspective on this issue.

In addition to the general analysis of RES support schemes, this paper conducts a technology-specific analysis to mitigate issues related to joint tendering procedures and the potential prohibition or inhibition of individual RES technologies. Accordingly, separate analyses are performed on mature technologies, such as PV systems, and BESS.

II. METHODOLOGY

A. Contract for Difference

CFDs are well-established financial products with many applications across different sectors. In recent years, they have gained popularity in the RES sector as a mechanism to stabilize revenues and reduce risks for investors. There are two primary types of CfD mechanisms: the one-way and the two-way mechanism. They are both based on the difference between fixed strike and viable reference price. Strike price is usually determined through tendering procedures by the tender bidders and the reference price is set in advance for the determined time periods (hours, days, weeks, months). The mechanism's core involves an annual net payment exchanged between two entities. The two-way mechanism operates as follows: If the strike price exceeds the reference price, producers receive payments. Conversely, if the reference price exceeds the strike price, producers are required to make payments to the counterparty, typically a government or national entity. The one-way mechanism follows a similar procedure, with the key difference being that no payments are made by producers to the counterparty when the reference price exceeds the strike price. [3].

Given the inherent complexity of CfDs, a well-defined methodology is essential for conducting robust economic analyses and facilitating effective market implementation. This study employs an economic analysis of various RES systems, utilizing multiple derivations to achieve comprehensive insights.

Strike prices are established based on the average Day-Ahead Market (DAM) price in Slovenia for 2023 [7], set at 105 EUR/MWh. The analysis examines three strike price scenarios: 85 EUR, 105 EUR, and 120 EUR/MWh. Reference prices cover a range of average hourly, daily, weekly, monthly, and yearly intervals and is also determined based on DAM market. The analysis incorporates CfDs with band gaps (BGs), designed to introduce flexibility by disregarding minor discrepancies between the strike and reference prices. This approach minimizes number of insignificant payments, which have negligible impacts on annual net payments. For this analysis, the contract duration is 15 years, although the economic evaluations are conducted based on a single annual settlement.

B. Power Purchase Agreement

PPAs are designed to sell or purchase electricity outside the wholesale electricity market. These contracts are signed by two or more entities, specifying terms such as duration, quantity, pricing methods, and invoicing procedures [8].

Due to the variety of PPA structures, implementing and executing the mechanism can be complex. For this study, a simplified scenario with two entities is considered. The electricity producer owns the RES technology, while the consumer is an energy-intensive company operating continuously. This means that all electricity produced by the producer is fully consumed by the company, which also fully bears reconciliation costs.

Given the low liquidity of Slovenian power futures, the prices were obtained from the Hungarian Derivative exchange HUDEX [9] as Quarter Futures for 2024 Q2, Q3, Q4, and 2025 Q1. These prices were then adjusted by factors of 2 %, 7 %, and 12 % to make the system profitable for both stakeholders, the producer and the consumer. A price spread

of 10 % was applied to enable a sensitivity analysis. The contract duration is set to 15 years, with economic analyses formulated on annual basis.

C. Coexistence of Contract for Difference and Power Purchase Agreements

To ensure the transparent and equitable coexistence of CfD and PPA mechanisms in the market, thorough analysis and legislative adaptations are required. Poorly designed mechanisms or legislation can lead to market distortions, such as incorrect production signals (e.g., producing when prices are below marginal costs or ceasing production when prices are above marginal costs) or non-cost-based bidding that affects price formation [3], [10]. On the other hand, the synchronous implementation of these mechanisms may result in lower target prices being offered in tendering procedures. When generation is divided between the two mechanisms, a sufficiently competitive price within the PPA mechanism enables producers to offer a lower target price in the tendering process [4].

This study examines four coexisting mechanisms:

- Switch off CfD/on PPA when the market prices are negative.
- Switch off CfD/on PPA when the market prices fall below 50 % of the CfD reference price.
- Predefined minimum mandatory production under the CfD scheme.
- Predefined ratio of CfD/PPA mechanisms.

D. Mature technologies

The term “mature technologies” refers to well-established RES technologies, such as wind and PV energy sources. Two specific cases are analysed:

- 1.) A prosumer with a 10 kWp PV installation and household-based self-consumption.
- 2.) A producer with a 100 kWp PV installation and no self-consumption.

