

Internship - Flexibility Driven Industrial Investment for Risk Averse Decision Making Contexts.



Industrial
Performance Lab

S. LEDUR
M.D. EL ALAOUI FARIS



2026



6 months

About Air Liquide R&D

Air Liquide est le leader mondial des gaz, technologies et services pour l'industrie et la santé. Présent dans 80 pays avec environ 65 000 collaborateurs, le Groupe sert plus de 3,5 millions de clients et de patients.
Air Liquide place la diversité au cœur de ses activités et s'engage notamment en favorisant l'égalité professionnelle et l'emploi des travailleurs en situation de handicap.

Le Innovation Campus Paris (78 - Les Loges en Josas) est le plus grand centre de R&D d'Air Liquide.

Il développe des **solutions innovantes** pour l'ensemble des activités du Groupe. Plus de 250 chercheurs travaillent dans 48 laboratoires dotés de matériel de pointe et de plateformes expérimentales, permettant d'explorer de nombreux domaines de recherche.

Missions

The operations research team of Air Liquide R&D works on diverse optimization and simulation methods to support decision-making on key operational and strategic business objectives.

This internship focuses on developing a decision support framework for strategic capital investment in industrial energy systems, specifically addressing market volatility and future uncertainty for risk-averse decision-makers. An example application is optimizing electric boiler or heat storage sizing for an existing natural gas-fired cogeneration plant. The methods could be extended to hydrogen and oxygen production and storage integrated systems.

The main tasks are:

- Formulate a two-stage robust optimization (2-stage RO) model to capture the investment decision (e-boiler / heat or power storage sizes) and subsequent operational decisions under price uncertainty.
- Implement and solve the bilevel optimization problem, exploring techniques such as the Column-and-Constraint Generation (C&CG) and compared to alternative decomposition methods.
- Quantify the value of generating a cost-robustness Pareto front, and comparing it with deterministic and stochastic optimization methods to provide clear, actionable insights for decision-makers.

Background & Skills

- ✓ Final year engineering student / Master 2 in computer science or applied mathematics.
- ✓ Strong background in applied mathematics: optimization, operations research, and MILP modeling.
- ✓ Good programming skills: Scientific Python (NumPy, SciPy, etc.), and OR modeling frameworks (e.g., Pyomo). Familiarity with robust optimization concepts and solvers (e.g., HiGHS, Gurobi, CPLEX) is a plus.



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