



CLEANHORIZON

The Energy Storage Experts



Emerging opportunities for energy storage in Spain and Portugal

July 8th 2020





Clean Horizon was started in 2009 and is the world's sole consultancy specifically dedicated to energy storage.

MARKET ANALYSIS



Our experts track the development of energy storage markets and related regulations on all continents and leverage this knowledge to develop go-to-market strategies tailored to our customers' needs.

Update from the Field
Monthly analysis Notes

CHESS
Storage projects database

TECHNICAL CONSULTING



Relying on CRE-STORE, our dedicated energy storage modeling tool, we act as owner's engineer and lender's engineer for IPPs worldwide.

We also work for national utilities to help them quantify their energy storage master plan.

CRE-STORE
Storage simulation tool



Webinar



Rise of the Iberian markets for stationary storage

Spain awaits an imminent regulatory change to initiate the deployment of commercial utility-scale storage

Portugal gives its green light to storage developers with an entry door in the next long-term solar auction

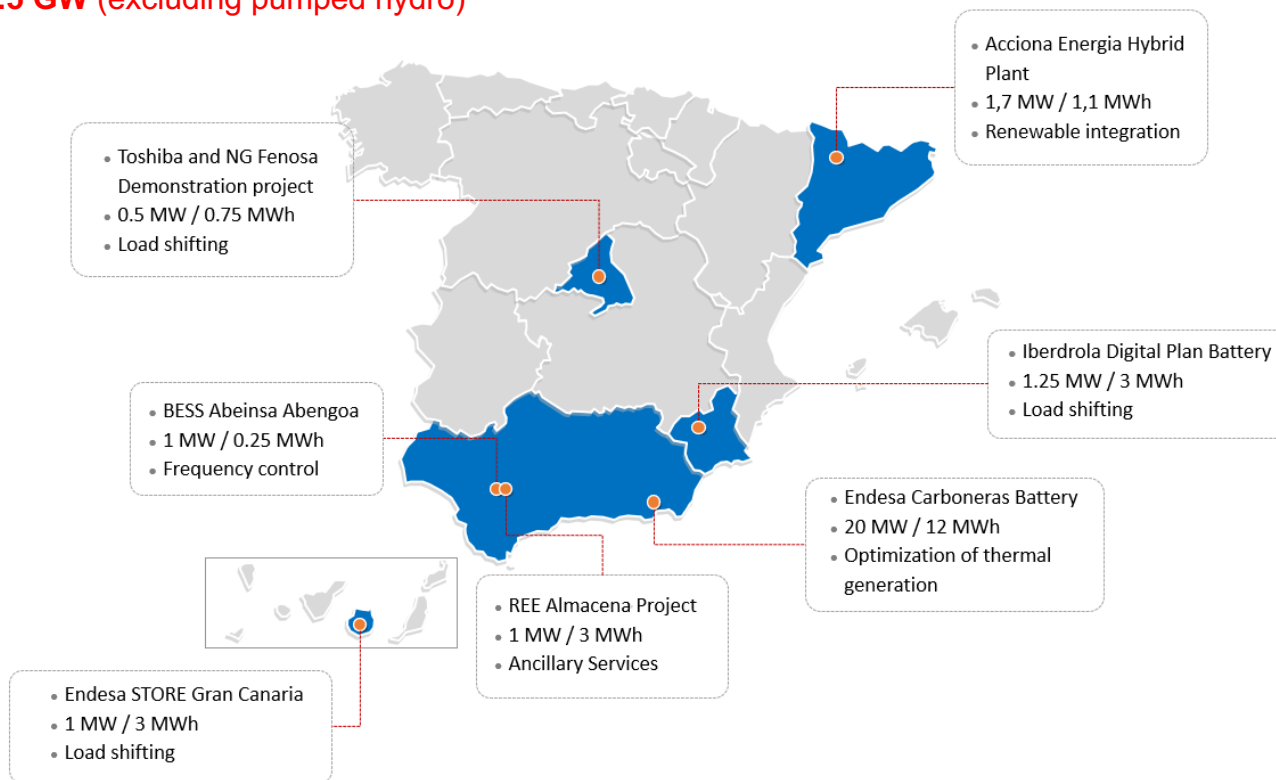


Spain has an ambitious target of 2.5 GW of battery storage deployed by 2030

While the presence of utility-scale stationary storage remain marginal in Spain today, a goal of 2.5 GW has been set up for 2030

Operational utility-scale battery storage systems in Spain

Storage capacity targeted by 2030 according to the National Energy and Climate Plan is **2.5 GW** (excluding pumped hydro)



Source: Clean Horizon Energy Storage System database (CHESS), based solely on publicly available information

- Most of the existing storage systems in Spain are demonstration projects
- The situation should change rapidly given the storage deployment objective fixed by the Spanish NECP.