1) Prosumer

The first case considers a prosumer, where the power profile is based on the yearly load profile of an average Slovenian household [11]. The profile of a rooftop PV system with a capacity of 10 kWp was added to assess self-consumption and market interactions. The annual PV production data was obtained from [11] and scaled accordingly. The total annual electricity consumption of the prosumer is 6,76 MWh, while the PV system produces 12,15 MWh annually, as shown in Figure 1. During periods of high production, the excess electricity is sold at market prices, while during times of higher consumption than generation, the prosumer purchases electricity from the grid at a retail price of 0.2025 EUR/kWh [12]. Prosumers participating in the analysed schemes are not eligible for additional support mechanisms such as net metering or net billing.

2) Producer

As opposed to a prosumer, large production unit owner acts solely as electricity generator and do not engage in self-consumption. All generated electricity is directly fed into the market. The scenario described could represent various PV systems, including agrivoltaics and larger rooftop installations, among others. By applying the same system scaling approach as in the prosumer case, the PV system with

a 100 kWp capacity is estimated to generate 121.50 MWh annually.

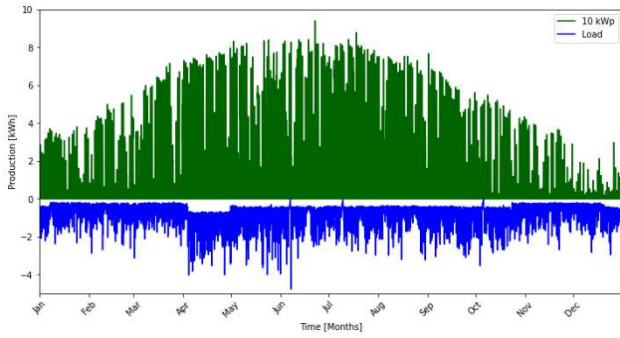


Figure 1: Yearly production and load profiles of the prosumer.

E. Battery energy storage system

With the increasing need for flexibility services such as load-shifting and peak-shaving, this paper also evaluates the economic viability of BESS installations. The technical and operational constraints of BESS are considered, including:

- A depth of discharge (DoD) equal to 92 % of the nominal capacity.
- A round-trip efficiency (RTE) of 85 %, with a single charge/discharge cycle per day.

In scenarios where electricity consumption is included alongside BESS, the following methodology is applied:

- Electricity drawn directly from the grid is settled at retail prices.
- Electricity used for BESS optimization is settled based on 15-minute market price readings, excluding distribution margins.

To implement this, BESS must be metered and billed separately from other electricity consumption and generation, requiring the submetering system. To assess the economic feasibility, four different scenarios were analysed:

- Prosumer with a 10 kWp PV system and an 8 kWh/4 kW BESS.
- Business entity with a 100 kWp PV system and an 80 kWh/40 kW BESS.
- Household without PV system but with an 8 kWh/4 kW BESS.
- Business entity without PV system but with an 80 kWh/40 kW BESS.

III. RESULTS

A. Mature technologies

1) Prosumer

Based on the predetermined household load profile, the annual electricity expenditure taken from the grid amounts to 722.23 EUR. At the same time, surplus electricity from the rooftop PV system that is not self-consumed is sold on the market, generating revenue of 699.74 EUR. As a result, the average yearly electricity cost for the prosumer is reduced to just 22.50 EUR. If the prosumer participates in the CfD mechanism, all electricity sold to the grid is subject to the CfD scheme.

The results in Figure 2 highlight the importance of setting an economically viable initial price in tendering procedures.

- If the strike price is set too low, tenders may be unsuccessful due to insufficient capacity offers.
- If the strike price is too high, it creates an excessive financial burden on the state budget, leading to market distortions.
- Longer reference periods lead to lower investor revenues, as higher reference prices correlate with longer settlement intervals.



Figure 2: Annual revenues of CfD mechanism (prosumer).

