

The Evolution of the Greek Solar PPA Market:

Policy Framework,
Key Developments & Expert Views



Introduction

Evidently, the energy price crisis is affecting both larger industries and private consumers.

Undeniably, the world finds itself at a major crossroad. On the one hand, the climate crisis and the irreversible damage due to climate change are accelerating, while on the other hand, a never-before-seen energy price crisis is affecting all industries and consumers.

Combined with the increase in electricity demand and the reduction of fossil fuel-related investments, especially in Europe, we have a major riddle to solve.

Mainstream renewables are called upon to provide a sustainable solution on both the climate change and energy crisis fronts.

Clearly, renewables can be deployed in the shortest time and the global available investment capital has increased for the mainstream technologies (Solar PV and Wind). However, the industry is still facing major bottlenecks in the areas of legislation, planning, and grid capacity.

A significant result of the issues above is that the industry has made a turn towards PPA-driven revenue models. This trend can now also be witnessed in Greece.

This publication will provide an overview on the developments and changes in the Greek PPA market, and the framework that is being shaped by the recent legislative changes.



Demand Side

Due to the sharp increase in power prices, medium and large industrial consumers face far greater challenges, and the idea of long-term PPAs have started to gain traction on the demand side. It also marks the market's growing interest, given that ESG criteria are increasingly becoming a part of organizations' "day-to-day operations". The following graph shows the evolution of energy prices in Greece from January 2022 to August 2022, during which the impact of the disruptions due to gas shortage is evident, with the current peak in August at 697€. It goes without saying that the major issue amongst industrial consumers is the cost of energy. Therefore, PPAs with bankable producers that uphold ESG and HSE criteria are very high on everyone's agenda.

Greek market day ahead prices January to August 2022



Supply Side

In terms of supply, developers and investors are investigating the possibility of PPAs as the market's next growth engine. The main driver is that renewable auctions have become increasingly more competitive and are observing a downward pricing trend, especially for solar projects. Moreover, as seen in other markets, it's become clear that the 2030 National Energy and Climate Plan (NECP) targets for Greece cannot be met solely through subsidized projects. As a result, merchant projects with PPAs will be crucial in realizing the nation's potential for renewable energy. Another aspect of the changes in the revenue models adopted by suppliers is the change in the risk profile that financiers and lenders are willing to accept. Both suppliers and lenders are willing to engage in discussions and ready to leverage the high energy prices by allocating part of their production in the merchant market. Therefore, new models allow 70% – 80% of the annual yield to be secured under a PPA (until now we see that there is a requirement for a minimum 10-year tenor) and the remaining to be openly traded in the day ahead markets. However, there is a catch: the asset can borrow and is underwritten only against the secure PPA revenue value. The potential merchant revenue is disregarded in the financial structuring, but can bring a significant upside to knowledgeable asset owners.

Evolution of the Greek PPA market

Until recently, the PPA market in Greece was still in its infancy, even though large domestic and international players have been showing growing interest. Municipalities, small and large industrial consumers, large commercial enterprises, and companies with high energy costs could be potential offtakers for PPAs. As pointed out by the Greek Minister of Energy & Environment in May 2021, the government's goal is for green PPAs to cover 20% of the power demand in energy-intensive industries. The lack of a regulatory framework for PPAs, coupled with the heavy reliance on subsidies, did not create fruitful conditions for the corporate PPA market to flourish. Up until the first half of 2022, the only PPAs signed in Greece were from vertically integrated energy groups, between their subsidiaries.

The PPA market is maturing

The situation is now rapidly changing, as PPAs have started to gain momentum in Greece. In June 2022, the Greek energy exchange (HENEX) launched a pre-feasibility study for a non-mandatory auction platform, which suggests that HENEX is investigating the possibility of implementing corporate PPAs. In July, Cero Generation announced what is quoted as “the first private PPA-backed utility-scale solar project” for a 100MW solar project under construction in Northern Greece. In August, The Ministry of Environment and Energy issued a decree concerning the criteria for grid connection priority. Projects with a draft PPA in place, where the off-taker is a domestic industrial consumer, will be prioritized over those aiming to secure tariffs through auctions.

