Selected Natural Gas Resource Assessments
- A Survey of Methodologies -

May 2004
Western Interstate Energy Board

Studies surveyed include:

1) New England Natural Gas Infrastructure – December 2003, FERC Staff Report
2) Natural Gas Market Assessment – August 2003, CEC Staff Report
3) Steady-State Analysis of New England's Interstate Pipeline Delivery Capability, 2001-2005 Phase I – January 2001, ISO NE
4) Steady-State and Transient Analysis of New England's Interstate Pipeline Delivery Capability, 2001-2005 Phase II – January 2002, ISO NE
5) Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy – September 2003, NPC (Volumes I & II)
6) Washington Natural Gas Report – Spring 2004, WA CTED

1) New England Natural Gas Infrastructure – December 2003, FERC Staff Report

Summary
The FERC New England Study assesses the ability of natural gas transmission and storage facilities to meet current and projected demand through 2010. Above ground storage, pipeline imports and LNG imports are evaluated and the potential for their expansion is discussed. Recommendations to help maintain the reliability of natural gas service are provided.

The potential impact of natural gas curtailment on electric generation was evaluated by quantifying firm and interruptible commodity and transportation contracts for natural gas used in electric generation. A curtailment equivalent to the one that occurred in January 2000 was specifically modeled.

FERC, in consultation with the DOE, contacted state public utility commissions, the New England Conference of Public Utility Commissions (NECPUC), the New England Independent System Operator (NE-ISO), and the Northeast Gas Association (NGA) and solicited their input via meetings and written comments. Contractors were hired to develop pipeline, use and distribution information. Energy and Environmental Analysis, Inc. came up with the study assumptions. Merrimack Energy Group generated the report, "An overview of the gas transportation capacity contracting practices of gas-fired electric power generators in new England."

Sources cited include:

- National Petroleum Council report "Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy"
- NE-ISO report "Steady-State Analysis of New England's Interstate Pipeline Delivery Capability"

- EEA July 2003 Base Case
- DOE reports on the Impact of Interruptible Natural Gas Service and Expansion and Changes in the Natural Gas Pipeline Network

Sources of supply are discussed, but supply is not assumed to be limiting during the study period. Projections of energy use and capacity are based on a synthesis of data from EEA, DOE's Energy Information Administration (EIA), and the FERC.

Below is a listing of key points by section/chapter:

New England Natural Gas Infrastructure – Section 3
- Study lists gas companies and their assets – source NGA, CERA and FERC staff
- Study lists recent and pending gas infrastructure/pipeline projects

Natural Gas Storage – Section 4
- No underground storage in NE so it relies on that of NY and PA
- Lists LNG and liquefied petroleum gas storage facilities
- Lists recent and pending storage projects

Adequacy Evaluation – Section 5
- quantifies the amount of interruptible sales and transportation contracts and evaluates their potential impact – source: EIA reporting on FERC form 423 contains information on the type of contracts used to purchase natural gas for utility and non-utility electric generation.
- evaluates effect of loss of 0, 60, and 100 percent of *gas-only* electric generation on New England's ability to meet its peak electric demand; also looked at loss of 10% of *total* electric generation
- January 2000 curtailment modeled – lower than usual temperatures increase demands on gas for heating
- Adequacy evaluation based on projected peak monthly demand and projected available import capacity

Strengthening the Natural Gas Infrastructure – Section 6
- New LNG import terminals – proposals are listed
- Further integration (linking) of existing pipeline systems – proposals are listed
- Satellite/peak shaving storage facilities

2) Natural Gas Market Assessment – August 2003, CEC Staff Report

Summary

The report uses the North American Regional Natural Gas (NARG) model to assess natural gas market trends, price and supply availability and infrastructure issues over the next decade (2003-2013). An assessment of the natural gas supply, demand, and price trends was conducted by integrating the Commission's electricity assessment as well.

Scenario analyses include assumptions and conditions from both natural gas and electricity markets. Policy recommendations are made.