Spain ancillary services do not provide a real opportunity for storage, although the secondary reserve revenues are highly interesting

Secondary reserve revenue could reach more than 140 000 € / MW / year for a battery system year but the market rules are not flexible enough for storage

Summary of the potential energy and ancillary services markets for storage in Spain

Application / Service	Storage participation	Technical Details	Maximal revenue for storage	Status
Wholesale Market Arbitrage « Mercado Diario »	Yes	<ul style="list-style-type: none">Day-ahead auction	6.5 k€/MW/year	N/A
Primary Reserve for frequency control « Regulacion primaria »	No	<ul style="list-style-type: none">Mandatory for large generation units (1.5 % of nominal power)Obligations can be sold to a third party	Non-remunerated	Integration with European FCR mechanism is not planned for the moment
Secondary Reserve for frequency control « Regulacion secundaria »	No specific rules for storage	<ul style="list-style-type: none">Activation ~ 100% of the timeDay-ahead auction (pay-as-clear)1 hour block bids in €/MW10 MW minimum (aggregation authorized)Energy activated remunerated at Tertiary Reserve marginal price	140 k€ / MW / year capacity payment + remuneration for activated energy (in €/MWh)	To be aligned with European PICASSO-project (2023-2024)
Tertiary Reserve for frequency control « Regulacion terciaria »	Pumped storage is allowed to participate	<ul style="list-style-type: none">Activation ~ 65% of the timeBid actualization 1 hour before delivery1 hour block bids in €/MWh10 MW minimum (aggregation authorized)2 hours minimal delivery capacity15 minutes full power activation time	Remuneration for activated energy (in €/MWh)	To be aligned with European MARI-project (2021)

Source : <https://www.ree.es/en/datos/balance>

Note : The « Maximal revenue for storage » is computed considering a full time participation of storage in eachmarket (24/24, 7/7)



Economically viable business case



Potential business case



Insufficient revenue for a business case

- The primary reserve for frequency control is neither accessible nor remunerated
- Secondary reserve features high available capacity payments but the participation rules are unfavourable to battery storage systems
- The rest of the services are poorly remunerated

