Powertech 2021

Probabilistic forecasting for sizing in the capacity firming framework

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Context & contributions

Capacity firming: the **intermittent** power from a PV plant can be **maintained at a committed level** for a period of time.

Goal: the **sizing** of a grid-connected PV plant and a battery energy storage system (BESS) in the capacity firming framework. *Extension of [1].*

Contributions:

1. A mixed-integer quadratic programming formulation compatible with a scenario approach to address the planning;
2. A Gaussian copula methodology to generate PV scenarios;
3. **Sizing** of the system in the capacity firming framework.

[1] Dumas, Jonathan, et al. "Stochastic and deterministic formulations for capacity firming nominations." 2020 International Conference on Probabilistic Methods Applied to Power Systems (PMAPS). IEEE, 2020.

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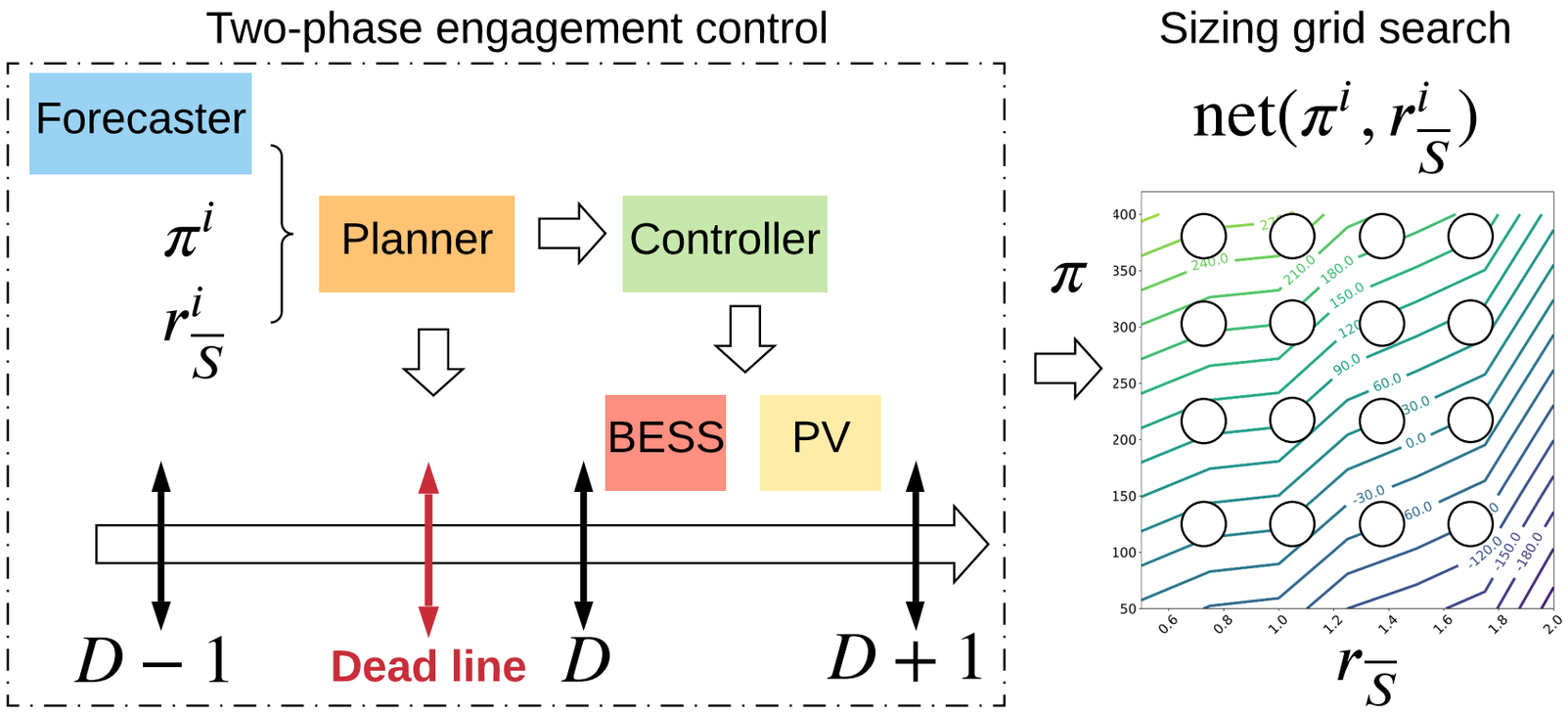
Problem formulation



« 2 stage stochastic programming »

Figure 1: Sizing problem formulation.

