

# Assessing the membership of Portugal and Spain in the FCR Cooperation

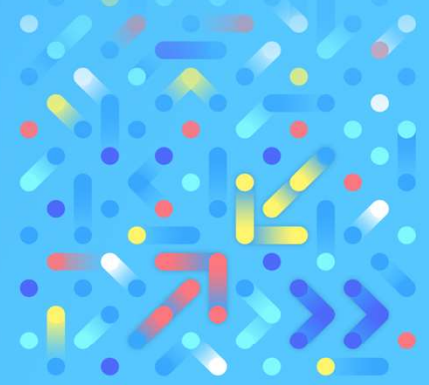


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## 1. PROBLEM FORMULATION

The reliable operation of modern power systems depends on a balancing service named the Frequency Containment Reserve (**FCR**). If a power plant suddenly goes offline, for instance in Poland, the frequency will drop in the whole of Europe since the grid is interconnected. The FCR guarantees that several power plants acting as balancing service providers (**BSPs**) will need increase their power output in less than 30 seconds to compensate for this loss. These power plants participating in the FCR are from distant countries such as Portugal and Greece.

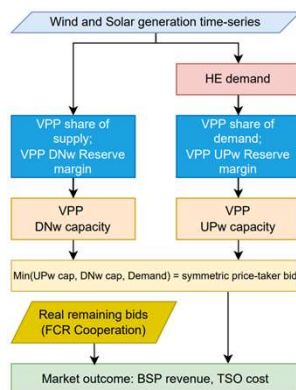
Currently, 9 European countries participate in the FCR Cooperation, a market platform where BSPs sell their service, which is procured by Transmission System Operators (**TSOs**). Yet, Portugal and Spain do not participate in the Cooperation; in fact, these two countries have no market mechanisms in place for this service. From this fact, two problems arise: (i) only traditional power plants can participate in this ancillary service, and (ii) the cost of this service for the final consumers is not transparent nor efficient.

The research questions are as follows:

- 1 – What would be the cost for Iberian TSOs to join the FCR Cooperation?
- 2 – What would be the revenue of a BSP, particularly a VPP aggregating solar, wind and Hydrogen Electrolysers (**HEs**) in this market?

## 2. METHODOLOGY

Using real data of wind and solar generation, HE demand is estimated. Six user-defined parameters allow for computing bids to be submitted to the FCR Platform. Past data from the platform (prices) allow to compute BSP revenue and TSO cost easily using six equations.



Scenarios:

**“Pessimistic”**: in 2025 Portugal and Spain achieve half of the promised goals for HE installation for this year

**“Expected”**: in 2025 Portugal and Spain achieve the promised goals for HE installation for this year

**“Pledged”**: in 2030 Portugal and Spain achieve the promised goals for HE installation for this year

## 3. MAIN RESULTS

Table 1: TSO Costs. \*data for 2020 only for 6 months

	2020	2021	2022
PT	1.8*	7.6	10.1
ES	13.6*	57.5	76.9

Table 2: VPP Revenue (VR). \*data for 2020 only for 6 months

Results	Scenario 1 "pessimistic" 2025		Scenario 2 "expected" 2025		Scenario 3 "pledged" 2030	
	PT	ES	PT	ES	PT	ES
$VR_{2020}^*$	0.17 M€*	0.89 M€*	0.36 M€*	1.17 M€*	1.32 M€*	0.86 M€*
$VR_{2021}$	0.81 M€	3.96 M€	1.66 M€	8.28 M€	5.90 M€	38.01 M€
$VR_{2022}$	1.1 M€	6.28 M€	2.26 M€	14.09 M€	7.78 M€	38.83 M€
Average % of FCR covered by VPP	10%	7%	21%	13%	76%	60%
Capacity factor of HE	56%	71%	56%	71%	50%	58%

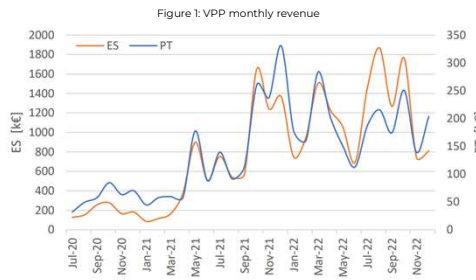


Figure 1 shows monthly revenue for scenario “expected” in both Portugal and Spain. Since the two countries have similar wind-solar-HE installed power, although on a different magnitude, the shape of the curves is similar, the difference being higher proportion of solar in Spain.

Prices vary monthly reflecting both wind/solar production but above all reflect market forces (the international price on the FCR Cooperation).

## 4. Conclusions

Results are highly dependent on prices in the FCR Cooperation, which have been increasing from 2020-2023 and are difficult to predict in the future, but the order of magnitude of TSO costs and VPP revenues have been assessed. Using market data from 2022 it can be concluded that the Portuguese TSO would have paid 10 M€ for acquiring FCR in the international platform. A Portuguese VPP aggregating 50 MW of HEs and as little as 3% of the existing wind and solar generators, both operating with a 20% reserve margin, would be able to have a revenue over 1.1 M€, assuming 2022 market prices.

## 5. PUBLICATIONS

1. “Assessing the membership of Portugal and Spain in the FCR Cooperation: TSO costs and VPP revenue” accepted for presentation in the 6<sup>th</sup> International Conference on Smart Energy Systems and Technologies (SEST), September 4-6, 2023.
2. Journal paper under preparation to be submitted to Energy Policy journal
3. Input data and results of published as open-access at Zenodo: <https://zenodo.org/record/8092399>

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