Platform for Investment Analysis of Energy Assets - Part II

Power-flow MILP optimization, lifetime-cycle planning and photovoltaic forecasting module

This investment tool for long-term energy infrastructure planning, allows to assess both technical feasibility and economic performance simultaneously. It helps determine which assets to build, when to build them and for how long to operate them ; all with the goal of minimizing total system costs. The platform is modular and lets users configure different network topologies, asset types, storage, maintenance/building costs, and load profiles.

At its core, the model combines a DC Optimal Power Flow (DCOPF) algorithm for physical power flow simulation with a mixed-integer linear programming (MILP) framework for investment decision-making. By introducing binary decision variables for each candidate asset, the MILP formulation can automatically select the optimal combination of new builds and retirements from the full asset pool, integrating these choices directly into the power flow optimization. This unified approach removes the need for manual scenario definition (as in the earlier VT1 model), enabling global optimization across all possible asset mixes and commissioning schedules within one model run.

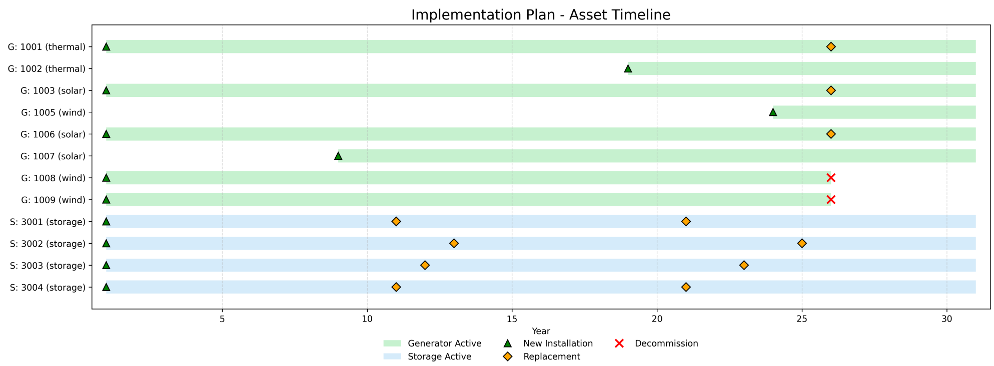

Figure 1: Asset timeline over the 30-year planning horizon

As a result, the system provides a clear view of long-term investment outcomes. Users gain access to annual economic cost breakdowns, optimal build plans over the planning horizon, and technology comparisons based on financial metrics like Net Present Value (NPV) or annuity calculations. This allows for precise sizing of storage or generation, identification risks and a realistic evaluation of strategies under changing grid conditions and demand growth.

A separate module handles photovoltaic generation forecasting, built with the XGBoost machine learning algorithm. It predicts short-term solar generation using time, lag, and weather features, and its performance is compared with classic time-series models such as SARIMA. Theg goal was to understand the impact of physic-engineered features. Please note that full model evaluation are not included in this repository.

Author Rui Vieira
Supervisor Dr. Giovanni Beccuti
Study Program MS in Business Engineering (FS25)