As an alternative to the CfD, the PPA mechanism was also analysed. Under a PPA, electricity is not sold to the wholesale market but directly to a designated buyer. The main advantage of the PPA for prosumers is its lower risk compared to CfD, as it shields them from short-term market price fluctuations. The profitability results of PPA and two-way CfD mechanisms are shown in Table I. Compared to the CfD scheme with the highest strike price and hourly reference period, PPA delivers comparable results. Considering the design of both mechanisms – including risks, expenses, and market dependencies - the PPA mechanism appears to be the more favourable option for prosumers.

TABLE I. RESULTS OF PPA AND TWO-WAY CFD MECHANISMS (PROSUMER)

Adjustment factor (PPA)	Revenue [EUR/Year]		Profit/Loss [EUR/Year]		
	Hour	Day	Week	Month	Year
+ 2 %	883.5				161.31
+ 7 %	926.9				204.62
+ 12 %	970.2				247.93
Target Price (CfD)	Profit/Loss [EUR/Year]				
	Hour	Day	Week	Month	Year
85 EUR/MWh	-8.6	-128.1	-132.7	-121.1	-148.2
105 EUR/MWh	135.1	16.4	1.9	-6.6	-22.5
120 EUR/MWh	243.7	114.6	100.8	95.6	58.0

2) Producer

A producer with a 100 kWp PV system generates 121.50 MWh of electricity annually, all of which is sold directly to the market. This results in an annual revenue of 9,988.8 EUR. When producer enters the CfD mechanism, the profitability of the project can either increase or decrease depending on the target price and market conditions. Figure 3 presents the results of CfD implementation on the market. Similar to the smaller PV system, profitability decreases as:

- The reference period lengthens, leading to lower effective revenues.
- The target price is set lower, reducing the subsidy effect.

The one-way mechanism (without clawbacks) offers the highest revenues but is not suitable for broad market implementation, as it shifts all the risk from the producer to the state budget. The introduction of a band gap reduces extreme revenue variations, making the mechanism more manageable and cost-effective. However, the overall financial impact remains limited, and the fundamental cost-benefit balance of the CfD scheme remains unchanged.



Figure 3: Annual revenues of CfD mechanism (producer).

The PPA analysis was conducted in the same manner as for the 10kWp PV system. As shown in Table II, revenues under the PPA scheme are comparable to those under the two-way CfD mechanism, even slightly higher than in the highest strike price scenario, when considering both market sales and revenues from the CfD mechanism. Therefore, PPA remains a lower-risk and profit higher option compared to CfD, making it an attractive alternative.

TABLE II. RESULTS OF PPA AND TWO-WAY CFD MECHANISMS (PRODUCER)

Adjustment factor (PPA)	Revenue [EUR/Year]				
	+ 2 %	12,225.2			
+ 7 %	12,824.5				
+ 12 %	13,423.8				
Target Price (CfD)	Revenue [EUR/Year]				
	Hour	Day	Week	Month	Year
85 EUR/MWh	9,878.9	8,460.4	8,430.6	8,567.3	8,252.4
105 EUR/MWh	11,874.5	10,464.7	10,290.8	10,168.7	9,988.8
120 EUR/MWh	13,374.4	11,825.7	11,667.8	11,581.2	11,101.1

3) Evaluation of CfD-PPA coexistence scenarios

A detailed analysis was performed to evaluate the simultaneous integration of the PPA (+ 7 %) and two-way CfD mechanisms. Four different scenarios were examined to assess their feasibility and economic impact:

a) *Switching off CfD and switching on PPA when market prices are negative*

- This mechanism relies on continuous monitoring of 15-minute electricity price fluctuations.

- Due to the rarity of negative electricity prices, this approach proved inefficient for PPA stakeholders as shows Table V in the Appendix.
- However, with increasing RES penetration, negative prices are expected to become more frequent, potentially making this scenario more viable in the future.

b) *Switching off CfD and switching on PPA when market prices fall below 50 % of the CfD reference price*