CEC uses the North American Regional Natural Gas (NARG) Model as the principle tool to predict natural gas market fundamentals (demand, supply etc.) and generate the California border price forecast. Model inputs include estimates of resource availability, proved reserves and expected appreciation, production costs, pipeline capacity and transportation costs, regional demand projections, and other market fundamentals. The basecase scenario is derived from the above inputs assuming average hydroelectricity and weather conditions and well-functioning competitive markets. Scenarios were developed with alternative assumptions to test the impacts of varying conditions on price and supply availability and to investigate the inherent uncertainty in the natural gas market.

Below is a listing of key points by section/chapter:

Introduction – Chapter 1
The report covers:

- Evaluation of supply and demand balance over the short term and over a ten-year period
- Evaluation of the influences and impacts of storage operations and capacity in the seasonal market balance
- Evaluation of pipeline capacity, and assessment of regional infrastructure improvements on reliability
- Evaluation of natural gas demand from power generators in the state, and the impacts of the Western Electricity Coordinating Council (WECC) area-wide demand for natural gas on prices and availability in California
- Assessment of impacts resulting from changes in demand trends on natural gas prices and supply
- Evaluation of prices and supplies resulting from weather, economic, and regulation changes in the gas market.

Basecase – Chapter 2

- The chapter features information on current natural gas demand, supply, price, and infrastructure which provides the basis for the basecase forecast of natural gas price and supply availability - a 'business as usual' trend. The basecase assessment is done on annual average conditions for the various price and flows analyzed. Hence the basecase represents a long-term outlook and not short-term market conditions such as peaking demand condition, seasonal cycles and operation of storage facilities.

- **NARG model** - general equilibrium model that predicts the quantities and prices of natural gas needed to balance supply and demand throughout North America over a 45-year forecast horizon in five-year increments; model incorporates natural gas demand data from the contiguous United States, Alaska, Canada, and portions of Mexico. also incorporates information on resource availability, production costs, pipeline capacity, and pipeline transportation costs; latest version of model includes

20 demand regions, 18 north American supply regions and 4 LNG import locations on Atlantic and Gulf coasts; (see pages 5-10 for model details)
- Once projected natural gas demand and supplies are incorporated into the NARG model, the model solves for the equilibrium price and quantities consumed over the forecast period.

- **Demand** - data is from EIA Annual Energy Outlook 2002, with exceptions: CA data from CEC's California Energy Demand Forecast 2003-2013; CEC Electricity Analysis Office provided information on natural gas demand for electricity generation within WECC; and Canadian nat gas demand is based on 2001 data from the Canadian Energy Research Institute (CERI); see p11-15 for demand assumptions
- **Supply** – model forecast took into account recent pipeline additions
- **Environmental Implications** – surveyed environmental impacts of increasing supply

- **Price Forecast –** forecast of natural gas prices, includes 1) wellhead prices in North America, 2) prices for electricity generators in the WECC region, and 3) prices for customers of California's largest gas utilities
- natural gas prices for the end-user are a function of the wellhead price, the cost of gathering and conditioning the natural gas, the price of interstate pipeline transportation, and utility costs of distribution.
- Natural gas price forecasting requires the following three sequential analyses:
  - An analysis of likely supply and infrastructure, along with wellhead and border prices.
  - An analysis of differing market conditions that influence resource availability.
  - An analysis of sector-by-sector customer demands that influence delivery costs.

- **Infrastructure –** section explains the pipeline network that serves California and its capacity to serve anticipated demand. Analysis focuses on interstate pipelines that bring natural gas from the producing basins in U.S. & Canada.
- Report assesses the impact of increased demand due to adverse weather conditions on the need for additional interstate pipeline capacity, but only under annual average conditions. An analysis of the market under short term conditions, to capture seasonal variations, will be completed after 2003
- recommendations are made for infrastructure/pipeline expansion

- **Storage -** general description of California's natural gas storage system and its usage.

<u>Scenarios</u> – Chapter 3

Demand Scenarios

- Low hydro
- High economic growth
- Low economic growth
- High DSM – double efficiency spending
- Low DSM – no efficiency spending by utilities
- Nat gas use in transportation sector – 5% and 10% of nat gas use in state by 2020

Supply Scenarios
- Low gas supply (resources)
- LNG – looks at nat gas infrastructure impacts on California and neighboring states if proposed LNG facilities are constructed, and bring significant quantities of LNG to Western States.

