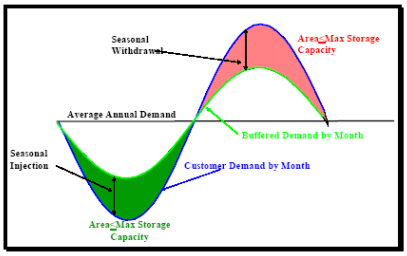
IPA'S WORLD GAS TRADE MODEL



Bringing international natural gas projects to market is a very long, expensive and risky process. In addition to developing production, players must either build or secure access to liquefaction facilities, an export terminal, LNG tankers, an import terminal, re-gasification facilities and pipelines. Players must commit colossal sums of money and commit to destination markets many years before gas is sold. Competitors are doing the same.

- How will local demand and production change the target markets?
- How will new LNG volumes change various regional and national markets when the gas finally arrives? How will public policy such as carbon tax, pollution controls and terminal siting restrictions impact demand and prices?
- How will US consumer gas demand be moderated by price?
- What about the commercial and industrial sectors in developing countries and the full range of development economics?
- What about competition from other fuels for power generation?

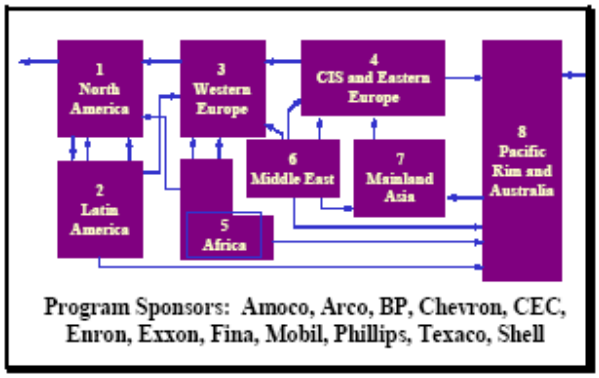
These are important questions, ones you have assuredly found difficult to quantify. IPA offers the World Gas Trade Model (WGTM) that will allow you to quantify the answers to these questions and more.

The World Gas Trade Model (WGTM).

WGTM simulates how regional interactions among supply, transportation, and demand interact to determine market clearing prices, flowing volumes, reserve additions, and pipeline entry and exit through 2040.

The WGTM divides the world into major geographic regions that are connected by marine freight. Within each major region are very detailed representations of all market elements: production, liquefaction, transportation, market hubs, regasification and demand by country or sub area. All significant existing and prospective trade routes, LNG liquefaction plants, LNG regasification plants and LNG terminals are represented. Competition with oil and coal is modeled in each region. The ability to model the related markets for emission credits and how these may impact LNG markets is included. The model represents this detail in a total of 421 regional diagrams: 9 world LNG shipping regions, 22 liquefaction regions, 15 regasification regions, 33 pipeline regions, 169 supply regions and 173 demand regions. Each regional diagram describes how market elements interact internally and with

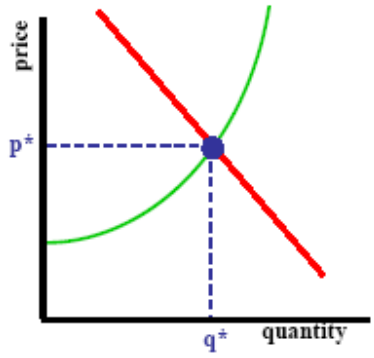
other regions. These contain 3490 nodes and 3932 links. Nearly 50 percent of this number of nodes and links represents North America, which is embedded in the world model.



Suppose as an example you are planning to export LNG from Australia and want to examine alternative disposition strategies. Some involve new terminals and regasification plants. The volume of new LNG tanker construction is uncertain over a significant range. With the WGTM, you can now quantify the market impact of a reference case and any number of"what if" risk analysis cases before you spend significant money in pursuit of your project. The model comes complete with the latest production information from the US Geological Survey. The best available demand forecasts are updated annually. Using the WGTM's advanced demand modelling capabilities, you can perform sophisticated studies to simulate the effect of an array of factors that can impact world gas demand: price, GNP, weather, lag and other phenomena.

Economic Methodology

The WGTM rigorously adheres to accepted microeconomic theory to solve for supply and demand using an "agent based" approach. To understand the unequalled benefits of the agent based approach, suppose you have a market comprised of 1000 agents, i.e., producers, pipelines, refineries, ships, distributors, and consumers. If your model of that market is to be correct, how many optimization problems must there in your model of that 1000 agent market? The answer is clear—there must be 1000 distinct, independent optimization problems. Every individual agent must be represented as simultaneously solving and pursuing his or her own maximization problem, vying for market share and trying to maximize his or her own individual profits. Market prices arise from the competition among those 1000 disparate, profit-seeking agents. This is the essence of microeconomic theory and competitive markets—people vying in markets for profits—and The WGTM scrupulously approaches the problem from this perspective.



