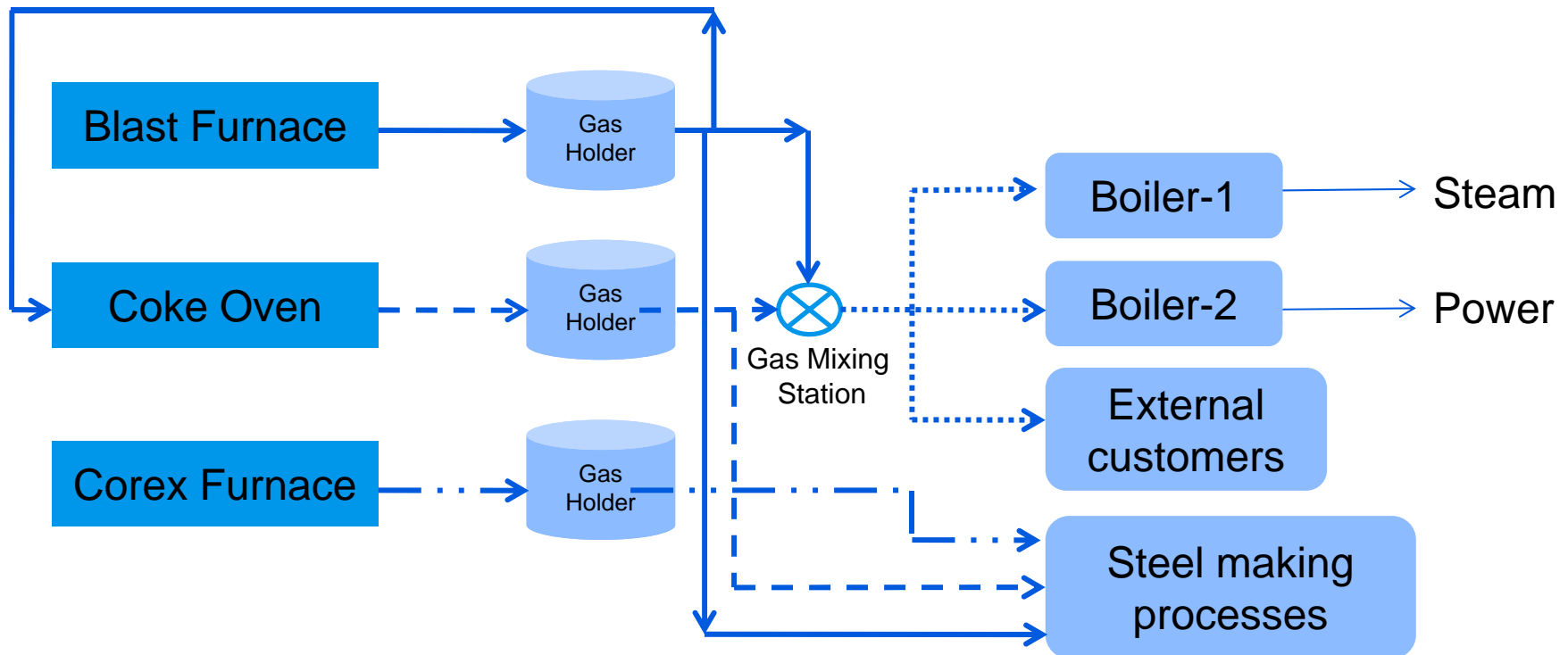




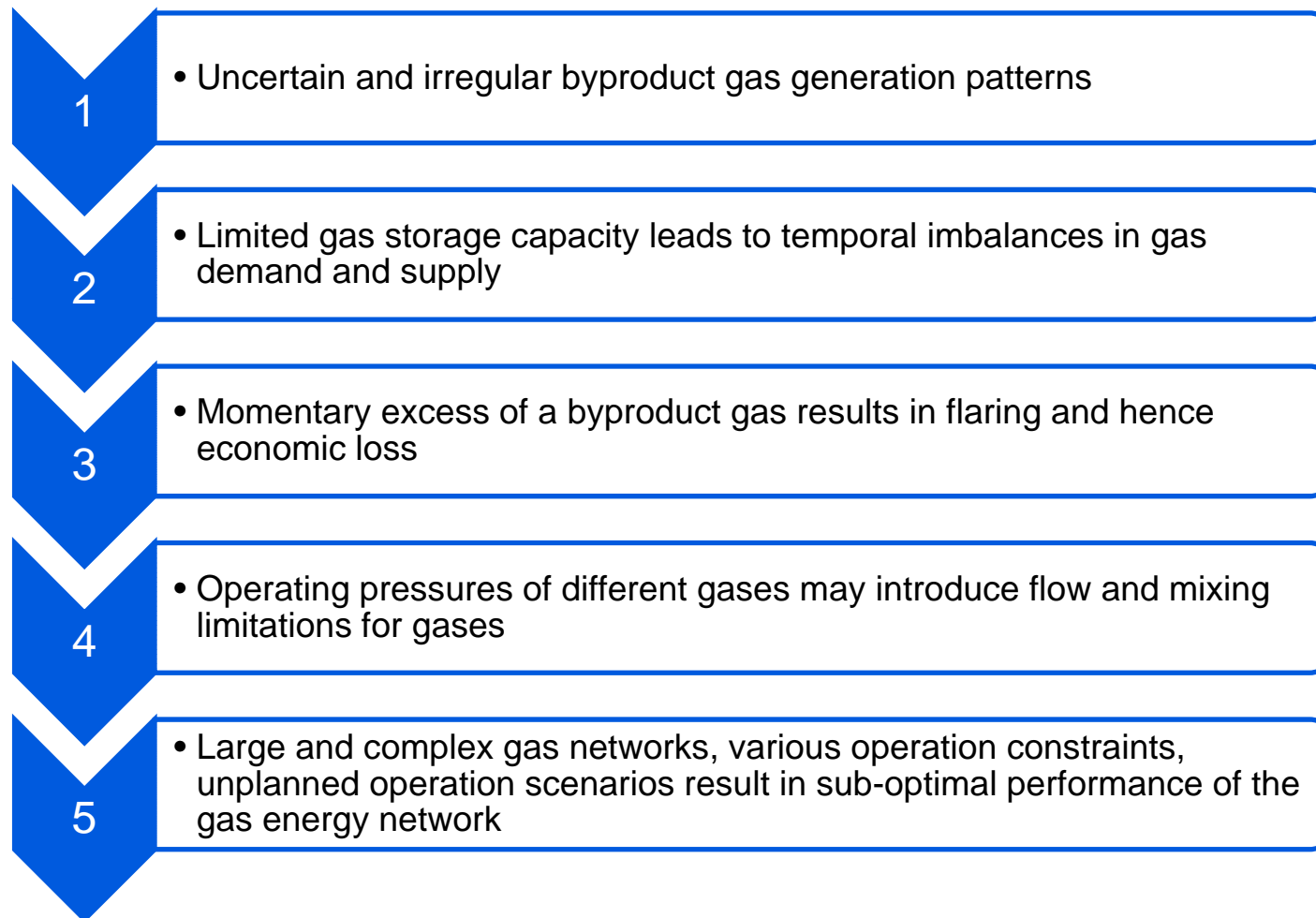
# Energy Management Optimal Byproduct Gas Distribution in Iron and Steel Making Plants