Key takeaways from the recent grid priority framework

Although this decision does not provide the much-anticipated framework for PPAs in Greece, but rather lays out the criteria for grid connection priority, it does present useful indications of how the market will evolve:

- The framework covers up to 1,500MW of projects with draft PPAs until October 2022. It is uncertain whether this is the first in a series of incentives for PPA-backed projects or if the total capacity of 1.5GW will be covered by the deadline. It definitely sets the stage for utility-scale projects, either wind or solar, to negotiate and close bilateral supply contracts with major industrial consumers, helping the market mature rapidly. This in turn will create a snowball effect, generating more interest from developers and industries alike.
- Eligible PPAs only involve large domestic and commercial consumers, leaving households and foreign conglomerates out of the picture – for the time being. The rationale behind this is that consumption from industrial consumers is significant and fluctuations in fixed costs, such as electricity, are devastating for their budget. At the same time, PPA negotiations with large companies can be more straightforward than structuring a product for households or navigating cross-border energy interconnections and trade rules. Nevertheless, there are cases of corporate PPAs with foreign entities, such as the collaboration between CERO Generation and AXPO, as well as products for households, like Heron ENA, a small-scale long-term PPA for residential customers and retail chain stores.
- The minimum duration of eligible PPAs is set at 8 years, which is on the short side, but still renders a project bankable. This is in line with the trend observed in Europe, where in 2021 the length of publicly-disclosed PPA deals averaged just over 11 years. In 2018, the average tenor was still 14 years, dropping from the 2016 level of 16.5, according to ICIS, the Independent Commodity Intelligence Services.

The role of Greek banks

There is no doubt that transactions involving renewable energy projects now make up a sizable share of project financings in Greece. As renewable energy projects in the country steadily move away from government subsidies toward the open (and price-volatile) market, third-party funding sources, such as banks, would be unlikely to offer project financing without long-term security. In the future absence of a government subsidy, a long-term PPA can provide that assurance. As banks will play an integral role in the growing PPA market, it is encouraging to see that they are incentivizing large clients to enter into private PPAs by providing relatively-low interest rates, though they are still not as favorable as those for subsidized projects. Banks consider the optimal tenor/duration for a PPA in Greece to range between 8-12 years. This provides assurance and security in terms of risk for the lender while allowing the project owner room for manoeuvring if the market conditions change radically within the next decade.

PPA pricing and risk management

Signing a corporate PPA can help both buyers and sellers eliminate financial risks related to energy. However, PPAs are complex contracts with different parameters depending on the risk appetite of both sides. The structure and specific clauses of each contract ultimately dictate how risk is allocated between the parties in terms of volume, project performance, balancing, credit, price fluctuations, tenor, etc. The following table (provided by RE-Source, The European platform for corporate energy sourcing) summarizes the different PPA risks by category¹.

Risk	Summary
Development	The renewable power plant is not consented/permitted or constructed on a timely basis or at all
Performance/Operational	The renewable power plant does not perform as expected (for example it fails to achieve a minimum agreed level of operational availability)
Volume	The renewable power plant does not produce the volume expected from modelling of long-term (i.e. 20-30 years) meteorological data as a result of different than expected resource levels (wind speed / solar irradiation etc.)
Shape/Profile	Even if the overall volume of output is produced as expected, the hourly production from a renewable power plant will differ from a 24-hour baseload delivery of electricity (quoted for standard products). Differences in hourly prices lead to a production value which is greater or less in aggregate than the equivalent standard baseload product
Cannibalisation	The spot price of electricity has a negative correlation with the supply of renewable electricity, and this is expected to increase as more renewable electricity penetrates the market. For example, when the wind is blowing, more electricity from wind farms enters the grid at very low marginal cost and the abundance of cheap power pushes prices down. When the wind is not blowing and the wind farms are not producing power, spot prices are likely to rise again. The same negative correlation applies to solar photovoltaics
Basis	The reference price of electricity for payments in the PPA contract can differ from electricity prices that the corporate buyer is exposed to under its local (physical) electricity supply arrangements (more relevant for financial PPAs or physical PPAs in markets with zonal pricing)
Balancing	The hourly deviations between scheduled production and real production due to error in weather/ electricity production forecast
Credit-Replacement	The buyer may default (or the subsidy may be cancelled or altered) and a replacement arrangement has to be made
Liquidity	Electricity cannot be traded quickly enough to avoid a change in price, determined by the bid-ask spread
Price	Losses can occur from adverse movements in the market price of electricity. For instance, if a corporate buyer locks in a price based on projections of future prices and the spot price falls below the agreed PPA price for long periods

¹RE-Source (2020) Risk mitigation for corporate renewable PPAs.
<https://resource-platform.eu/wp-content/uploads/files/statements/RE-Source%203.pdf>