Integrated price and supply scenarios
- Considers factors influencing both gas and electric markets
- 2 scenarios model a combination of factors including changes in: natural gas resource supply potential, LNG availability, natural gas demand projections and the availability of alternative fuels competing with natural gas

Implications and Policy Issues – Chapter 4
- report identifies long-term technical and policy issues that need to be resolved in areas of: demand, supply, infrastructure, prices and markets

3) Steady-State Analysis of New England's Interstate Pipeline Delivery Capability, 2001-2005 Phase I – January 2001, ISO NE

Summary
The report is a technical assessment of the delivery capability of New England's interstate natural gas pipeline infrastructure. The primary objectives of the study are:

- To evaluate the consolidated system capability on a winter Peak Day, a summer Peak Day, and winter 60-Day period when the expected demands of the region's gas utilities and merchant power producers are considered on a coincident basis;
- To identify "hot spots" in New England where bottlenecks or other system constraints hinder adequate flow to merchant generators;
- To consider a number of mitigation measures which have the potential to ameliorate potential threats to New England's energy security; and,
- To provide ISO-NE with the technical gas pipeline modeling capability which will allow continuous monitoring of dynamic developments in New England's gas and electric power markets.

A network model was developed from public operating and market data and discussions with regional gas companies. For the forecast period 2001-2005, two scenarios were formulated: a Reference Case representing expected gas utility and power demands, and a High Case representing a high demand scenario wherein merchant entry and conventional gas utility demand are increased. Gregg Engineering's proprietary WinFlow steady-state model was used to evaluate transport adequacy on winter and summer peak days and winter 60-day periods in 2001, 2003 and 2005. A number of contingency scenarios were also run including: the loss of a large gas-burning generator, the loss of Hydro-Québec facilities, as well as failures on key pipeline segments or compressor stations. The

availability of LNG supplies was considered throughout. Finally, recommendations were made on how to ensure the adequacy of the region's pipeline infrastructure.

Below is a listing of key points by section/chapter:

Structure of the Nat Gas Industry in NE – Section 1

- Historical perspective - Brief history of federal gas policy/regulation and effects on market
- NE Nat Gas Supply – where does the region's gas come from?; Data sources:
  - Gas Technology Institute, 2000 GRI Baseline Projection of U.S. Energy Supply and Demand to 2015, Natural Gas Supply June, 2000.
  - Natural Resources Canada, Canadian Natural Gas Review of 1999 & Outlook to 2010, May 2000.
  - National Petroleum Council, Meeting the Challenges of the Nation's Growing Natural Gas Demand, December 1999.
  - U.S. Energy Information Administration, Accelerated Depletion: Assessing Its Impacts on Domestic Oil and Natural Gas Prices and Production, July 2000.
  - National Energy Board, Canadian Energy, Supply and Demand to 2025, 1999.
  - Natural Resources Canada, Canadian Natural Gas, Review of 1999 & Outlook to 2010, May 2000.
- Array of interstate transportation and "BTU" services – cites specifics of contract for gas transport
- Scheduling Priorities During Congestion
- Pipeline flow dynamics into NE – which pipelines serve the area
- Recent regional pipeline projects
- LNG and peaking supplies – stats on imports and storage capacity

Demand for Nat Gas in NE – Section 2

- Approach on demand profiling - Formulation of the steady-state model of NE pipeline capability encompasses traditional LDC demand as well as natural gas for power production and industrial users.
- Electric power and gas loads are considered together by evaluating: 1) peak-day consumption in the winter when LDCs take 100% of their entitlements to serve regional gas demand; and 2) peak-day consumption in the summer when LDC demands are lower and merchant generators fire at full load to serve cooling load.
- Historical demand growth
- Annual gas demand forecasts:
  - Sources: WEFA's "Conventional Wisdom" forecast of residential, commercial and industrial gas consumption serves as the basis for LDC demand; "The Potential Demand for New Pipeline Capacity in the North Atlantic Gas Market" (Economics Resource Group); "The Northeast Heating Fuel Market: Assessment and Options" (EIA, May 2000)
  - Gas requirements forecasts across all gas-fired generation in New England were furnished by ISO-NE from a ProSym chronological production simulation of NEPOOL generation dispatch.