# Byproduct Gas Network Overview



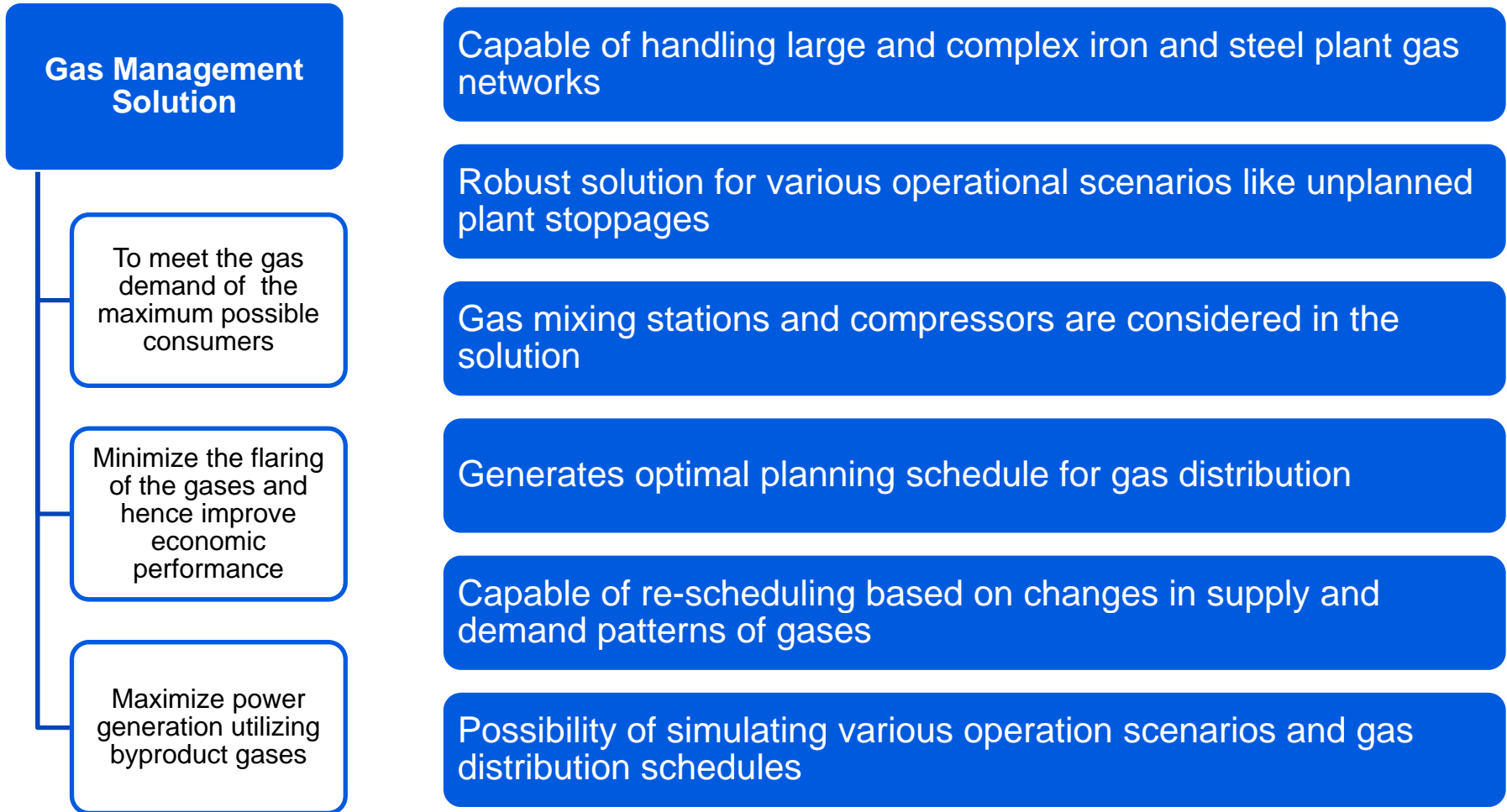
- Energy-rich ( $\sim 700 - 4300 \text{ Kcal/Nm}^3$ ) byproduct gases are generated in large volumes during iron- and steel-making processes
- Byproduct gases are consumed by iron- and steel- making processes and also to generate power in captive power plants
- Gas network may consist of gas mixing stations, compressors etc