System sizing : BESS / PV capacities $r_{\overline{S}} = \dfrac{\overline{S}}{P_c}$ (1)

Net revenue over the lifetime project $\textbf{net}(\pi, r_{\overline{S}}) := \dfrac{R}{E} - \textbf{LCOE}$ (2) [EUR/MWh]

Grid search sizing results

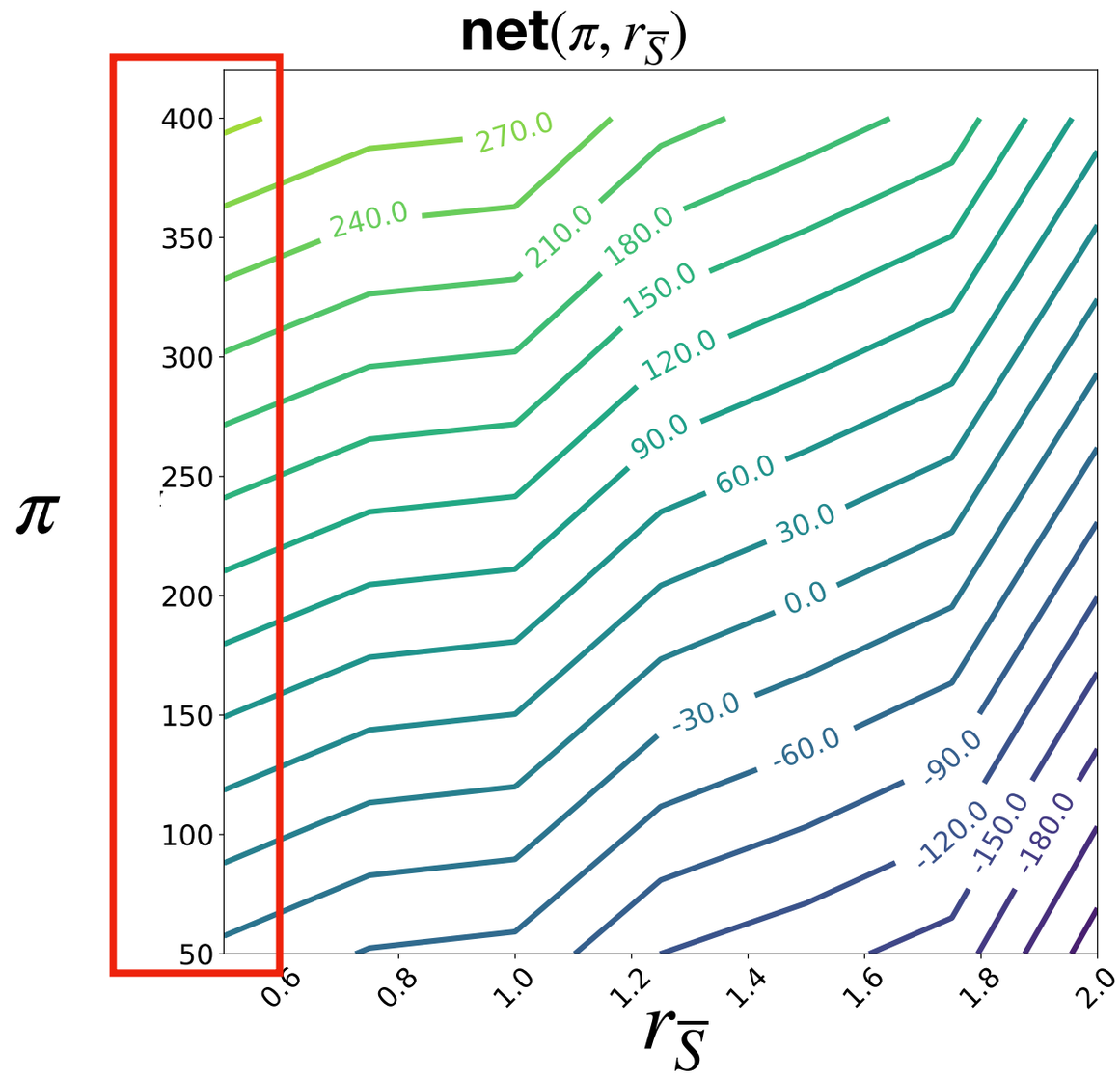


Figure 2: grid search sizing results.