- Impact of gas price on future gas demand
- Impact of Increased Industrial Fuel-Switching on Future Gas Demand – source: "The Northeast Heating Fuel Market: Assessment and Options" (EIA, May 2000)

The Steady State Model – Section 3
- The consolidated steady state regional pipeline model was developed primarily from the individual interstate pipelines' most recent flow diagrams reflecting Peak Day Design gas flows.
- To model contingency scenarios, reference models for each pipeline as well as the consolidated network were developed and enabled researchers to prove the validity of the model under a known set of pressure and flow conditions. The reference models conform to each pipeline's pressure/flow conditions submitted to FERC in the Schedule G exhibits attached to the certificate filings. Annual pipeline Form 567s were also used. (see p39-41 for specifics of reference models)
- General model assumptions
- Source Data and Overview of Individual Pipelines Design - operational and ownership highlights of the individual pipelines are provided
- Steady state modeling results and system operational effects – listed for each scenario run

Mitigation Measures and Back-up Fuel – Section 4
- Potential Physical Reinforcements to Mitigate Constraints
- Air Permits and Back-up Fuel – possible levels of back-up fuel switching and issues with emissions permits
- Scheduling Protocols for Natural Gas and Electricity

Recommendations – Section 5
- recommendations regarding ISO-NE actions that should be taken to address the pipeline infrastructure reliability issues, drawn from the results of the steady-state modeling analysis

4) Steady-State and Transient Analysis of New England's Interstate Pipeline Delivery Capability, 2001-2005 Phase II – January 2002, ISO NE

Summary
This report is an update to the Phase I steady-state simulation model (above). This Phase II study accounts for noteworthy market developments. Transient-flow simulation analyses are conducted to assess the resiliency of New England's pipelines on an intra-day basis.

The Phase II study estimates the amount of gas-fired generation potentially at-risk given evolving market dynamics. Recent market developments include a higher level of gas-fired merchant generation occurring on a faster development track than were considered in Phase I, anticipated investment in new pipeline facilities, and restrictive pipeline tariff provisions. Compared to Phase I, an additional 3,215 MW of gas-fired generation in the

Reference Case and 963 MW in the High Case are considered. The scope of inquiry was broadened to evaluate intra-day (transient) operational effects under gas or electric contingency events, including the hypothetical loss of liquefied natural gas (LNG). Key objectives of the Phase II study include:

- updated assessment of New England's pipeline infrastructure adequacy in light of changes in the amount and timing of new gas-fired generation as well as proposed pipeline facility improvements;
- quantification of the amount of at-risk gas-fired generation;
- assessment of the resiliency of New England's pipelines under a postulated set of potentially disruptive gas or electric contingencies, including, conceivably, the loss of Distrigas;
- examination of the impact of various pipelines' restrictive hourly take requirements.

5) Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy – September 2003, NPC (Volumes I & II)

Summary
The National Petroleum Council is an industry group whose purpose is to advise, inform, and make recommendations to the Secretary of Energy on any matter, requested by the Secretary, relating to oil and natural gas or the oil and gas industries. In March 2002 Secretary Abraham requested a study of natural gas which examines the implications of new supplies, new technologies, new perceptions of risk, and other evolving market conditions that may affect the potential for natural gas demand, supplies, and delivery through 2025. The study was to provide insights on energy market dynamics, including price volatility and future fuel choice, and an outlook on the longer term sustainability of natural gas supplies.

In response, the Council formed a Committee on Natural Gas, a Coordinating Sub-Committee and three Task Groups with their own sub-groups:

Demand	**Supply**	**Transmission & Distribution**
Electric Power	Resource	Transmission
Industrial	Technology	Distribution
Commercial/Residential	LNG	Storage
Economics/Demographics	Arctic	
	Environmental/Regulatory	

Separately, an ad hoc financial team looked at capital requirements and capital formation while another team examined the issue of increased gas price volatility.

