

PSR

OPTFOLIO

OBJECTIVE

With the rapidly growing share of intermittent renewable sources, power projects are becoming increasingly subject to significant financial risks in markets worldwide, making the decision process a challenging task. OptFolio is an analytical tool that aims at helping decision-makers manage portfolios of power projects - composed of both physical and financial assets - taking those risks into account. Using a Monte-Carlo simulation approach combined with optimization techniques and risk statistics, such as Value-at-Risk (VaR) and Conditional-Value-at-Risk (CVaR) the tool allows portfolio managers to:

Simulate a portfolio's outcome under different scenarios	Assess the impact on results of adding additional PPAs or physical assets to the portfolio	Optimize the volume of power to sell through PPAs from a risk vs. return perspective	Evaluate and optimize sales and/or supply strategies considering one or more risk constrains to cash-flow
Estimate the value of existing or new power projects, whether they are stand-alone projects or part of a larger portfolio	Optimize investment strategies considering future trends such as decreasing capex costs	Dynamic decision modelling using decision trees	Goal seek analysis: calculate the contract price needed to reach a targeted profitability

Through a scenario approach, OptFolio considers uncertainties (and underlying correlations) in:



Spot prices



PPA prices



Non-conventional renewable output



Project cost overruns



Project delays

METHODOLOGY

OptFolio formulates a multistage stochastic mixed linear-integer problem that maximizes the net present value of a portfolio considering a user defined risk aversion profile. Its main inputs are a set of scenarios of power market prices and power plant dispatch (output) - these can be generated by SDDP, PSR's system dispatch simulation tool or with the help of PSR's Time Series Lab (TSL) tool in case of non-conventional renewables. The tool also considers several other sources of revenues and expenses such as capacity payments, fixed production costs, tax payments and CAPEX disbursements.

It calculates the portfolio's resulting cashflow for each scenario, thus allowing it to build a probability distribution for the portfolio's outcome and estimate different risk statistics.

As an example, when run in optimization mode, OptFolio calculates the optimal trading strategy by calibrating the volume of energy sold through PPAs (or even the size of the physical asset to invest in) so as to comply with user-specified constraints – for instance, for every year of the time period considered the portfolio's resulting cashflow cannot be smaller than X million \$ with 95% confidence.

In terms of general constraints applied to the problem, the model can represent the following aspects:



MAIN RESULTS

The following is a non-exhaustive list of outputs:



Risk statistics:
expected value,
VaR and CVaR



Portfolio IRR



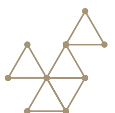
**Optimal PPA
volume to trade
(level of contracting,
contract term
and so on)**



