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:

- **Power contracting limits**
- **Short selling prevention**
- **Limit on financial exposure**
- **Budget constraints**
- **Obligatory, mutually exclusive or associative project sets**

**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
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.
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.

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<th>Country</th>
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<td>Strategic Consultancy on the Chilean Wind and Solar Power Industry.</td>
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<tr>
<td>COLOMBIA</td>
<td>Integrated expansion planning in the Coatzacoalcos river basin.</td>
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<td>MEXICO</td>
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<td>BRASIL</td>
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