Merchant Risk	The combination of revenue (or cost) risks for a seller (or buyer) arising from an unknown volume and unknown price of electricity to be produced
Tenor/Length of contract	The buyer (or seller) can be locked into costs which can be above or below market price. The risk increases with length of contract
Legal	Credit support, Force Majeure, Change of Control, Termination, and Conditions Precedent amongst other key clauses that need to be negotiated. Changes in law may affect the balance of benefit or risk between the parties, e.g. tax changes
Changes in law	Changes in law may affect the balance of benefit or risk between the parties, e.g. tax changes
Regulatory	Regulatory changes can affect the economics of a project. For example, retroactive changes to Feed-in Tariffs systems seen in Spain, Romania and the Czech Republic in the early 2010s.
Force Majeure	Events can occur which are out of the control of any of the parties involved which can delay the completion of a project or impact its generation e.g. flood, fire or storm damage

As PPA markets mature, developers and offtakers are looking for innovative ways to allocate project risks, which in turn determines the fair value of each PPA closed. Therefore, when the agreement deviates from the industry's standard terms - for example having a variable instead of a fixed volume - it is expected that the final agreed price can widely differ from the market average. Aurora Energy Research visualizes this concisely in the following table².

Commercial contract clauses determine the risk distribution and the fair value of the PPA AURORA

Commercial clause	Description	Offtaker	Who holds the risk?	Developer
Price clauses				
Fixed price	Fixed long-term price, offtaker takes on full price risk	✈		
Collared	Price follows capture price, contract guarantees a max/min price		-----✈-----	
Floating/Indexed price	Price linked to baseload index, offtaker only takes on capture price cannibalisation risk			-----✈-----
Tenor clauses				
Short term (<=5 years)	Not suitable for price hedging as futures liquid, suitable if no debt financing required. E.g. Onshore / solar > 20 yrs COD (out of EEG)		-----✈-----	
Medium term (6 - 9 years)	Allows debt financing for smaller new build projects. E.g. solar and onshore merchant		-----✈-----	
Long term (>9 years)	Allows for highly debt-leveraged finance required for high risk projects, e.g. offshore wind (zero bids)	✈		
Volume clauses				
As produced	Offtaker receives asset generation profile	✈		
Monthly % of P90	Asset(s) guarantees minimum pattern		-----✈-----	
Fixed pattern/ baseload	Asset delivers power at a pre-agreed fixed pattern			✈
● Common	● Few cases	● Uncommon		

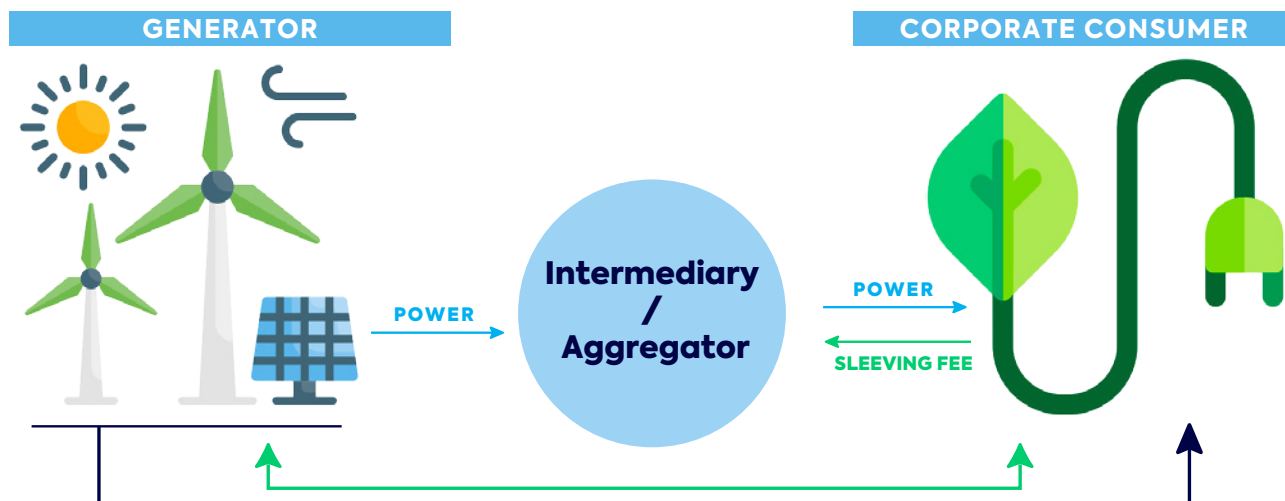
In terms of the actual PPA price, precedent deals and transactions in the Greek market are not yet sufficient to reach a safe conclusion. According to publicly available information from Cero Generation – who signed the first corporate PPA in Greece with a third party – the PPA prices will range between 38€/MWh and 45€/MWh in the near term, dropping at 28€/MWh to 38€/MWh by 2030. One of the few disclosed deals in the Greek market, albeit this being from the vertically integrated Mytilineos group, closed at 33€/MWh for a 200MW solar farm. We observe increasing pressure in terms of renewable energy project revenue, both for subsidized and unsubsidized projects, while both CAPEX and OPEX are experiencing an upward trend. Therefore, we currently observe a slight increase in PPA prices, which reflects the current market projections and higher project costs. However, forecasts assume that the wholesale electricity prices will not remain at the current levels for a prolonged period of time and this is reflected in the PPA prices over a 10-year period.