- Table VI in the Appendix shows market sales, CfD and PPA revenues. In comparison to previous scenario the market sales revenues were lower.
- However, absolute CfD revenues decreased due to the earlier switch-off, while PPA revenues increased significantly.
- This approach is highly applicable in volatile market conditions, where daily and seasonal price fluctuations are driven by demand response and RES integration

c) *Predefined minimum mandatory production under the CfD scheme*

- A threshold of 45 kWh was established, meaning electricity generated beyond this level was sold through the PPA mechanism, while the base production was traded under the CfD scheme and sold to the market.
- The revenue from electricity sold on the market was equal to 8,797.1 EUR, which is lower than in previous scenario.
- Figure 4 illustrates the boundary conditions for switching between mechanisms, Figure 5 shows the results of the two-way CfD mechanism.
- Table III shows the revenues of the PPA and two-way CfD mechanisms.
- During spring and summer, when electricity prices are typically lowest, the predefined production boundary was frequently exceeded.
- This approach improves transparency, reduces financial burdens on the state, and prevents market distortions.

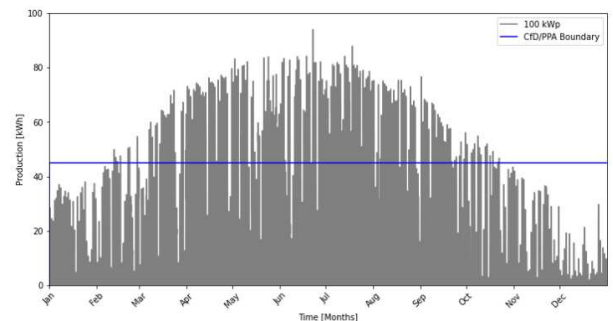


Figure 4: CfD/PPA boundary conditions.

d) *Predefined ratio of CfD and PPA mechanisms*

- In this scenario, 75 % of the electricity was sold under the CfD scheme, while 25 % was allocated to the PPA mechanism.

- The mechanism was applied on an hourly basis, meaning the predefined ratio remained constant regardless of price fluctuations.
- Market sales revenue totalled 7,491.6 EUR, slightly lower than in the previous scenario.
- While revenue distributions were similar, the transparency of this approach is questionable due to constant engagement in both mechanisms without adjusting for price signals.

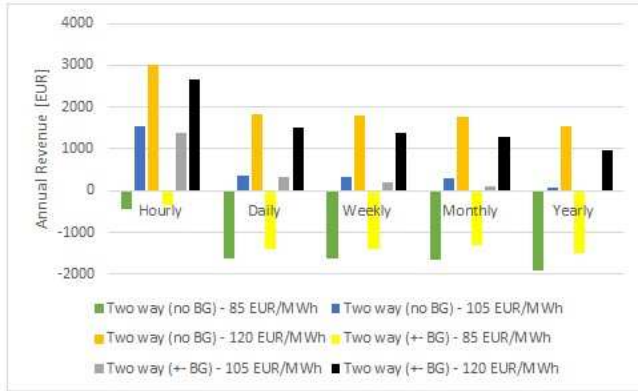


Figure 5: Two-way CfD mechanism (predefined minimum mandatory production under the CfD scheme).

TABLE III. RESULTS OF PPA AND TWO-WAY CfD MECHANISM OF THE PREDEFINED MINIMUM MANDATORY PRODUCTION UNDER THE CfD SCHEME SCENARIO

Adjustment factor (PPA)	Revenue [EUR/Year]				
+ 2 %	1,906.7				
+ 7 %	2,000.1				
+ 12 %	2,093.6				
Target Price (CfD)	Revenue [EUR/Year]				
	Hour	Day	Week	Month	Year
85 EUR/MWh	8,455.1	7,406.8	7,399.4	7,502.2	7,314.0
105 EUR/MWh	10,171.3	9,122.9	8,994.5	8,887.4	8,797.1
120 EUR/MWh	11,452.2	10,293.3	10,178.5	10,093.0	9,747.1

The analysis demonstrates that the coexistence of CfD and PPA mechanisms can offer greater flexibility and risk mitigation for investors and policymakers. While each mechanism has its advantages, their combination under well-defined switching conditions can enhance market efficiency and reduce financial uncertainty.

Among the evaluated scenarios, the predefined minimum mandatory production under the CfD scheme appears to be the most transparent and economically viable approach, ensuring predictable revenues while maintaining grid stability. The predefined CfD/PPA ratio mechanism, although providing steady income distribution, raises concerns regarding its responsiveness to dynamic market conditions.