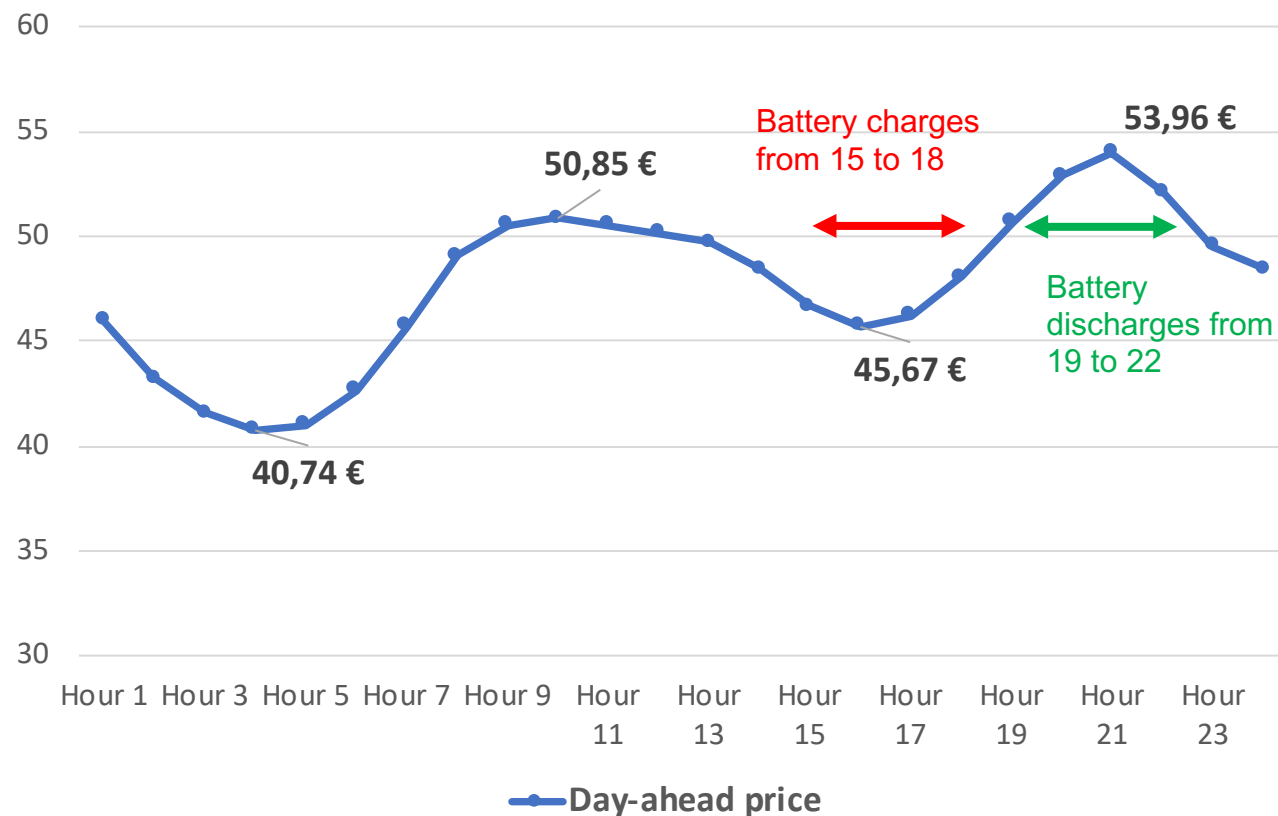


Current day-ahead electricity prices are not volatile enough to justify the addition of storage in PPAs

A solar PPA agreement could be more attractive if providing energy during peak consumption periods rather than traditional solar hours

Average day-ahead price curve in Spain (2019)

Price of energy in €/MWh



Source: <https://www.esios.ree.es/es/mercados-y-precios>

- Price spread between solar generation hours and peak time is not high enough to justify storage investment
- A growing penetration of solar assets could increase this spread but not if they are involved in PPAs

