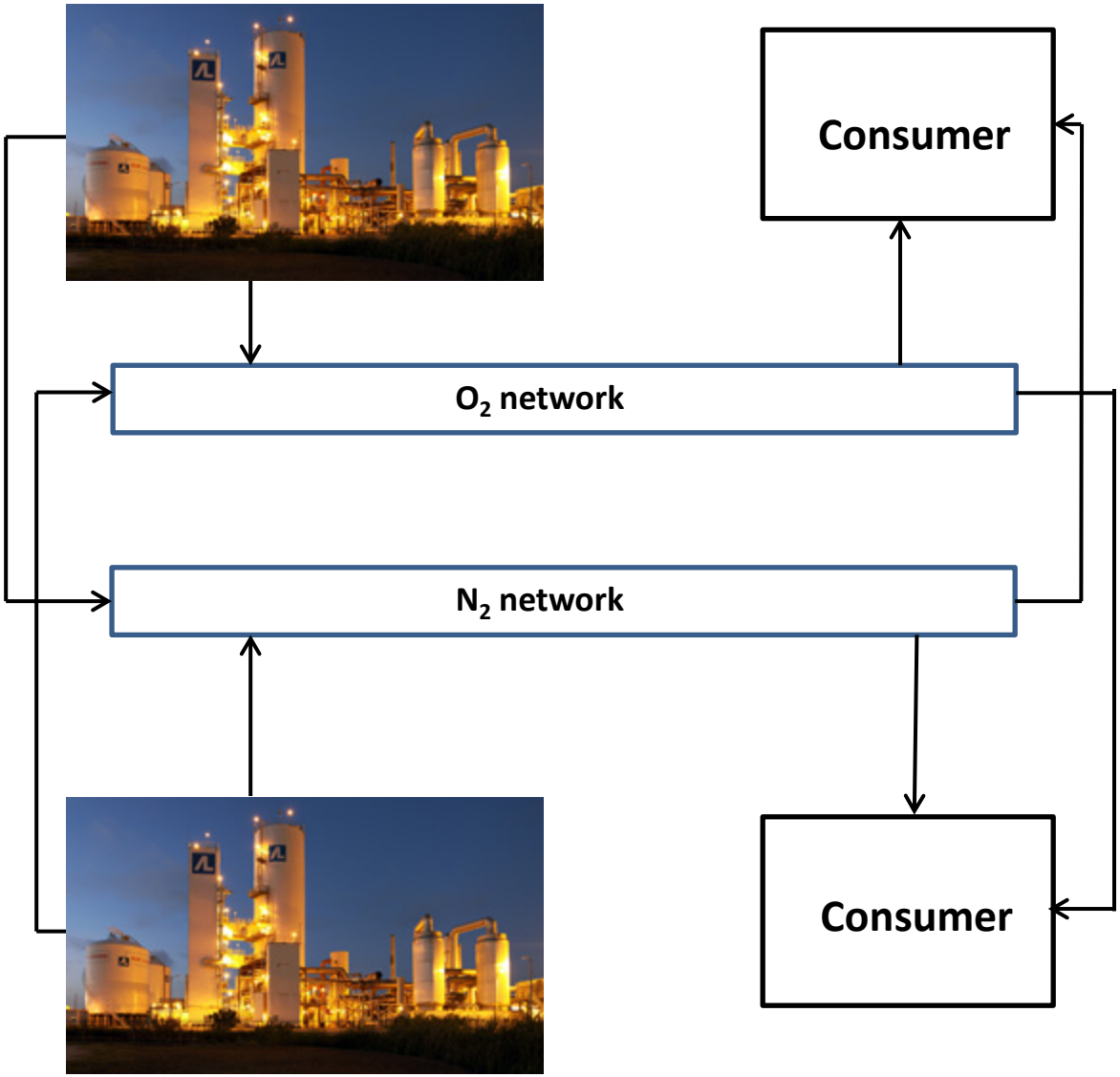
REAL-TIME OPTIMIZATION FOR AIR LIQUIDE GAS PIPELINES NETWORK

Yash Puranik and Nick Sahinidis (CMU)

Tong Li, Darrin Feather and Brian Besancon (Air Liquide)

MOTIVATION

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



MOTIVATION

- **Demand from customers keeps varying across time periods**
- **Electricity prices fluctuate continually**
- **Real-time optimization techniques necessary to efficiently utilize the production network to meet the demands**

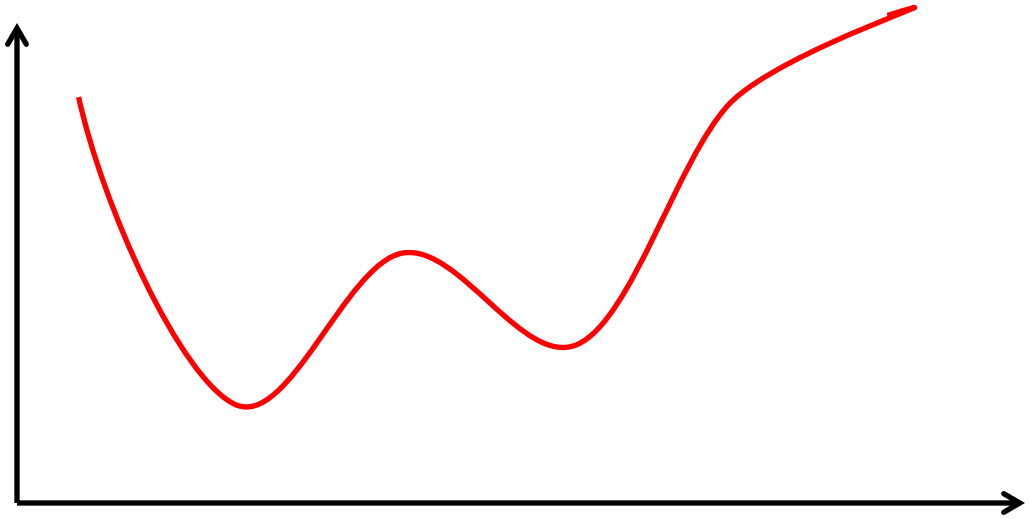
NATURE OF PROBLEM

- **Problem framed as an MINLP to minimize total cost of production while satisfying customer demands**
  - **Nonlinear regression models**
  - **Conjunctions – Certain pieces of equipment must be used in concert**
  - **Disjunctions – Certain pieces of equipment cannot be used together**

- **Problem Size - ~150 binaries, ~600 continuous variables, ~800 equations**

CHALLENGES

- **Nonconvexity – Presence of a variety of nonconvex terms for the physical model of the plant**
- **Leads to multiple minima and necessitates global optimization techniques**



CHALLENGES

- **Solution Time – The model must be solved in reasonable time for its use in an RTO setting**
- **Highly nonlinear model. Even finding a feasible solution is very difficult.**

APPROACH

- **Reformulations – Convert the problem to a form more amenable for global optimization**
  - **Use techniques to convert the conjunctions and disjunctions to their convex hull equivalents**
  - **Use scaling techniques to improve numerical behaviour of model**

- **Develop novel ideas for generating cuts to speed up convergence to global optimum**