**Portfolio's net
present value**



**Cashflow
scenarios**



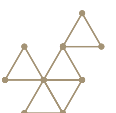
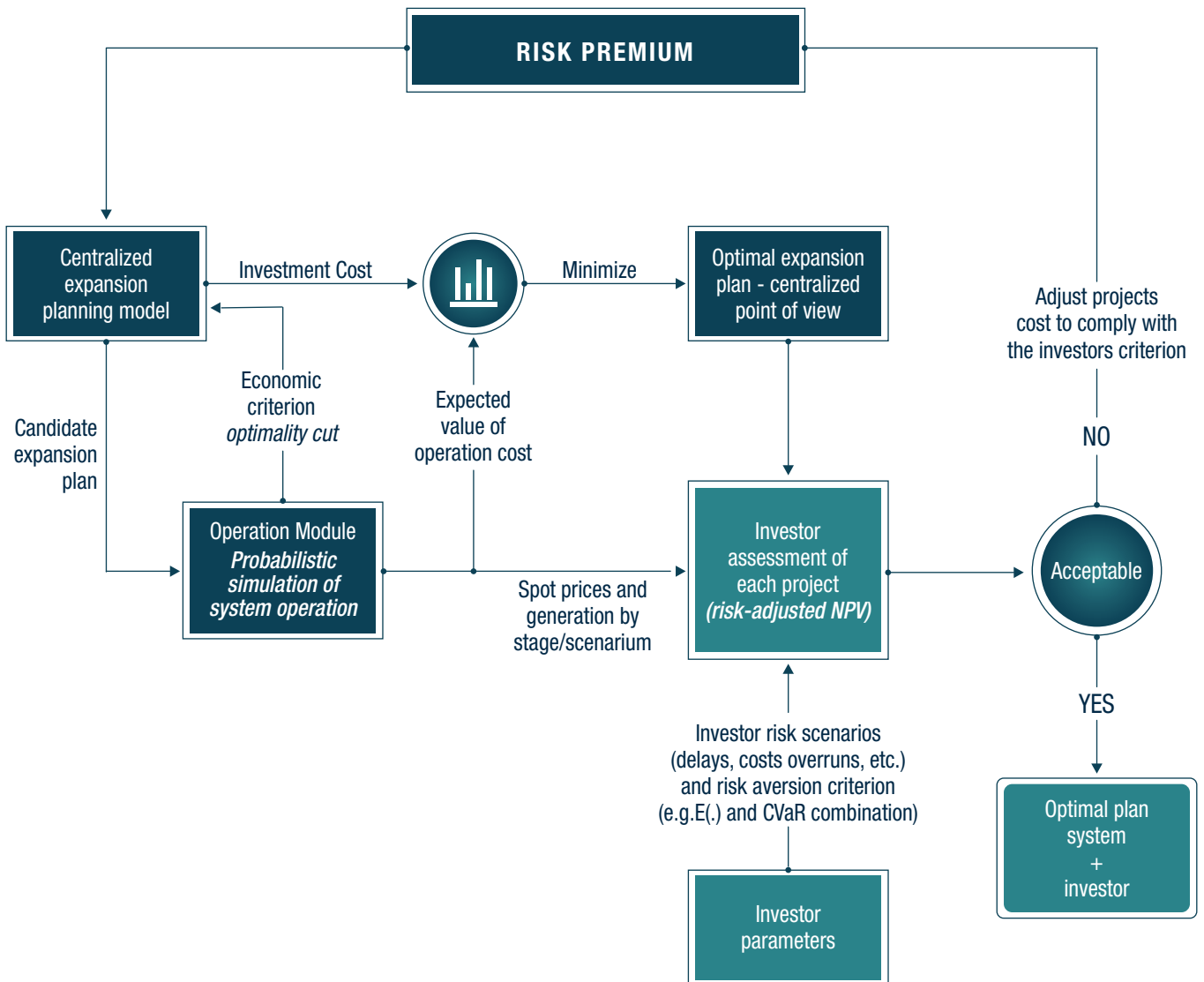
INTEGRATED EXPANSION PLANNING

How to consider the investors point of view into a centralized framework?

Taking into account the investors perspective into the expansion planner's outlook is a challenging task. PSR is able to solve this problem by combining OptFolio to OptGen, which is PSR's G&T expansion planning model tool. Its objective is to determine an optimal portfolio of projects for power systems, considering their uncertainties and energy policies (such as clean energy target and emission constraints). Because the model decides on the best combination of projects from the system planner's perspective (centralized planning), and does not have precise (and detailed) financing and contractual information, the selected projects may not be attractive from an investor perspective.

The integration between OptGen/OptFolio aims to incorporate an ex-ante risk analysis process into the planning task, similar to what is done by the investor in his decision process. In an automatic iterative process, OptFolio calculates and assigns a premium to the riskiest projects (which will be reflected in OptGen in

terms of an increment in the investment cost), making them more expensive for the system, that is, from the perspective of the planner. As a result, this methodology determines an expansion plan that has satisfactory projects for both the centralized planner and the investor's point of view.



USES OF OPTFOLIO

The OptFolio model has been used in a wide range of studies, from portfolio simulation, sales and supply strategy definition, due-diligences, analysis of feasibility of potential renewable projects, portfolio risk analysis, etc. It has also been used to model portfolios in several countries, such as Brazil, Chile and others.

 CHILE	 COLOMBIA	 MEXICO
Strategic Consultancy on the Chilean Wind and Solar Power Industry.	Integrated expansion planning in the Coatzacoalcos river basin.	Integrated expansion planning in the Magdalena river basin.
 BRASIL	 BRASIL	 BRASIL
Design of contracting strategies to generators and retailers.	Risk quantification of spot prices time granularity increase for wind and solar generators.	Portfolio diversification strategies for risk mitigation.