# Byproduct Gas Management Challenges



# Gas Management Solution

## Optimization of Gas Distribution



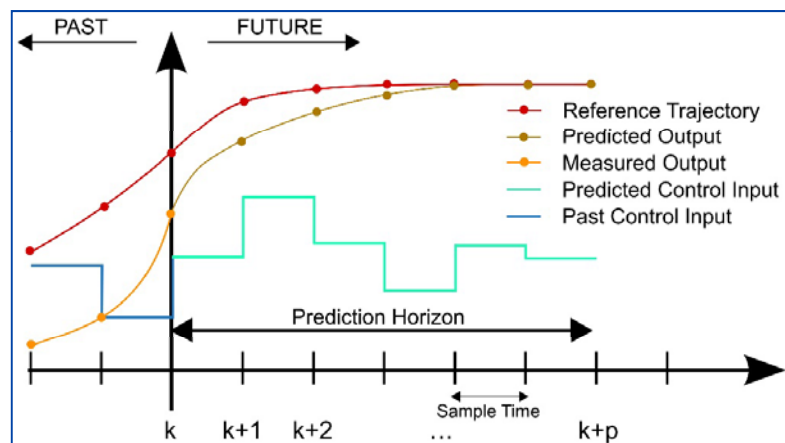
# Gas Management Solution Strategy

## Model Predictive Control Technology

### Future prediction and Optimization

#### Inputs

- Gas Generation profile
- Demand profiles of consumers

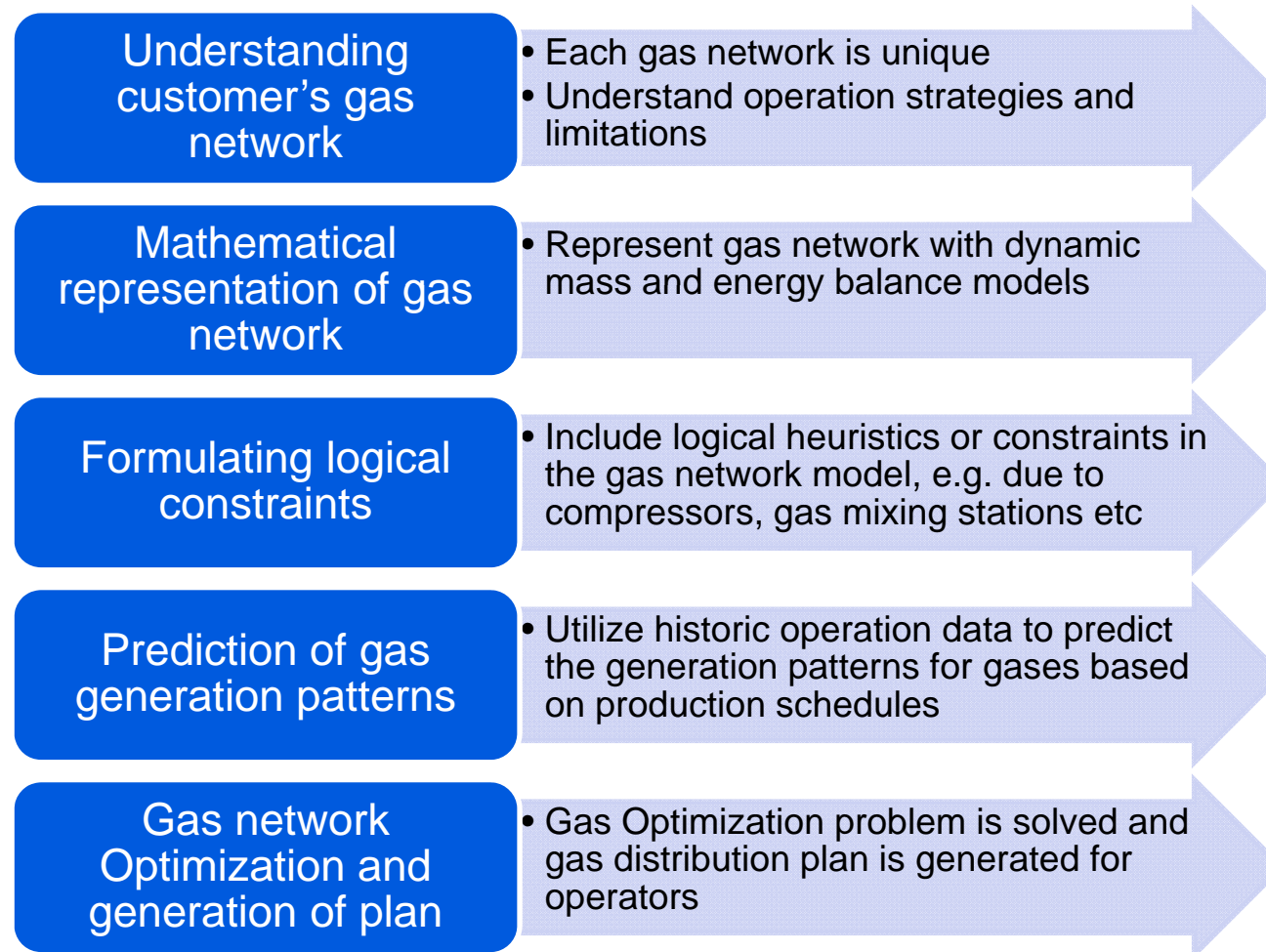


#### Outputs

- Future plan and schedule of gas distribution
- Provides which gas and in what amount to be supplied to each consumer

- Dynamic mathematical models for gas holder level predictions
- Theory of propositional calculus and mathematical representation of logical relationship