IPA therefore make simple yet empirically very desirable assumptions about individual behavior in a market system:

- **Price taking, profit maximizing producers competing with and complementing each other in a network of supply chains that comprise the electric, gas, and other energy systems.** It is unassailably true that the international gas business contains myriad independently operating, self-interested, profit-maximizing producers. WGTM represents each and every such producer as a profit-seeking entity and computes the balance of forces that applies in an economy of simultaneous profit seeking entities.

- **Price taking, utility maximizing consumers competing in a network of supply and consumption chains.** Analogous comments to producers apply. Consumers independently pursue their private self interests, and IPA's WGTM represents such pursuit.

- **Walrasian equilibrium (market clearing).** In the real world (as well as the models), markets clear. There is neither excess supply nor excess demand because prices adjust. (Some people might not like how high or how low prices actually have to go in order to
effectuate the adjustment and market clearing mechanism, but prices demonstrably and empirically clear markets.) Walrasian equilibrium is a mathematically precise condition that means zero excess supply and zero excess demand in any market at any point in time. WGTM applies pure Walrasian equilibrium to decentralized decision making by producers and consumers.

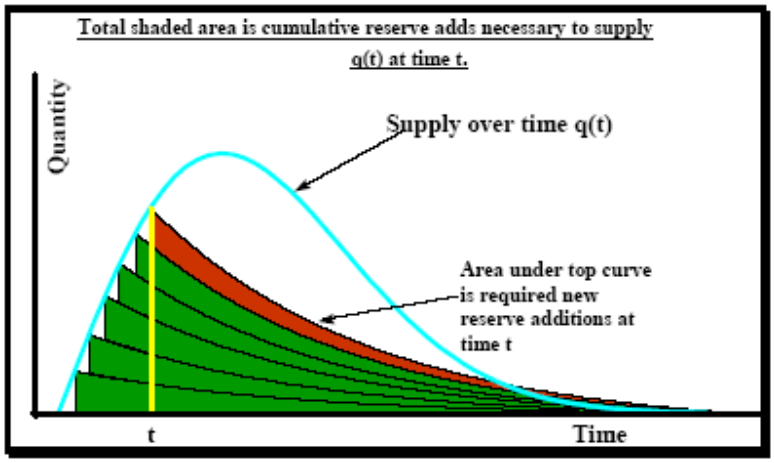
- **Zero arbitrage across space or across time at equilibrium.** The model solution must have the property that market agents fully arbitrage everything that is arbitrageable in the market. Profit maximizing producers, utility maximizing consumers, and Walrasian equilibrium give the zero arbitrage solution. This is an absolutely critical property one will want in his or her gas model. Without the zero arbitrage condition, people can withdraw and deposit money from a bank and beat your model solution!

- **There must be zero incentive to change away from the market clearing prices and quantities that the model calculates.** Every agent in one's model must be pursuing a "best response" to the actions of every other player. There must be no incentive for any player in the model to change away from what he or she is doing.

Supply Methodology and Data

The United States Geological Survey (USGS) delivers to IPA its best and most current world oil and gas supply data including proved reserves, conventional undiscovered resources, growth of reserves in existing fields, continuous and unconventional deposits, deep water potential, and exotic sources.

Derived from detailed probabilistic analysis of the world oil and gas resource base (575 plays in the US alone), the USGS data lies at the heart of IPA's reference case oil resource database. Only the USGS does a world wide, "bottom up" resource assessment.



Customers can easily substitute their own proprietary view when they believe they have superior information.
The WGTM allows the use of sophisticated depletable resource modeling to represent production of primary oil and gas (an extended Hotelling model). The IPA's Hotelling depletable resource model uses a "rational expectations" approach, which assumes that today's drilling affects tomorrow's price and tomorrow's price affects today's drilling. Thus The WGTM combines a resource model that approaches resource development the same way real producers do with the superior worldwide data of the USGS.