B. Battery Energy Storage System

The performance of the BESS was optimized based on DAM market price signals, PV production, and the prosumer's load profile. For this analysis, only the one-way CfD mechanism was considered as the two-way mechanism would impose clawback obligations on producers during high-

price periods, reducing the economic incentive for BESS deployment. A one-way CfD is more suitable because BESS owners should be encouraged to sell electricity during peak price periods and avoid discharging during low-price periods.

For a prosumer with a 10kWp PV system, the annual expense of electricity purchased from the grid was 443.2 EUR, while revenue from selling stored or directly purchased electricity was 964.6 EUR. Additional revenue was generated under the CfD mechanism. The PPA mechanism was also examined, showing annual revenues of around 1,000 EUR. Overall, the one-way CfD mechanism yielded higher revenues than PPA, making it a more attractive option for prosumers.

For a producer with a 100 kWp PV system, the same methodology was applied. The total revenue from electricity sales reached 12,203.4 EUR and one-way CfD integration increased total revenue to over 15,000 EUR. In comparison, the PPA mechanism generated significantly lower revenues, as shown in Table IV below and Table VII in the Appendix.

TABLE IV: PPA RESULTS OF THE BESS IMPLEMENTATION

Adjustment factor	Revenue Prosumer [EUR/Year]	Revenue Producer [EUR/Year]
+ 2 %	944.7	12,069.7
+ 7 %	991.0	12,661.3
+ 12 %	1,037.3	13,253.0

STANDALONE BESS SCENARIOS

In addition to PV-integrated BESS, two additional scenarios were analysed:

- A household and a business entity without PV installations, equipped only with BESS (8 kWh/4 kW and 80 kWh/40 kW, respectively).

In the PPA scenario, an aggregator or balancing service provider (BSP) could manage BESS operations independently from the owner. The BSP would purchase electricity from the owner under a PPA and sell it during high-price periods, generating profits for both parties. However, this arrangement introduces risks:

- During extended low-price periods, aggregators may delay discharging BESS, reducing owner revenue.
- To mitigate this risk, contracts should define a minimum number of discharge cycles per day or week.

For a household without PV, annual electricity expenses were 1,365.8 EUR. After installing BESS, revenue from market sales reached 235.9 EUR. Although a one-way CfD mechanism was considered, it did not significantly increase revenues as BESS was already optimized for high-price periods. In this case, the PPA mechanism proved to be a more favourable option.

For a business entity without PV, the annual grid electricity cost was 11,145 EUR. After installing BESS, electricity expenses rose to 14,596 EUR, but revenue from BESS energy sales reached 8,605 EUR, leading to a net electricity expense of 5,990 EUR. This resulted in an annual profit of 5,155 EUR due to the BESS operations.

The one-way CfD mechanism provided additional income, but revenues remained lower compared to the PPA mechanism, once again making PPA the more economically viable option for standalone BESS.

IV. CONCLUSION AND FUTURE WORK

The paper presents novel support schemes for faster and more efficient integration of RES. A detailed economic analysis of mature technologies and BESS was conducted, focusing on CfD and PPA as suitable support schemes. Both schemes were analysed individually, while certain scenarios examined their coexistence to assess potential synergies.

Economic analysis shows relatively small economic differences between the support schemes in the chosen area of analysis. Two-way CfD mechanisms are suitable for mature technologies, while one-way CfD mechanisms are better suited for BESS integration. PPA should be encouraged wherever feasible, as it offers a lower-risk alternative. The coexistence of both mechanisms should be seen as an opportunity for faster, lower-risk RES expansion. Among the four proposed approaches, the predefined minimum mandatory production under the CfD scheme emerges as the most transparent, economically viable, and technologically feasible option.

Calculations of the payback period for BESS installations were not performed, as rapid technological advancements and significant price reductions in the past year would make such estimates unreliable.

In the future, other RES technologies should also be analysed. Bioenergy, specifically biomass power plants with a stable production profile, show significant potential for electricity generation. Additionally, innovative technologies such as hydrogen will play a key role in the EU's green transition. The Carbon Contract for Difference (CCfD) should be thoroughly analysed as a support scheme for facilitating the market integration of emerging RES technologies.