- “Branch and Bound” optimization technique to solve Mixed Integer Linear Programming (MILP)
- State-of-the-art commercial solver “cplex” from ILOG to solve gas optimization

# Gas Management Solution Workflow



# Case Study

## Feasibility Analysis

Feasibility study carried out on a gas network of an integrated iron and steel plant

- Blast Furnace Gas, Corex Gas, LD Gas, Coke Oven Gas network

Manual operation of gas network results in excessive flaring of byproduct gases

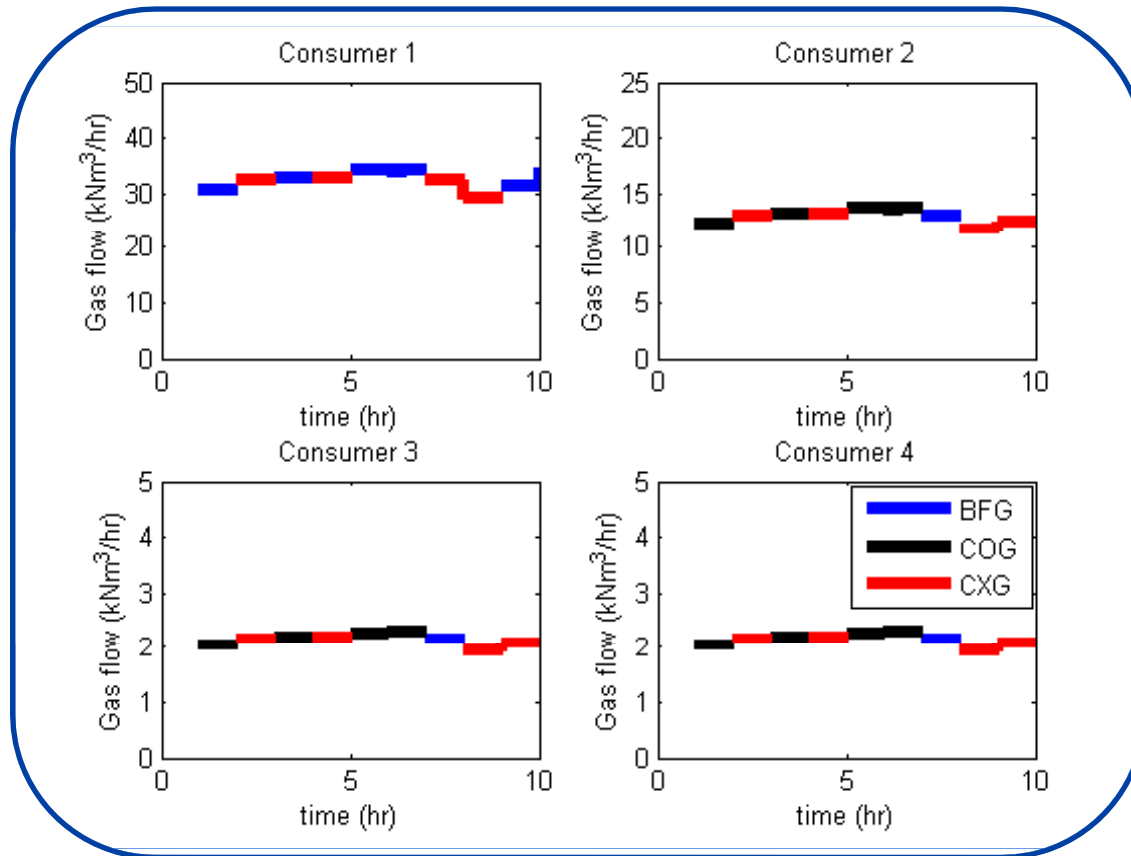
- 5 – 10 % Blast Furnace Gas flaring;
- 0.5 – 1 % Coke Oven Gas flaring
- 1.5 – 2 % Corex Gas flaring