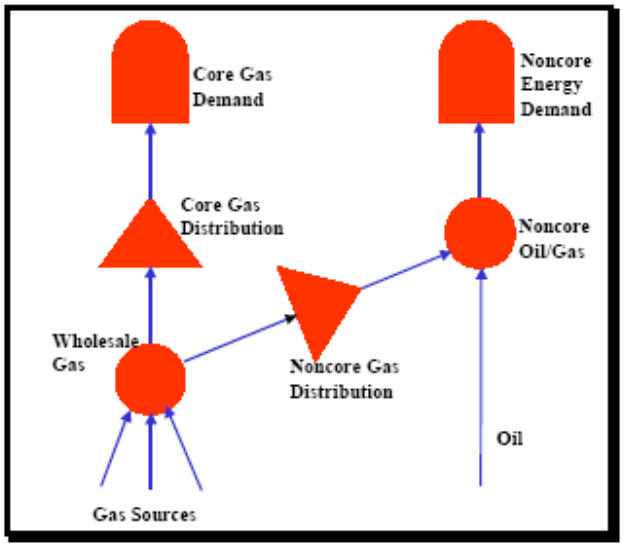
Transportation Data

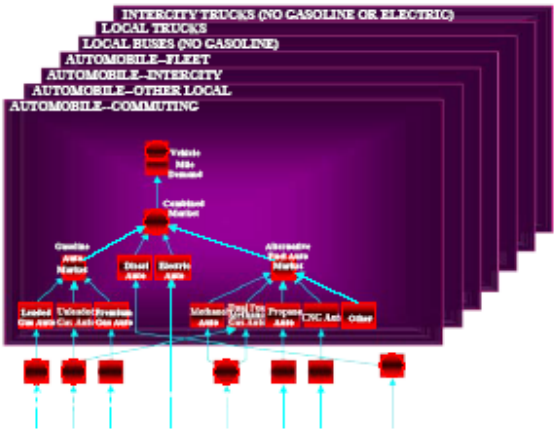
IPA maintains the best and most current transportation data around the world. IPA and our clients continually revise and update the transportation data including capacity (obtained by continual downloading of EIA, FERC and other data), tariffs, embedded cost, discounting behaviour, dates of entry of prospective new pipelines, and costs of those new pipelines.

Demand Methodology

The WGTM allows using general, multi-variable nonlinear representations of demand by sector, without limit on the number of demand sectors. IPA is skilled at performing regression analyses on historical data to evaluate the effect of price, weather, GNP, etc on

demand. (Customers who choose to do so can provide their own demand data and override ours.)



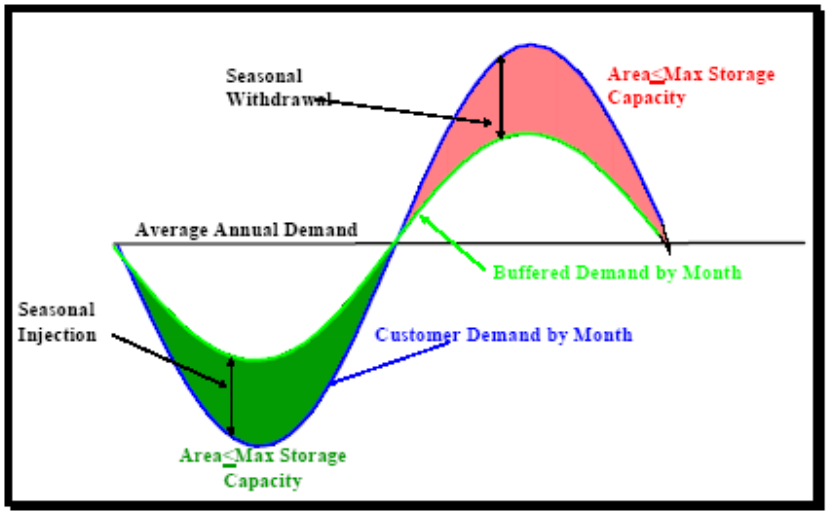


Using our methodology, IPA systematically models the impact of price change on demand (demand price feedback) to provide much more realistic results than models that use simple exogenous demand projections (e.g. 2% per year increase regardless of price), which is the standard fare in the business today.

Storage Methodology

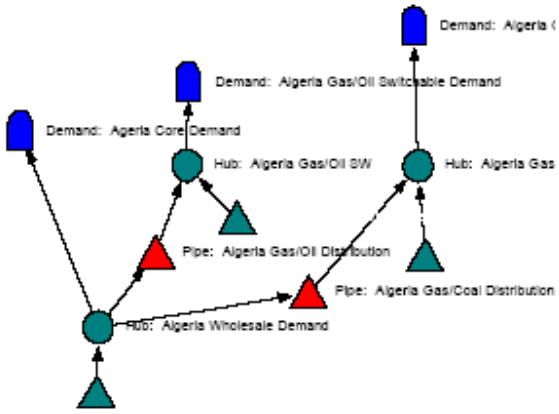
The WGTM's storage process represents the profit maximizing behavior of a storage facility owner (or lessee). A schedule of additions and withdrawals is endogenously determined so as to maximize the present value of profitability of the storage activity, taking full account of current and full forward price over time, storage cost, interest rates,

maximum injection rates (with ratchets), and maximum withdrawal rates (with ratchets). The owner of a storage asset is represented as buying from the market when prices are low (e.g., off peak during the summer for heating oil or natural gas) and sell back to the market when prices are high, i.e. during winter for heating oil or natural gas.



In the model as in the real world, buying during low price periods and selling during high price periods moderates both the peaks and valleys in market prices. This renders the optimization and market price problems highly interactive, and we believe our model to be the only one in the industry that can properly represent the feedback. Modeling this feedback is absolutely essential if you are to represent markets that have storage assets properly and understand their effect on price.

Functionality



The WGTM uses a fully visual, fully graphical, drag and drop approach. You drag and drop icons (which represent producers, pipelines, refiners, consumers) from a palette to draw the market diagram on the screen. You then interconnect them on the screen into a comprehensive network of supply chains. If you choose, the WGTM can be fully coupled with a geographic information system (GIS) to allow drawing directly on to a map. We deliver correct models preimplemented within the software, but users can build and operate their own customized models at their volition. No programming is required; all software is fully built in.

More Information

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