Computer modeling was employed to give quantified estimates of potential outcomes of natural gas demand, supply, price and investment over the study time horizon, with a particular emphasis on illustrating the impacts of policy choices on natural gas markets. Significant modeling and data support were obtained from outside contractors; and an

internal NPC study modeling team was established to take direct responsibility for some of the modeling work. The Coordinating Subcommittee and its Task Groups made all decisions on model input data and assumptions, directed or implemented appropriate modifications to model architecture, and reviewed all output. Energy and Environmental Analysis, Inc. (EEA) of Arlington, Virginia, supplied the principal energy market models used in this study, and supplemental analyses were conducted with models from Altos Management of Los Altos, California.

Two future scenarios were modeled. The Reactive Path scenario assumes continued conflict between natural gas supply and demand policies that support natural gas use, but tend to discourage supply development. This scenario results in continued tightness in supply and demand leading to higher natural gas prices and price volatility over the study period.

The Balanced Future scenario builds in the effects of supportive policies for supply development and allows greater flexibility in fuel-switching and fuel choice. This results in a more favorable balance between supply and demand, price projections more in line with alternate fuels, and lower prices for consumers.

In addition to the modeling results, the Council proffered advice on actions that can be taken by industry and Government to increase the productivity and efficiency of North American natural gas markets and to ensure adequate and reliable supplies of energy for consumers.

More detailed methodologies covered in Volume II by chapter and sub-part are presented below:

Chapter Three: Natural Gas Demand
Study Approach

- An assessment of historical and expected macroeconomic and demographic factors affecting the demand for natural gas.
- A detailed evaluation of installed and likely additions to future power generation capacity within the regions and sub-regions of the North American Electric Reliability Council, including the manner in which this capacity will likely be used. This analysis also assessed the recent, massive buildup in natural gas-based generation.
- An assessment of natural gas utilization in the most energy-intensive industries, including estimates of short-term demand elasticity and the potential for short and longer term demand destruction.
- An assessment of future trends for residential and commercial gas consumption.
- Assessments of the effects of energy efficiency and technology advancement on natural gas demand.

Industrial Demand

An accurate representation of the sector required a "bottom-up" approach to modeling for the NPC study. The model was developed to forecast U.S. industrial demand for 26 industries, 11 regions, and 4 end-use categories (boilers, process heat, feedstocks, and other) reflecting economic growth assumptions and a range of natural gas prices. Because of its size, complexity, and importance to gas-consumption trends, the modeling of the chemical industry was further disaggregated into ammonia, methanol, hydrogen, and other chemical industry products.

Residential and Commercial Demand

Electric Power Sector

The NPC evaluated electric power supply (capacity) and demand regionally using a model that solves for monthly electricity demand, power generation by type of fuel, generating capacity additions, and fuel use. New capacity builds were determined in a separate model using logic parameters provided by study participants. Wide ranges of potential generation technologies were considered whenever the model logic called for new capacity to be built. The study participants imposed some constraints on new builds fueled by coal and residual fuel oil, but the general approach was to allow economically rational choices to be made in both the Reactive Path and Balanced Future scenarios. Canada was modeled and analyzed, but with much less detail and rigor than the U.S. lower-48. The portions of Mexico that are interconnected at border regions were treated as interconnected net power transfers.

Nuclear and hydroelectric based generation quantities were input into the dispatch models as discrete exogenous values implying the models did not "dispatch" these units. Additionally, wind power was used as a proxy for all renewable technologies, but this decision was a simplifying assumption, not an endorsement of wind generation technologies over other renewable technologies.

The study approach was to model current laws and regulations in environmental emissions, siting, and ongoing operations. The power model used for the study does not allow discrete generation unit evaluation of environmental emissions, but each case, sensitivity and scenario output was evaluated to ascertain whether total calculated emissions met projected allowance budgets for sulfur dioxide (SO2) and NOx.

