Gas System Optimizer (GSO)

the first of its kind transient optimization engine

GSO

The Gas System Optimizer (GSO) is designed to optimize dynamic scheduling and operation of a natural gas pipeline network. GSO finds optimal flow, delivery schedules and concurrent operations of compressor stations and line pack dynamics. In parallel, GSO determines economic value of natural gas at any point in time and at any location on the network.
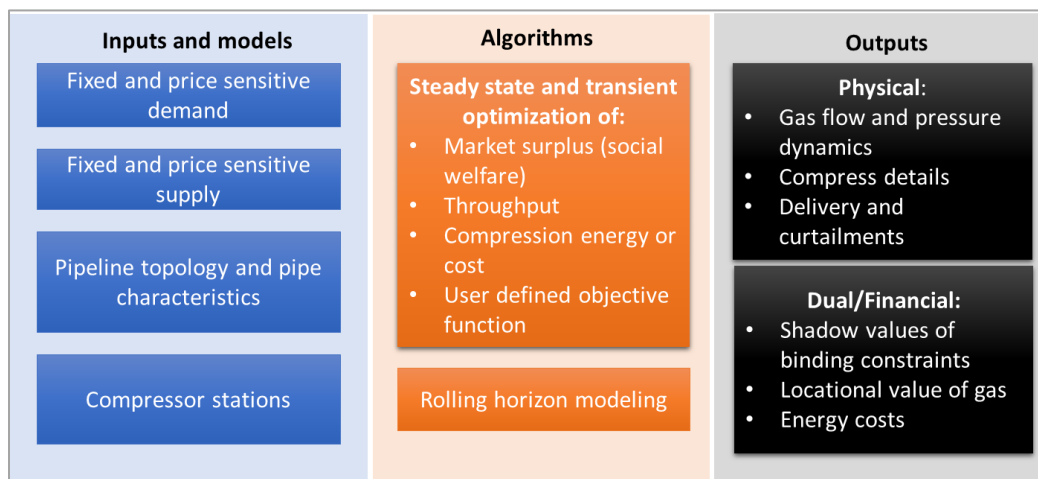
Inputs and models	Algorithms	Outputs
Fixed and price sensitive demand	**Steady state and transient optimization of:**	**Physical**:
Fixed and price sensitive supply	• Market surplus (social welfare)	• Gas flow and pressure dynamics
	• Throughput	• Compress details
Pipeline topology and pipe characteristics	• Compression energy or cost	• Delivery and curtailments
	• User defined objective function	
Compressor stations		**Dual/Financial**:
	Rolling horizon modeling	• Shadow values of binding constraints
		• Locational value of gas
		• Energy costs

Figure 1. GSO Schematics

APPLICATIONS

GSO can be used within the natural gas industry for natural gas trading support and asset management, operational analysis, delivery scheduling, system expansion analysis, economic valuation and benefit assessment.

Generating companies with gas-fired generation in their portfolio can use GSO for asset management, fuel deliverability assessment, project development planning.

RTOs, pipeline operators, NERC, regulatory agencies can use GECO ENELYTIX® with GSO for system coordination planning, operational analysis, market design, reliability and resilience assessment studies.

GSO ADVANTAGE

By offering transient optimization capability, GSO holds a critical advantage over tools presently used in the industry. GSO can help pipeline operators to increase pipeline capacity and throughput and to manage pipeline transportation function with higher economic efficiency.

Existing simulation tools accurately predict flow and pressure dynamics given a user specified set of inputs but cannot optimally select compressor settings and/or delivery schedules.

Existing optimization tools either ignore the physics of pipeline flows or use steady state approximations. Both approaches provide inadequate representation of intra-day dynamics and inaccurately assess pipeline capacity available under dynamically changing operational conditions. These limitations make existing optimization tools unsuitable for controlling pipeline scheduling and operation and as planning tools.

GSO successfully overcomes limitations of existing tools because it has a solid foundation in physics of compressible gas turbulent flow dynamics and in representation of key engineering constraints of pipeline network operations. Gas flows in each pipe is represented by a system of non-linear partial differential equations linking natural gas flux and density and known properties of non-ideal gas. Flows are controlled by the operation of limited in capacity compressors that must keep pressures at each node and in each pipe within allowable operating limits.

GSO became possible due to a highly scalable and precise computational method developed at the Los Alamos National Laboratory (LANL) for simulating and optimizing the dynamic of compressible gas flows within a network.

LOCATIONAL TRADE VALUE (LTV) OF NATURAL GAS

A unique feature of GSO is its capability to identify the true economic value of natural gas assessed with an unparallel locational (any node, any pipe) and temporal (hourly or sub-hourly) granularity – Locational Trade Value (LTV). GSO values natural gas consistently with the physics of gas flow and subject to engineering constraints of pipeline operation. In addition to LTVs, GSO reports shadow economic values of pressure, horse power and compression constraints at any node pipe and compressor station.

BENCHMARKING

GSO's demonstrates excellent precision when benchmarked against high fidelity solvers for partial differential equations and against commercially available pipeline simulators. GSO has also demonstrated high precision when benchmarked against SCADA measurements for an existing pipeline.

SOFTWARE IMPLEMENTATION

GSO can be used in a stand-alone mode on a local server, run within ENELYTIX® modeling environment on AWS cloud both in the gas only mode or as a part of GECO ENELYTIX. GECO ENELYTIX system has been specifically designed to model coordinated operation of the power and natural gas networks and markets.

CONTACT INFORMATION
GSO is provided as a component of the ENELYTIX® platform. For more information about GSO and ENELYTIX, contact info@enelytix.com