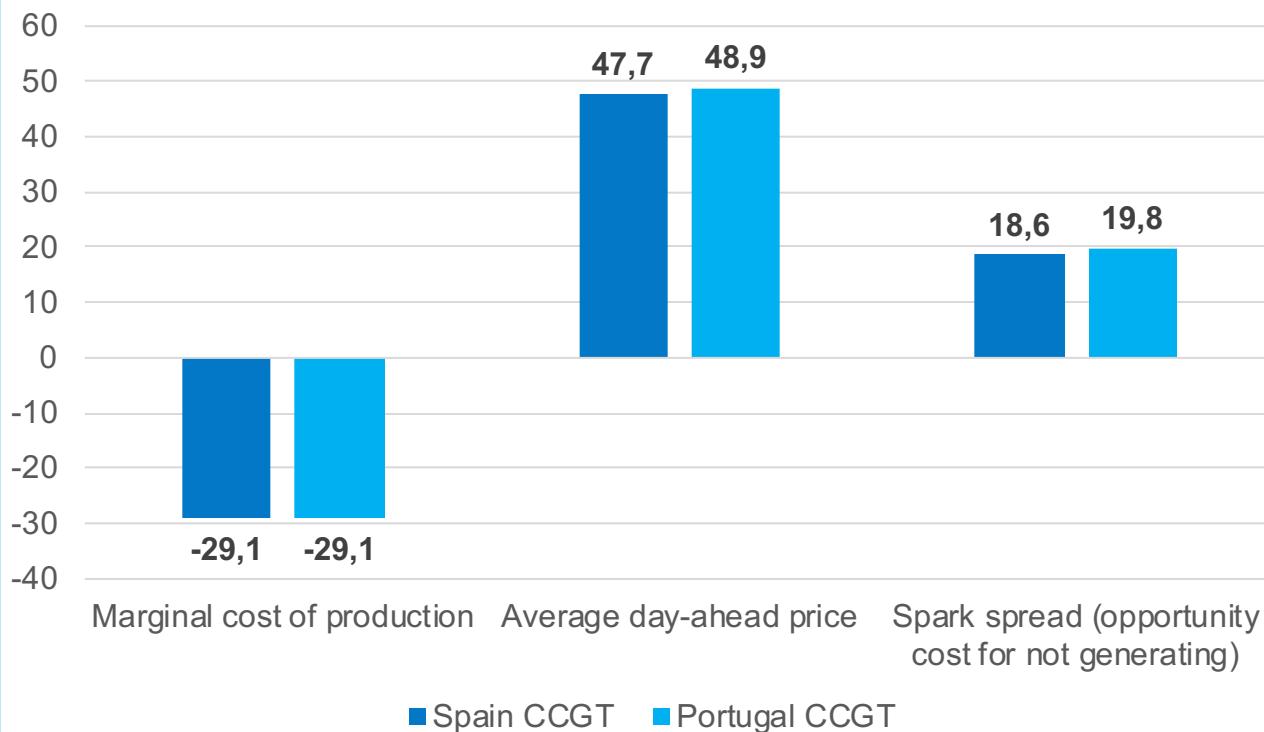


The opportunity cost of frequency regulation provision would justify a storage business case in Iberian countries... but it is not clear how achievable this is

A battery storage system providing FCR instead of a CCGT unit in Spain could generate additional energy sale revenues of 160 k€/MW of storage/year for the plant

Opportunity cost of a CCGT plant providing primary frequency reserve

In €/MW/h



In Portugal, **only** the generators which are « **technically unable** » to provide their required frequency control service can contract a third party to do it on their behalf.

Note : Considering gas spot price of 16 €/MWh-t and CCGT plant yield of 55%, day-ahead market prices of 2019

- A thermal plant has to dedicate 1.5 % of its nominal power to primary frequency regulation in Spain, 5% in Portugal which leads to important opportunity costs.
- Investing in a battery storage system could be viable to enable the plant to use its nominal power at 100%



A regulatory change benefiting storage is imminent in Spain, but its nature is still unknown

Multiple indicators confirm that Spain will soon create the market conditions to incentive the deployment of a large amount of storage

1. A public consultation has opened right after the sanitary crisis to collect opinions and suggestions on how energy storage should be deployed regarding the National Energy and Climate Plan
2. The number of grid connection requests to Red Electrica have skyrocketed these last months
3. Industry stakeholders show a growing interest toward the Spanish market since 2019

The “triggering event” could take several forms including a new capacity mechanism or the adaption of the existing ancillary services to storage

The recent publication of the Royal Decree 23/2020 (just at the end of June) is a new step towards the integration of energy storage in the Spanish electricity system.



**Real Decreto-Ley
23/2020**

➔ This decree improves the definition of the energy storage status and its participation to energy markets

Source: <https://renewablesnow.com/news/spanish-govt-plans-to-back-ppas-for-energy-intensive-industry-687950/>

- **The current interest toward the Spanish market is justified by the upcoming regulation change**
- **The result of the public consultation should finally enable the market for storage to open in Spain**



Rise of the Iberian markets for stationary storage

Spain awaits an imminent regulatory change to initiate the deployment of commercial utility-scale storage

Portugal gives its green light to storage developers with an entry door in the next long-term solar auction



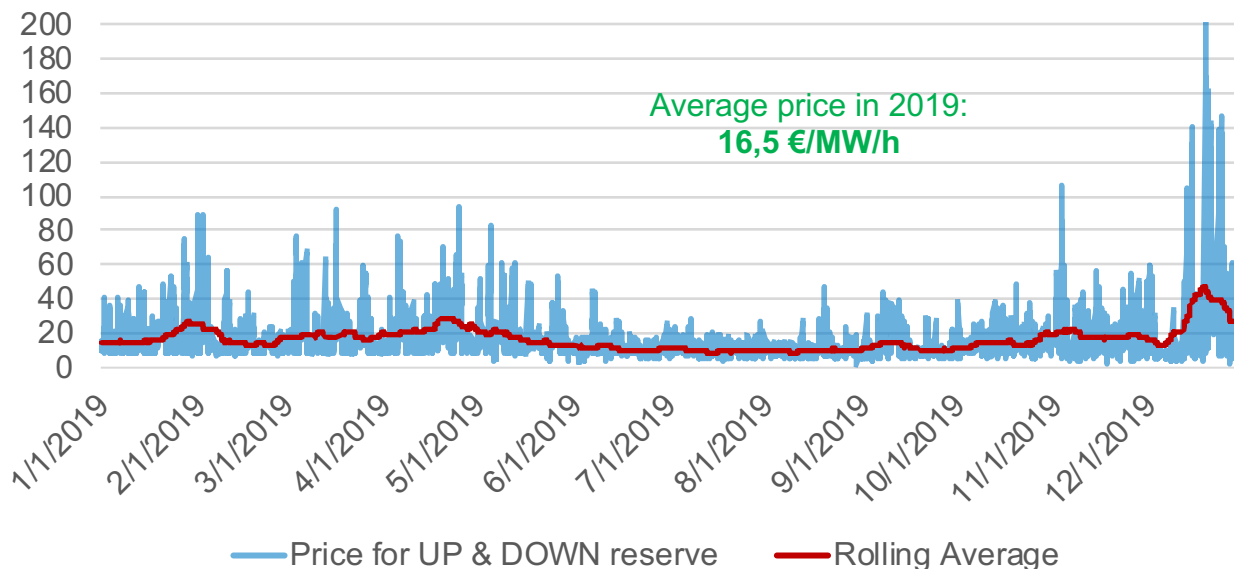
Similarly to Spain, Portuguese ancillary services opportunities for storage are limited to a lucrative but currently inaccessible secondary reserve