Chapter Four: Natural Gas Supply

Study Approach

- A comprehensive review of the North American gas resource base using the best publicly available data. This assessment included a thorough review of both conventional and nonconventional resources (including tight gas, coal bed methane, and shale gas). In order to gain a solid understanding of potentially commercial recoverable resources, the review also included a detailed assessment of drilling and development costs, and the likely number and size of future discoveries.

- A comprehensive review of the production performance history for the mature basins of North America. This was needed in order to gain an understanding of the future production decline rates of existing reserves, the likely response to future drilling, and the potential for growth in proved reserves from revisions and extensions to existing fields.
- An evaluation of the effect of the permitting process and access restrictions on development of indigenous resources.
- An assessment of the effect that technology advances might have on the cost and availability of gas resources.
- An assessment of the potential contribution from major new supply sources, such as imported liquefied natural gas (LNG) and Arctic gas.

Resource Assessment

Best practice teams were organized to formulate methodologies for reserve growth, new field (undiscovered) assessment, cost, etc. Next, workshops were held for the purpose of reaching industry consensus on the various assessment parameters for significant plays and basins. Subsequently, a further series of workshops was held to re-validate, or change, assessment parameters in response to information learned from the models used to develop long-term forecasts.

Many sources of public and commercial data were used. For the United States, data from the Minerals Management Service (MMS) and United States Geological Survey (USGS) comprised the baseline. For Canada, the Canadian Gas Potential Committee (CGPC) assessment was primarily used. For Mexico, a combination of IHS Energy Group (IHS) and USGS data were used. Production-performance and fieldsize data were derived from the Energy Information Administration (EIA), IHS, and NRG Associates (Nehring). Cost data were derived from the American Petroleum Institute (API) in the United States and the Petroleum Services Association of Canada (PSAC) in Canada.

Cost Methodology

Costs were needed for all aspects of onshore and offshore gas development – exploration and development drilling, production and lease facilities, and operations and maintenance. Where possible, public and commercial databases were used to estimate costs. Sources included, among others, the API Joint Association Survey on Drilling Costs, the PSAC Well Cost Studies, and the EIA Oil & Gas Lease Equipment and Operating Costs report. In areas where adequate public and commercial data were not available, costs were based on available information and circulated for review and comment to industry experts familiar with costs in that area.

Production Performance Analysis

Technology Improvements

Access Issues

LNG Imports

The inputs for the LNG cases were exogenous to the model, meaning the volume profile was hard coded and not determined by the model. This treatment is based on the assumption that most of the projected LNG imports will be long-term base-load volumes. Once the development decision is made for these capital-intensive projects, these volumes should not be affected to any great extent by daily or monthly fluctuations in prices. The exogenous inputs include terminal locations/nodes, volumes, and timing of imports. The following is a summary of the key model assumptions:

- Long-term prices support increased LNG imports
- New terminals sized for 750 MMCF/D base load
- New terminal expansions sized for 750 MMCF/D base load
- New terminal permitting time of 2 years
- New terminal construction time of 3 years
- Ramp-up rate of 3 years upon commencement of imports
- Existing U.S. LNG terminals supplied first, followed by their expansions, followed by new build terminals
- Location of new terminals driven by available downstream pipeline access and ease of permitting
- Timing of imports driven by supply availability, shipping, and new LNG import terminal development
- Limited shipping and LNG supplies available in the near term.

Arctic Developments

Comparison to Other Supply Outlooks

Chapter Five: Transmission, Distribution, and Storage Infrastructure
Study Approach

This analysis relied upon supply and demand data provided by the other Task Groups as well as data from the Energy Information Administration, the American Gas Association (AGA), the Interstate Natural Gas Association of America (INGAA), and other industry associations. NPC member companies also provided data. Early in the study, the T&D Task Group determined and set the major exogenous variables required for the analysis. Examples of these determinations included: selecting pipeline capacity expansions and newbuilds within the first five years; setting the "lag" or delay between a price signal and the construction of a required pipeline developed subsequent to the first five years; determining the cost differentials for construction (pipeline, storage, and distribution) by region; and estimating the amount of storage required for human needs (residential/small commercial) services.