²Aurora (2021) PPAs in the Greek energy transition - Overrated or underrated? https://auroraer.com/wp-content/uploads/2021/12/joint_deck_EEX_webinar_Dec21_final-1.pdf

The dominant PPA model in Greece

The dominant model for PPAs in Greece will be the 'sleeved PPA' (as is already the case in most of Europe), i.e. a 'tripartite scheme' consisting of the producer, an intermediary (energy supplier or FOSE) and the final consumer.

sleeved PPA



According to this model, an intermediary between the RES producer and the consumer – either an energy supplier or a FOSE (Cumulative Representation Body) – enters the agreement to guarantee uninterrupted supply when there is shortage from the producer/generator. The FOSE meets demand either by purchasing energy from the wholesale market or from other assets of its own portfolio. For this service (availability service), the supplier receives a fee from the final consumer.

In the following table, Aquila Capital outlines other types of PPA which are present in more mature markets³.

Types of PPA		Volume delivery obligation & delivery profile	Volume risk	Production profile risk	Merchant risk
Fixed Volume	Baseload	<ul style="list-style-type: none"> Predefined volumes according to a predefined hourly profile Delivery profile obligations for every hour Pre-agreed fixed or floor price 	✓	✓	✗
	Fixed Volume for defined period	<ul style="list-style-type: none"> Annual/quarterly/monthly pre-defined volumes Delivery profile obligation within the predefined timeframe but no matter when Pre-agreed fixed or floor price 	✓	✗	✗
Variable Volume	As-Produced ("As-Produced")	<ul style="list-style-type: none"> Pre-agreed % of production at a pre-agreed fixed or floor price No volume delivery obligation or delivery profile obligation 	✗	✗	✗
	Route-to-Market	<ul style="list-style-type: none"> Pre-agreed % of production at market spot price No volume delivery obligation or delivery profile obligation No fixed or floor price 	✗	✗	✓

*merchant exposure depends on the percentage of production covered by the PPA

³Aquila Capital (2019) Power Purchase Agreements: A European Outlook. https://www.aquila-capital.de/fileadmin/user_upload/PDF_Files_Whitepaper-Insights/2019-11-15_Whitepaper_PPA_EN.pdf

Short interviews

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Stelios Psomas

Policy Advisor

What is the importance of PPAs for energy sellers or developers?

PPAs have become appealing over the past several years for three key reasons:

1. Subsidy schemes are available only for limited RES capacity (4 GW of RES projects will be auctioned in Greece until the end of 2025), and investors' appetite cannot be satisfied only through these schemes, consequently driving power generators to corporate offtake.
2. PV has by far the lowest LCOE nowadays, making PPAs strongly competitive with conventional sources of supply.
3. PPAs provide greater certainty when it comes to making environmental claims. Higher demand for Guarantees of Origin (GOs) may increase the price and volatility of these commodities when purchased on the open (unbundled) market or as part of a green contract.

Do you think the PPA market is promising for Greece and why?

Greece, along with other EU countries, is exposed to significant price volatility in energy costs. This expected volatility puts corporations in a precarious position. PPAs provide a means for companies to hedge against volatility by locking in a fixed price for power and protecting organizations from both forecasted and sudden price fluctuations.