Frequency regulation services are, like Spain, not offering a real tangible opportunity for storage.

The ancillary services market in Portugal is very similar to Spain's:

- Primary frequency regulation is mandatory
- **Secondary reserve is very attractive**
- Tertiary reserves do not feature interesting remuneration levels
- The day-ahead market is coupled to Spain's and has therefore a low volatility.

Clearing price for a double bid (up and down) on the **secondary reserve** in Portugal (2019)
In €/MW/h



Source: <https://www.apren.pt/en/renewable-energies/production>

- The ancillary services overview in Portugal features the same conclusion as its Spanish neighbour's
- The secondary reserve still requires a regulatory adaptation to enable storage participation (*rules are fuzzy...*)



Portugal is set to deploy 8 GW of new solar PV capacity by 2030

Portugal has committed to have nearly 10 GW of operational solar PV plants in 2030

Portugal's Solar PV deployment agenda according to its National Energy and Climate Plan (2019)

Year	2020	2025	2030
Installed solar capacity (GW)	1.9	6.6	9.9

In order to reach the aforementioned objective, Portugal has already started a first round of solar capacity national auction in 2019, with 1.15 GW awarded.

In 2019, a first auction was held to allocate up to 1.4 GW of new solar capacity. 1.15 GW were awarded to 12 developers, with a record price of **14.76 €/MWh** for a 150 MW plant.

In this first edition, energy storage was not allowed to participate and only 2 bidding options were available to participants:

1. Reference tariff in €/MWh (Contract for difference model)
2. A fixed contribution to the system in €/MWh to be able to sell at market prices

- The 2020 solar auction takes place in the context of an ambitious PV deployment objective in Portugal
- Last year's auction awarded 1.15 GW of solar capacity but did not feature a storage option

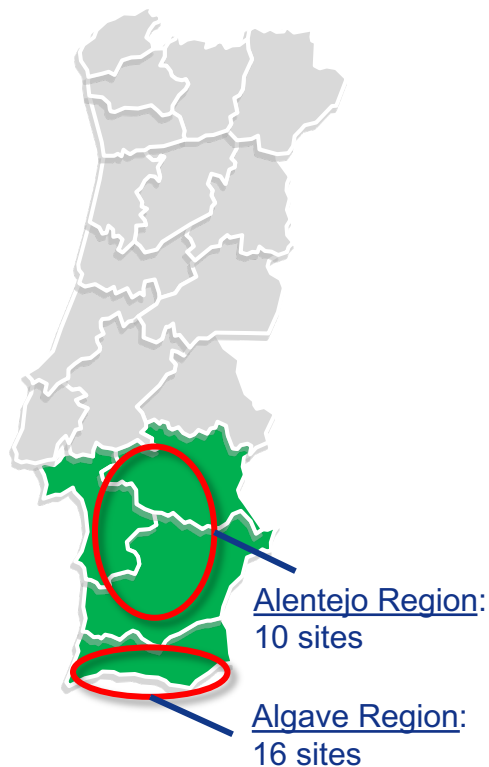


In 2020, up to 700 MW will be awarded, to be operational by summer 2024

26 grid connection points located in the south of Portugal will be awarded during the 2020 auction

Portugal's 2020 national solar auction general information:

- Amount of injection capacity auctioned: **700 MW**
- Maximal amount of capacity that can be awarded for a single bidder: **350 MW**
- Minimal bid size :
 - **10 MW** if connected to the Distribution Network (15kV and 60kV)
 - **50 MW** if connected to the Transport Network (150 kV and 400kV)
- Number of lots: **15**
- Number of sites: **26**
- Location: **See next map**
- Start date of operations: **June 30th 2024**
- Deadline for bidder participation: **July 31st 2020**
- Duration of the contract: **15 years**



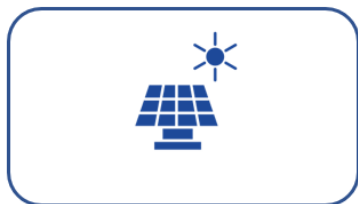
- **700 MW of grid injection capacity will be awarded on 26 different sites corresponding to 15 auction lots**
- **All these projects must be operational by June 30th 2024.**



Storage option includes a remuneration scheme based on a yearly capacity payment

The auction aims at procuring up to 700 MW of new capacity, regardless of the proportion of storage

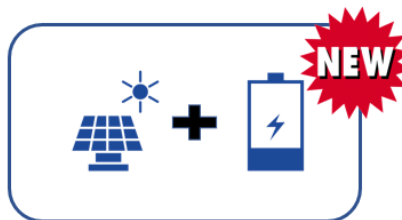
All participants will be competing simultaneously, regardless of their bidding option:



Bidding option #1 :
Guaranteed Remuneration



Bidding option #2 :
General Remuneration without storage



Bidding option #3 :
General Remuneration with storage



Discount (%) from a reference energy tariff in €/MWh



Contribution to the SEN in €/MW to have the right to sell at market prices



Discount (%) from a reference yearly capacity payment in €/MW



1 Auction – 700 MW

The three options will be compared from an economic perspective by the Sistema Elétrico Nacional (SEN) using a common Net Present Value methodology

→ The reference yearly capacity payment for 2020's auction has been fixed at **33 500 €/MW**

- The third bidding option will be competing in the same auction as bidding option 1 & 2, which means solar-plus-storage projects must prove their competitiveness against standalone solar.
- All bids will be converted into Net Present Value equivalents from the SEN perspective



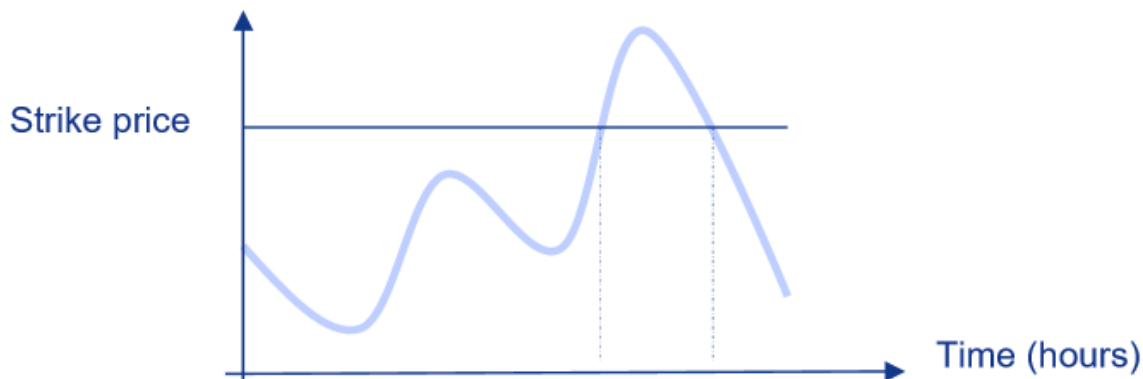
Solar-plus-storage will be remunerated with a fixed capacity payment for 15 years

The awarded bidder will be asked to pay back the difference between the strike price and day-ahead prices during peak periods

- To participate, the storage capacity must account for at least **20% of the total capacity** at the injection point and have at least a **one-hour discharge duration**.
- The bidder will propose a fixed payment per year computed as a percentage of a reference price given during the auction. **In exchange, the system must protect the electricity system from price spikes:**

Whenever the day-ahead market price goes beyond the strike price, the awarded system must pay back the difference between its selling price and the strike price to the Sistema Eléctrico Nacional (SEN), regardless of the energy effectively sold.

Day-ahead price (€/MWh)



Source: <https://leiloes-renovaveis.gov.pt/>

Solar-plus-storage plants will be remunerated a capacity payment in €/MW/year in exchange for mitigating the market price risk for the national grid



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Thank you!

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