GLOBAL OPTIMIZATION OF AN INDUSTRIAL GAS NETWORK

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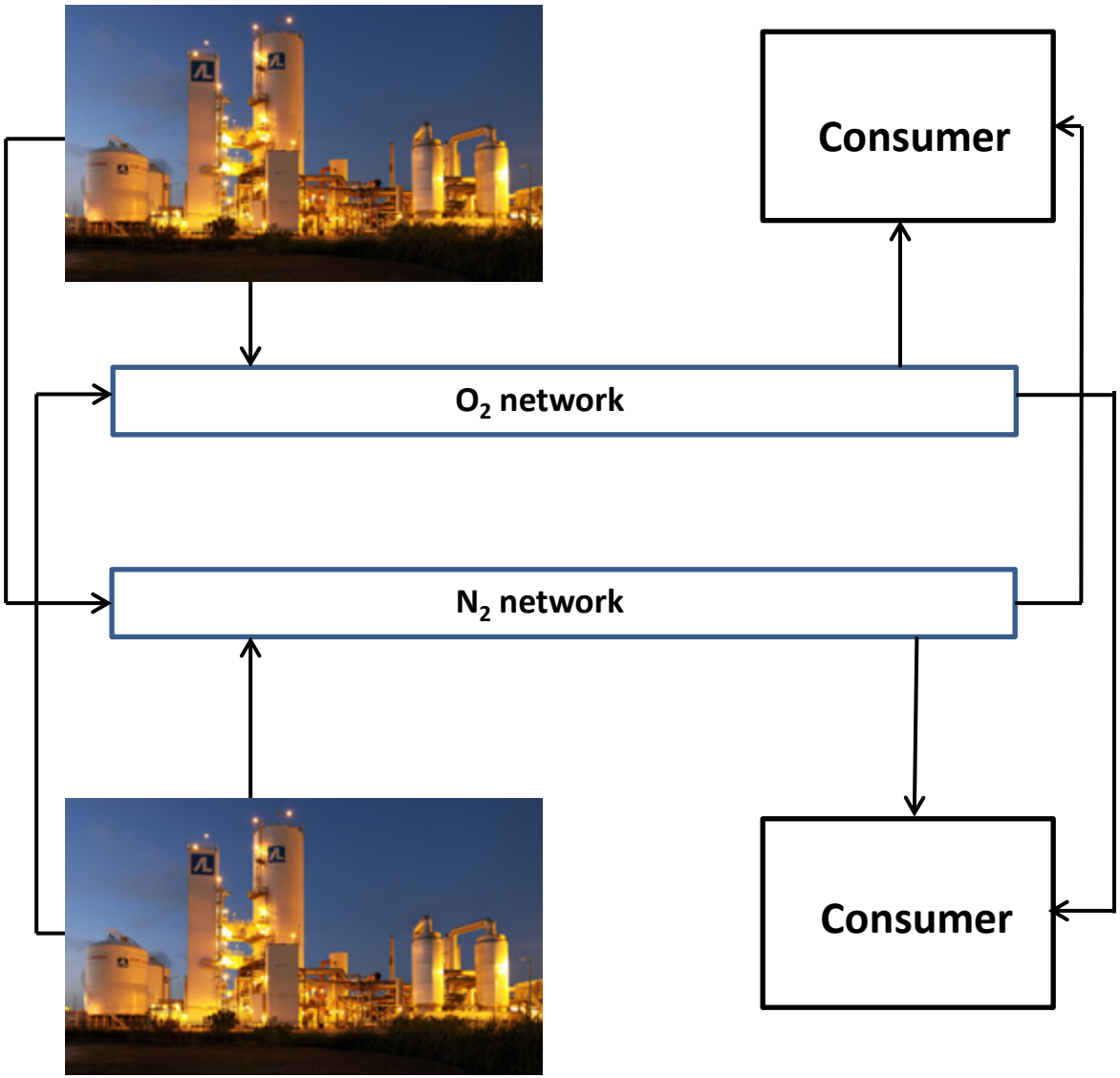
GAS PIPELINE NETWORKS

Pre-existing network of gas pipelines connecting air separation units and consumers



CHALLENGE

- **Numerical characteristics of the model proved a challenge to all solvers**
- **Difficult to use the results from a numerically unstable model in the RTO application**
- **It is necessary to develop global optimization facilities to deal with problems with many local solutions**

MODEL IMPROVEMENT

- **Quality of the model was improved with the following efforts:**
  - **Elimination of variables**
  - **Elimination of equations**
  - **Algebraic reformulations to make model more amenable to optimization**
  - **Disjunctive reformulations to effectively tackle logic conditions**

- **Numerical characteristics were improved by statically scaling equations and variables to avoid very large and very tiny coefficients**

INFEASIBILITY ANALYSIS

- **Combing regression models pertaining to various subparts of the model led to feasibility issues**
- **Motivated the development of IIS (Irreducible Inconsistent Sets) detection module in BARON**
- **IIS is an infeasible set with any proper subset feasible**
- **Isolating an IIS can provide insights into the model and speed up model correction process**
- **Feasibility in RTO model achieved after 6 iterations of corrections**

RESULTS

- **The improvements allow for solution of the original model within 5% gap within 1500 seconds, with a 15% improvement in objective value**

- **Fixing of a few binary variables through heuristics leads to a dramatic reduction in solution time**

- **Suboptimal solutions can be achieved through fixing of binaries in ~6 seconds**