Elegant Solutions to Power & Gas Sector Challenges

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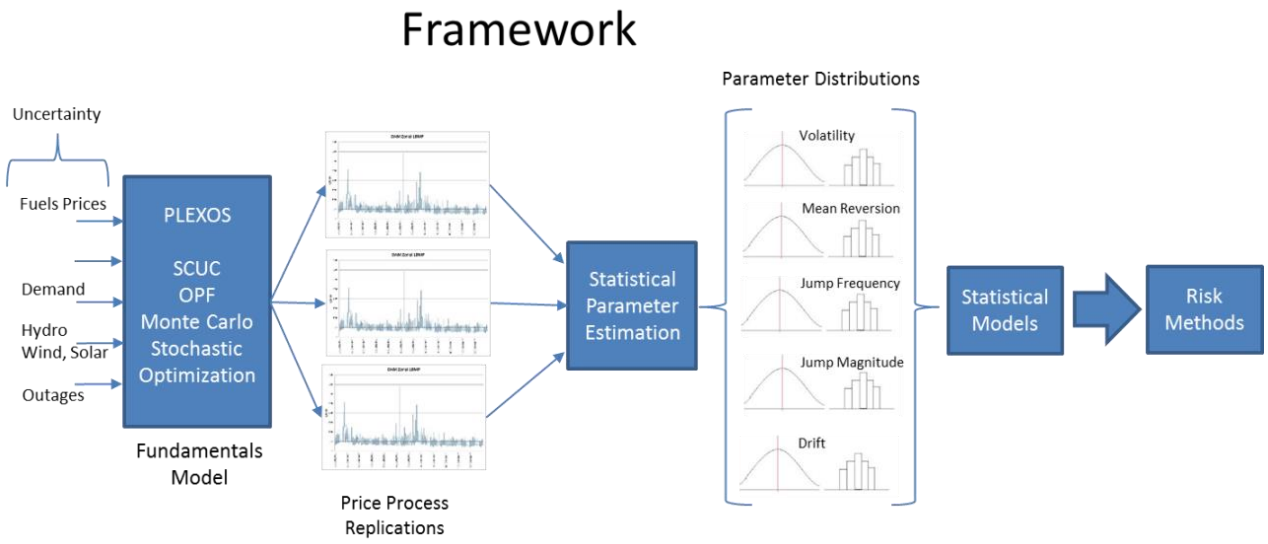
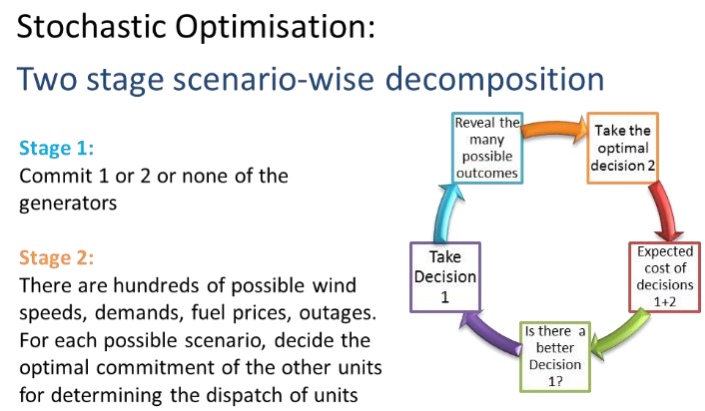
Leading the field in Energy Market Modelling

Uncertainty and Risk in the Evolving Energy Sector

There are all kinds of uncertainty today in the natural gas and electric sectors. For example with the advent of power markets and the evolution of market mechanisms both financial and physical positions have uncertainty that requires quantification to better plan for the future. In today's power sector transmission competes with generation and load competes with generation and transmission. How so? Active demand response and energy efficiency can reduce the need for generation capacity as well as transmission requirements. A load pocket can be served with transmission or local generation. Physical asset developers must evaluate all the risks of physical competition to see how competitive their solutions are and then shortlist the most competitive ones and use limited corporate resources to focus on the more likely winners. PLEXOS provides a framework for testing various assets valuations in markets where competition can emerge in the form of load, transmission or generation solutions. Likewise for natural gas infrastructure development PLEXOS provides a comprehensive valuation methodology that considers both electrical and gas sector gas demands. For financial risk evaluation PLEXOS mixes both statistical risk models with fundamentals models. Statistical risk methods depend on historical data and can suffer from in-sample bias where fundamentals models can generate price paths that can reflect structural change such as carbon price impacts, change in market rules, retirements and new entries of power plants, changes in demand forecasts and fuel forecasts and price paths subject to other uncertainty.