In Greece, bilateral agreements such as PPAs have become possible after the EU Target Model became effective on November 1st, 2020. A Green Pool model forwarded by the Greek Energy Ministry for European Commission approval, ahead of an envisaged launch at the beginning of 2023, will have the dual goal of setting energy costs for eligible industries at competitive price levels and bolstering green energy generation through power purchase agreements.

Due to differences in generation and demand profiles, the output power of RES must be shaped and firmed up to meet the industry's demand curve. The shaping costs induced by transforming the shape of the RES generation to a base-load profile, increase the cost of renewable electricity. An aggregator will be chosen under the Green Pool model to represent collectively RES producers to reduce these profile costs. It is expected that the aggregator will receive a state subsidy of up to 85% on anticipated profile costs (estimated at 5-15 €/MWh) which would normally be incurred by the offtakers.

What recent developments hamper or stimulate the further introduction/growth of PPAs on the Greek market?

Although there have been PPAs signed in Greece, these are almost all between offtakers and existing Energy Providers (who are already registered with HEnEx, the Greek Energy Exchange Market). The final step so that independent RES producers can sign a PPA has been taken recently (July 2022). From now on, there will be no problem in signing a PPA with an independent RES Producer. Furthermore, projects aiming at a PPA rather than state aid (e.g. through auctions) are given priority access to grids (up to 1.5 GW of such projects will have priority).

On the other hand, due to the current energy crisis sparked by the Russian invasion in Ukraine, the Greek government has imposed a cap of 85 €/MWh as a capture price for RES selling to the Day-Ahead-Market market until June 2023. This is not helping PPAs, as it reduces flexibility for stakeholders.

Aurora Energy Research



Evangelos Gazis,
Market Lead for South
Eastern Europe

What are your expectations for the Greek PPA market for the next 5 years?

Existing Contracts for Difference (CfD) auctions in Greece are expected to end in 2025, though this timeline could be extended. Therefore, further merchant RES deployment will be key for the realization of the ambitious decarbonization targets in Greece.

Green PPAs can be a particularly effective tool to reduce investment risk for merchant renewables and accelerate deployment. The Green Pool scheme, which will most likely be approved and implemented, is expected to kick off a large-scale PPA market in Greece.

Aurora's analysis shows that the available supply for green PPAs could surpass 10TWh by 2030. At the same time, increasing demand for green electricity is expected to drive demand for long-term PPA contracts from both corporates and utilities, resulting in a relatively balanced market within the same timeframe.

What is your view on the current price level of PPAs and how do you think the PPA prices will develop over time?

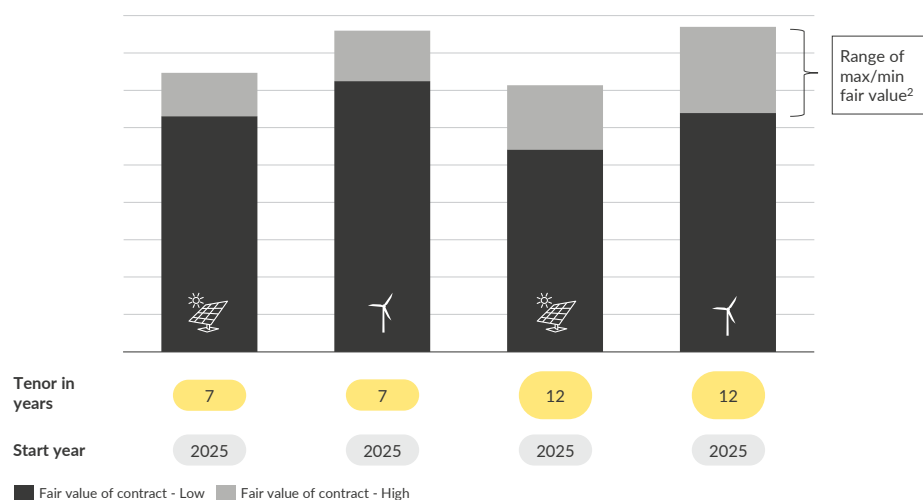
Although there is limited information on the current price level of signed PPAs, we expect that a contract signed today is likely to have a significant premium over CfD prices but also a significant discount over baseload prices which hover at record-high levels.

PPA prices are expected to drop due to three main drivers:

1. LCOE reductions in line with further cost declines, which would mean a steeper drop in solar costs.
2. Lower cost of capital as merchant projects become more bankable due to a decreasing risk premium
3. Baseload prices dropping significantly in the next 5 years, which would also put strong downward pressure on the market value of green electricity and by extension PPA prices.