Optimal sizing: $r^{\star}_{\overline{S}}(\pi) = 0.5$

Minimal selling price

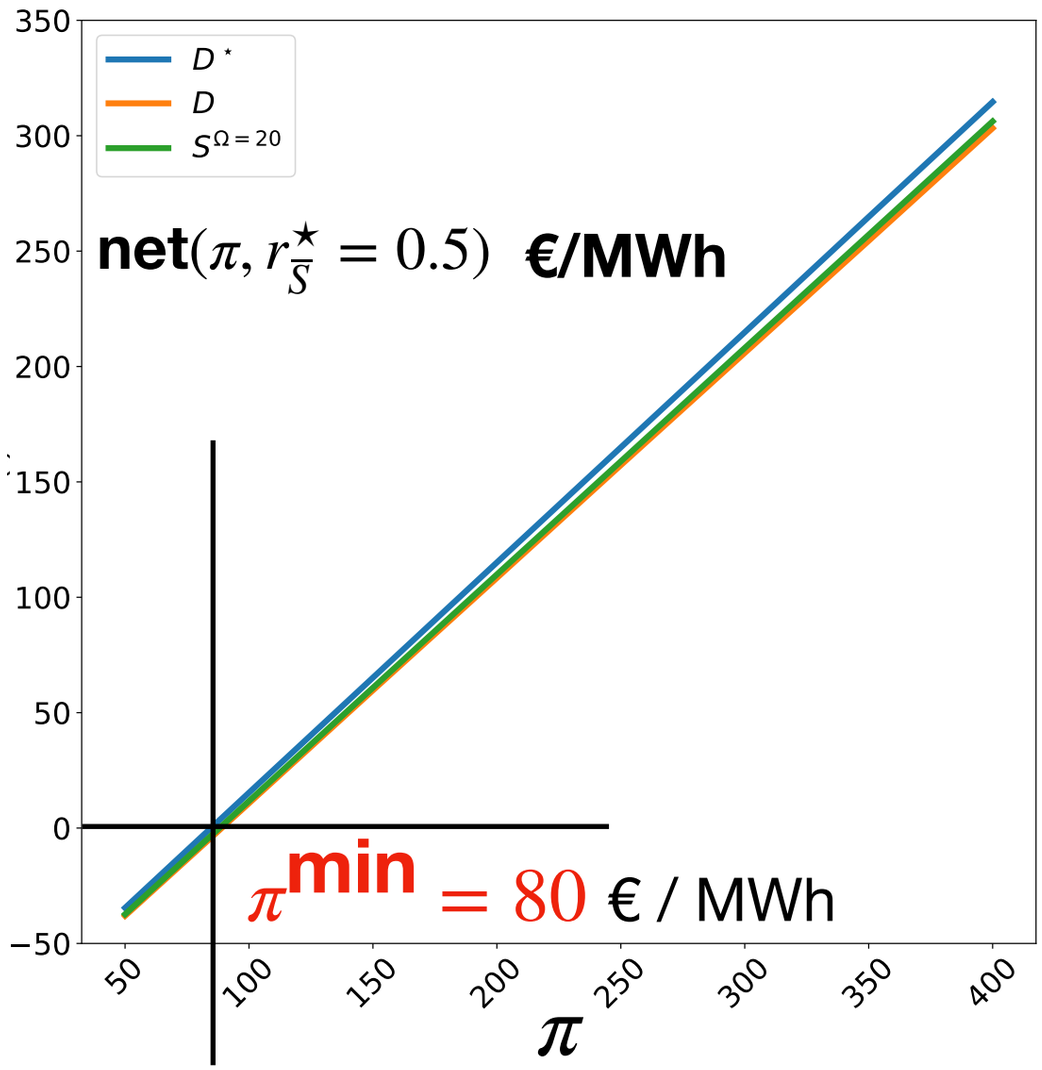


Figure 3: minimal selling price to be profitable.

Conclusions & extensions

Conclusions:
- A **methodology to size** the PV and BESS in the **capacity firming** framework;
- The minimal selling price to be profitable is approximately 80 [euro / MWh].

Extensions:
- Implement a more realistic controller that uses intraday point forecasts;
- Robust approach using PV quantiles forecasts, see [2].
- A single sizing optimization problem.

[2] Dumas, Jonathan, et al. A Probabilistic Forecast-Driven Strategy for a Risk-Aware Participation in the Capacity Firming Market. Uliège, 2021. Arxiv, *[under review for publication in IEEE Transactions on Sustainable Energy]*