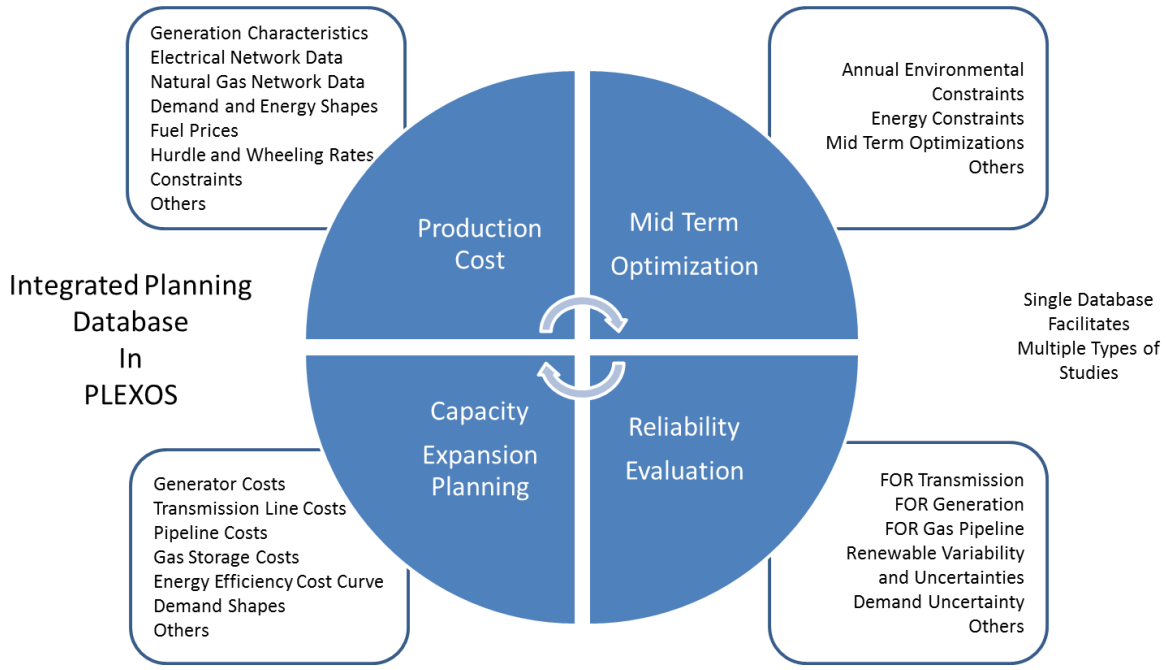
The combination of statistical methods and fundamentals is the preferred approach of today's risk managers where PLEXOS also offers the power of stochastic optimization which enables the risk manager to forecast robust price and fuel forecasts for generation assets, market prices, and other quantities.