The fair value of fixed price PPA contracts starting in 2025 could be between the mid 50s and high 80s EUR/MWh for volume as produced

Fair value of PPAs¹
EUR/MWh (real 2021)



■ Fair value of contract - Low ■ Fair value of contract - High

¹ The fair value is calculated assuming as produced volume clause and fixed price clause. ² The minimum value corresponds to a calculation that only considers the cost of capital at risk (effect of Low prices) and the value of the hedge (effect of High prices). The maximum value considers only the value of the hedge and does not take into account the cost of capital at risk.

Source: Aurora Energy Research

AURORA

Fair value of PPAs

- The fair value of PPA contracts differs, with the most important factors being:
 - Renewable technology
 - Price clause
 - Volume clause
 - Tenor
 - Starting date of contract
- A fair value for a 7-year PPA starting in 2025 is between the low 60s and mid 70s EUR/MWh for solar and between low 70s and high 80s EUR/MWh for onshore wind
- For a 12-year contract, a fair PPA value for delivery starting in 2025 is between the mid 50s and low 70s EUR/MWh for solar and between low 60s and high 80s EUR/MWh for wind

Which PPA will become dominant over time, a PPA with on-site solar generation or virtual PPAs?

Virtual PPAs are likely to dominate both due to the design of the Green Pool scheme proposed for Greece, but also since there is already a large pipeline of projects to be built, meaning that it won't be difficult to find suppliers. On-site solar generation will certainly remain an appealing prospect for certain offtake applications, especially in large industrial sites and electrolyzer facilities, but they are expected to have a minor contribution to the overall PPA market over the next decade.



Dr. Costas Baslis,
Energy Management Director

How would you describe the interest of corporations in PPAs?

The Greek retail market has gone through a major transformation in recent years, almost in a shock-based approach. Following the Covid-19 pandemic, which provided strong motivation to corporate consumers to remain short and avoid signing any medium- or long-term supply contracts, in order to benefit from the sharply declining spot prices due to the demand crunch, the energy price crisis which emerged in 2021 gradually pushed their interest to the opposite end. Facing ever-increasing energy costs, a large number of corporate consumers in Greece have now developed in-depth understanding of the key role renewable PPAs can play in their effort to shield their companies from adverse financial impact. Economic viability, long-term lock-in of affordable energy prices and efficient mitigation of risk exposure to volatile spot energy costs are the key motivations for Greek corporate customers to engage in PPAs. ESG-based targets, like securing project-specific guarantees of origin or supporting the development of new renewable projects, are also key targets within the PPA concept, especially for local branches of multinational conglomerates.

What recent developments hamper or stimulate PPAs on the Greek market?

What seemed to be an unprecedented push towards the creation of a liquid Greek PPA market, i.e. the ever-increasing demand for PPAs from electricity suppliers and corporate customers combined with the need of new renewable projects to secure financing, has now been hampered by the recent regulatory changes which imposed a price cap on the remuneration of renewable projects in the day-ahead wholesale market. This price cap is applied to the revenues of all renewable projects, regardless of whether they have signed PPAs or not, and has been defined at a level which is many times lower than the current wholesale spot prices. Since renewable producers and electricity suppliers servicing corporate consumers are now facing different wholesale market prices the fundamental settlement principles of a corporate PPA are highly distorted. Even if the legislation has been introduced as an extraordinary temporary measure, the risk of continuous prolongation as long as the energy price crisis persists is high.

What was your biggest learning from the signed PPAs offered by your company?

The biggest lesson was that the market can very quickly adapt to new challenges and accept radically new approaches in mitigating energy cost risks, which necessitates the respective responsiveness and readiness on the commercial, financial and regulatory level. In Heron's experience, signing the first corporate PPAs in the Greek market was mainly a task aiming to inform, educate and convince people on all parts of the supply chain which were not familiar to such a set-up, including renewable producers, energy sales managers and energy consumers, about the merits and the mechanics of the scheme. As soon as the basic concept became clearly understood, the path to execute the first deals became widely open. Immediately after, the next deals were closed at a much faster pace leveraging on the previous success. Heron ended up exploiting all the available renewable capacity offered by Terna Energy and has thus successfully supported many businesses in dealing with the unprecedented energy crisis. Corporate interest in PPAs has been steadily increasing ever after, and Heron is relentlessly developing its strategy to be able to meet its customers' demand. This is also why it is imperative to tackle the current barriers hindering the development of the Greek PPA market.

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