Gas network consist of 2 gas mixing stations

Byproduct gases supplied to Captive power plants and external power plants

~ 50 byproduct gas consumers were considered

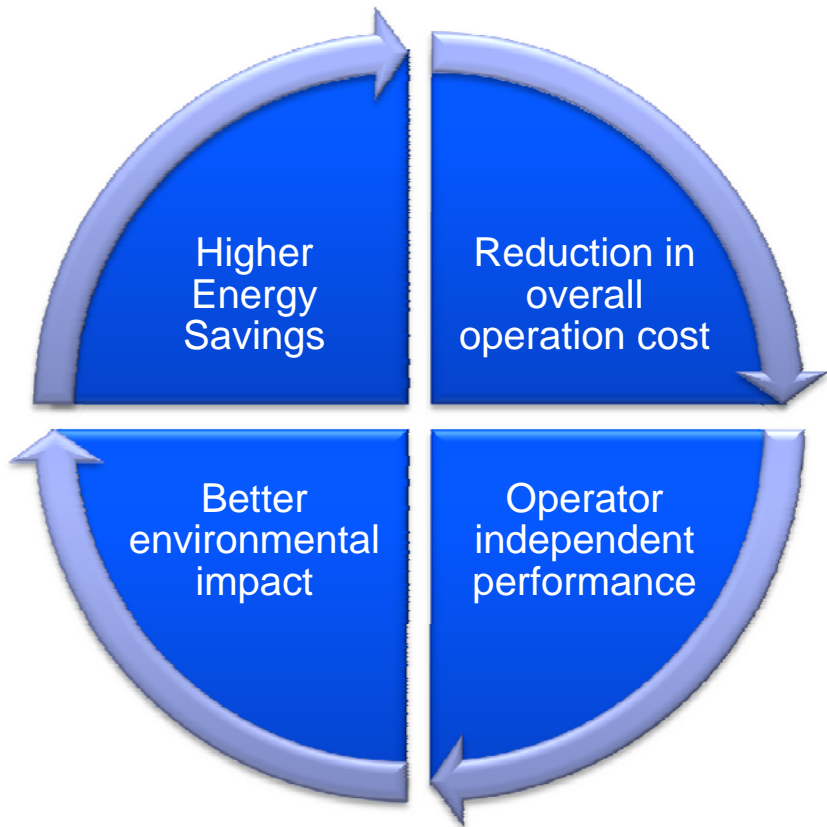
# Case Study Results



- Gas management solution computes optimal gas supply schedule
- For a particular consumer, results provide
  - Type of gas
  - Quantity of gas
  - Duration of supply of gas
- Optimal gas supply schedule result in minimal energy loss



# Gas Management Solution Expected Benefits



Benefits for 8 MTPA integrated iron- and steel-making plant

~ 50 % reduction in gas flaring

~180,000 Gcal energy savings per year

2 to 5 MUSD savings per year

Power and productivity  
for a better world™