It is essential to understand that this study primarily focuses on the economic aspects of novel support schemes. Regulatory framework, potential market distortions, and other systemic factors affecting the overall efficiency of those mechanisms fall beyond the scope of this paper.

ACKNOWLEDGMENTS

This contribution was co-developed through research activities within the ECOLOOP project, which is funded by the European Union's Horizon Europe Framework Programme for Research and Innovation (HORIZON EUROPE 2020) under Grant Agreement No. 101118127.

REFERENCES

APPENDIX

TABLE V. RESULTS OF THE CfD/PPA BOUNDARY WHEN THE MARKET PRICE IS NEGATIVE

	Reference Price [EUR/MWh]					
	Target Price [EUR/ MWh]	Hourly	Daily	Weekly	Monthly	Yearly
Market Revenue (no BG) [EUR/Year]	85	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
	105	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
	120	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
Market Revenue (with BG) [EUR/Year]	85	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
	105	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
	120	10,034.6	10,009.3	9,988.8	9,988.8	9,988.8
CfD Mechanism (no BG) [EUR/Year]	85	-612.7	-1,832.5	-1,832.8	-1,857.0	-2,225.6
	105	1,604.2	459.3	469.2	445.1	76.4
	120	3,266.9	2,178.1	2,195.7	2,171.6	1,802.9
CfD Mechanism (with BG) [EUR/Year]	85	-499.3	-1,573.2	-1,558.2	-1,421.5	-1,736.4
	105	1,415.5	421.3	302.0	179.9	0.0
	120	2,854.8	1,775.0	1,679.0	1,592.4	1,112.3
	85	417.8	49.5	0.0	0.0	0.0

- [1] Council of European Energy Regulators, "Key support elements of RES in Europe: moving towards market integration," CEER, Vienna, 2016.
- [2] European Union, "Regulation (EU) 2024/1747 of the European Parliament and of the Council," 13 Junij 2024. [Online]. Available: <https://eur-lex.europa.eu/eli/reg/2024/1747/oj/eng>. [Accessed 15 September 2024].
- [3] L. Kitzing, A. Held, M. Gephart, F. Wagner, V. Anatolitis and C. Klessmann, "Contracts-for-Difference to support renewable energy technologies: Considerations for design and implementation," European University Institute, Fiesole, 2024.
- [4] ENTSO-E, "Sustainable Contracts for Difference (CfDs) Design," ENTSO-E AISBL, Brussels, 1014.
- [5] European Union Agency for the Cooperation of Energy Regulators, "Assessment on the need of ACER's voluntary Power Purchase Agreement contract template(s)," 15 October 2024. [Online]. Available: <https://www.acer.europa.eu/documents/publications>. [Accessed 15 December 2024].
- [6] I. Schlect, C. Maurer and L. Hirth, "Financial contracts for differences: The problems with conventional CfDs in electricity markets and how forward contracts can help solve them," *Energy Policy*, vol. 113981, no. <https://doi.org/10.1016/j.enpol.2024.113981>, p. 186, 2024.
- [7] AGEN RS, "Električna energija, eMonitor," [Online]. Available: <https://www.agen-rs.si/web/emonitor/delovanje/elektricna-energija>. [Accessed 15 September 2024].
- [8] Commission de régulation de l'énergie, "Study: Power Purchase Agreements: Overview and evaluation," CREG, Brussels, 2024.
- [9] Hungarian Derivate Energy Exchange, "Market Data," HudeX, [Online]. Available: <https://hudex.hu/en/market-data/power/daily-data#quarter>. [Accessed 15 September 2024].
- [10] A. Khodadadi and R. Poudineh, "Contracts for difference – CfDs – in the energy transition: balancing market efficiency and risk mitigation," *The Oxford Institute for Energy Studies*, vol. OIES Paper: EL56, no. ISBN 978-1-78467-250-8, p. 30, 2024.
- [11] A. F. Gubina, Z. Jernej, M. Antončič and T. Andreas, *Story EU Project - added value of STORage in distribution systems. Deliverable D7.3 Report on large scale impact simulations*, Ljubljana: European Union's Horizon 2020, 2018.
- [12] Statistical Office of the Republic of Slovenia, "Prices of Energy Sources," Republic of Slovenia, [Online]. Available: <https://www.stat.si/StatWeb/en/Field/Index/5/30>. [Accessed 15 October 2024].