Complexities and Diversity of Resource Change in the United States

The US is seeing resource change driven by environmental policy and public policy where many areas of the US have minimal load growth projections. Although many organizations, regulators, ISO's, federal departments, labs, consultants and others are engaged in a multitude of studies for the future grid designs in America. In the past few years there has been increased recognition that environmental policy and public policy in combination to the vast shale gas developments will lead to increased reliance of the power sector on natural gas generation. Gas Electric coordination has emerged as a complex topic for regulators and the gas and electric sectors to confront along with the electrical system operators with concerns of present and future potential gas constraints that impact electric system operation and reliability. Many studies have been initiated for gas electric coordination in the major interconnects of the US. As well integration of renewables have driven IRP managers and ISO's to consider sub-hourly ancillary co-optimization analysis in production cost models for major areas of the US. In addition many regulators are interested in co-optimization of generation and transmission expansion to optimize resource change for integrated resource plan frameworks. New strategies of co-optimization of electric and gas infrastructure are becoming of interest as much of the natural gas sector growth may likely be driven by resource change and dependency of electrical sector on pipeline network and gas network operational issue. This is all in the back drop of active demand response, energy efficiency, and renewable portfolio standard adoptions by state governments as well as federal regulator orders such as FERC Order 1000 of considering public policy in transmission planning. Thus the study process and the complexity of issues is driving the demand for integrated datasets and integrated models i.e. one software package that can handle all the complexities of planning and operations and market analysis in the short, medium and long term.

The following diagram displays the integrated dataset for the PLEXOS® Integrated Energy Model.



How competitive are generation projects in light of the competition of demand response, potential transmission solutions, market structures, excess capacity, public policy, various demand forecasts, retirements, new entries, and environmental regulation uncertainty? Integrated datasets simulate the complexities of the energy markets and help to understand risks and rewards in a sector with many moving parts. The integrated database allows for co-optimization of ancillary services and energy market to study renewable integration and curtailments for sizing of transmission systems where traditional reliability tools are unable to size transmission optimally for public policy considerations. With the integrated datasets the system planner can switch on the fly from LOLE and LOLP studies to gas electric expansion to co-optimization of generation and transmission expansion and other planning analysis too. As the gas and electric sector coupling increases, transmission projects or pipeline projects can have impacts on electric or gas rate payers or both where the integrated energy model assists in the assessment of winners and losers in asset evaluations and for public policy cost allocations and inter regional planning assessments. The planning process has changed significantly since the 70's when much of the planning software was initially being used for solving complex problems of the day where today's world with the current challenges of the power and natural gas sectors the advantages of modern computer science can be exploited and the rapid growth of computing power and cheap memory and storage make integrated datasets a new trend that will help bring efficiency to the planning process. With the integrated datasets and integrated model frameworks the following table highlights some of the relevant modern applications of such tools.

Planning Objectives	PLEXOS Capability

Renewables Integration and System Flexibility Requirement Assessments	- Sub-Hourly Co-Optimization of Ancillary Services with Energy Market and Transmission Power Flows - Stochastic Optimization and Stochastic Renewables Models - PHEV, EE, DR, SG, Energy Storage Models
Least Cost Resource Change within and Across Regions	- Co-Optimization of Generation and Transmission Expansion - Generation Retirements and Environmental Retrofit Models - Reliability Evaluation, Interregional Planning
Minimizing production costs and consumer costs to electricity and natural gas rate payers	- Co-Optimization of Production cost of Electrical and Natural Gas Sectors - Electrical Network Contingencies and Natural Gas Network Contingencies
Sizing Natural Gas Network Components and Natural Gas Storage	- Co-Optimization of Natural Gas Network Expansion along with Electricity Sector Expansion - Electrical Network Contingencies and Natural Gas Network Contingencies
Environmental Policies	- Co-Optimization of Annual and Mid-Term constraints with short term optimizations - Energy Storage, Environmental Constraints, others
Integrated Reliability Evaluation	- Integrated Reliability Evaluation to Ensure LOLE and other Metrics Maintained with Co-Optimization of Electric and or Gas Sector Expansion or True Monte Carlo

Flexibility

Intermittent generation from renewables requires a rethink of resource development and having enough flexible resources to balance the grid for ancillary services in a sub-hourly time frame. For many decades resource plan analysis had minimal focus for constraints to secure enough sub-hourly ancillary services. In today's world with the prospects of significant percentages of intermittent resources making up the system, consideration of sub-hourly ancillary constraints becomes important in assessing resource plans and generation mixes. The elegance of optimization in PLEXOS is the capability to co-optimize energy and ancillary services in the sub hourly time frame to assist resource planners to assess levels of ancillary services requirements to facilitate integration of renewables for public policy. All kinds of products have come to market for sub-hourly ancillary services support such as fast start and flexible generators, energy storage, and others.