PPA Mechanism (Cfd with no BG) [EUR/Year]	105	417.8	49.5	0.0	0.0	0.0
	120	417.8	49.5	0.0	0.0	0.0
	85	417.8	49.5	0.0	0.0	0.0
PPA Mechanism (Cfd with BG) [EUR/Year]	105	417.8	49.5	0.0	0.0	0.0
	120	417.8	49.5	0.0	0.0	0.0
	85	417.8	49.5	0.0	0.0	0.0

TABLE VI. RESULTS OF THE CFD/PPA BOUNDARY WHEN THE MARKET PRICES FALL BELOW 50 % OF THE REFERENCE PRICE

	Reference Price [EUR/MWh]					
	Target Price [EUR/ MWh]	Hourly	Daily	Weekly	Monthly	Yearly
Market Revenue (no BG) [EUR/Year]	85	9,793.1	9,978.4	9,974.1	9,988.8	9,988.8
	105	9,638.2	9,914.7	9,974.1	9,988.8	9,988.8
	120	9,467.9	9,848.0	9,974.1	9,988.8	9,988.8
Market Revenue (with BG) [EUR/Year]	85	9,793.1	9,978.4	9,974.1	9,988.8	9,988.8
	105	9,638.2	9,914.7	9,974.1	9,988.8	9,988.8
	120	9,467.9	9,848.0	9,974.1	9,988.8	9,988.8
Cfd Mechanism (no BG) [EUR/Year]	85	-1,598.5	-2,044.1	-1,857.4	-1,857.0	-2,225.6
	105	140.5	-68.0	435.1	445.1	76.4
	120	1,340.9	1,345.5	2,154.5	2,171.6	1,802.9
Cfd Mechanism (with BG) [EUR/Year]	85	-1,423.7	-1,767.8	-1,580.8	-1,421.5	-1,736.4
	105	44.8	-63.7	270.4	179.9	0.0
	120	1,053.7	1,008.3	1,640.6	1,592.4	1,112.3
PPA Mechanism (Cfd with no BG) [EUR/Year]	85	2,049.4	482.8	52.5	0.0	0.0
	105	2,413.9	922.8	52.5	0.0	0.0
	120	2,754.5	1,253.6	52.5	0.0	0.0
PPA Mechanism (Cfd with BG) [EUR/Year]	85	2,049.4	482.8	52.5	0.0	0.0
	105	2,413.9	922.8	52.5	0.0	0.0
	120	2,754.5	1,253.6	52.5	0.0	0.0

TABLE IIIII. CFD RESULTS OF THE BESS IMPLEMENTATION

	Reference Price [EUR/MWh]					
	Target Price [EUR/ MWh]	Hourly	Daily	Weekly	Monthly	Yearly
Cfd Mechanism Prosumer (Cfd with no BG) [EUR/Year]	85	139.5	46.7	17.3	0.2	0.0
	105	233.7	109.2	81.2	67.3	5.5
	120	331.3	195.8	181.5	176.3	130.5
Cfd Mechanism Prosumer (Cfd with BG) [EUR/Year]	85	125.4	38.9	10.5	0.1	0.0
	105	204.3	88.1	56.4	39.4	0.0
	120	290.2	157.4	137.8	129.9	80.5
Cfd Mechanism Producer (Cfd with no BG) [EUR/Year]	85	1,396.6	731.9	315.3	33.8	0.0
	105	2,424.3	1,641.8	1,242.8	1,018.4	83.2
	120	3,542.8	2,892.9	2,700.7	2,610.1	1,964.5
Cfd Mechanism Producer (Cfd with BG) [EUR/Year]	85	1,249.0	615.9	215.1	18.5	0.0
	105	2,096.7	1,334.9	877.6	613.1	0.0
	120	3,064.5	2,338.9	2,068.3	1,933.5	1,212.0