With regard to the issues facing the T&D Task Group, EEA's Gas Market Data and Forecasting System model makes economically justified decisions to route natural gas, expand pipeline capacities, and construct new storage facilities. The modeling software consists of a complex nodal (physical flow) structure, which is fundamentally based on unit pricing concepts. Decisions to flow gas through existing facilities and/or decisions to

build pipelines between nodes, add incremental storage facilities, build additional facilities at the citygate, etc., are "calculated" in the model on a year-by-year basis. The network used in the model incorporates 115 supply/demand nodes and 317 transportation corridors . The model will always attempt to use existing facilities to their maximum, while at the same time looking for pricing signals that would support facilities expansion either to existing facilities or with greenfield projects.

Transmission

Distribution

Storage

Chapter Six: Mexico Supply/Demand Outlook

Chapter Seven: Natural Gas Markets

Market-Related Issues

Natural Gas Price Volatility

Chapter Eight: Capital Requirements

Chapter Nine: Sensitivity Analysis

Chapter Ten: Modeling Methodologies - see Volume II p. 311-315

The EEA Models
- Gas Market Data and Forecasting System
- Hydrocarbon Supply Model

The Altos Models
- The NARG Model
- The NARE Model
- Modeling Methodology
  - Resources and Supply
  - Pipelines
  - Demand

6) Washington Natural Gas Report – Spring 2004, WA CTED

Summary

The Washington assessment is based on figures and forecasts generated by others on reserves, production, supply and demand forecasts, prices, and pipeline and storage capacity. Each of these topic areas have their own section in the report and are discussed below:

Reserves - Section 2

Total resource base is the sum of proved reserves and potential gas resources (resources determined to be technically and economically recoverable plus estimated resources thought to exist and be technically recoverable). The WA study relies on total resource base estimates from NPC (Balancing Natural Gas Policy - September 2003) and EIA (Annual Energy Review – 2001).

Commercial resource base is the amount of the total resource base that can be brought to market at a specified price given a certain set of technological assumptions. The WA study relies on estimates of the commercial resource base from the NPC (Balancing Natural Gas Policy - September 2003) and the CEC (Natural Gas Market Assessment – August 2003)

Production - Section 3

U.S. production figures came from EIA and NPC (Balancing Natural Gas Policy - September 2003).

Canadian production figures were provided by: Cambridge Energy Research Associates, Statistics Canada, Canadian Energy Research Institute, EIA's 2001 Supply-Demand Report and Annual Energy Outlook 2003, the National Energy Board (NEB), Canadian Gas Potential Committee (CGPC), Alberta Energy and Utility Board (AEUB), and an analyst from Lehman Brothers.

Rocky Mountain production figures came from EIA (Annual Energy Outlook 2003) and NPC.

Gulf of Mexico production figures were derived from the testimony of Dr. Michelle Michot-Foss before the House Energy Committee, 2003.

Mexican production figures came from Alexander's Gas & Oil Connections.

Alaskan production figures are from NPC and Minerals Management Service of the U.S. Department of the Interior.

LNG import figures and forecasts are from the Gas Potential Committee, EIA (International Energy Outlook 2003, O&GJ 2003, and 2003 Mid-term Report), NPC (Natural Gas Policy - September 2003)

Supply & Demand Forecasts - Section 4

Short term supply & demand forecasts – EIA, Lehman Bros. quarterly on gas producers

Long term supply & demand forecasts – WA study reviewed and cited:

1. National Petroleum Council (1999): Natural Gas – Meeting the Challenges of the Nation's Growing Natural Gas Demand.
2. Energy Information Administration (2001): US Natural Gas Markets – Mid-term Prospects for Natural Gas.
3. California Energy Commission (2003): Preliminary Natural Gas Market Assessment.
4. National Petroleum Council (2003): Balancing Natural Gas Policy - Fueling the Demands of a Growing Economy.
5. Energy Information Administration (2004): Annual Energy Outlook 2004

Demand forecast for Pacific NW – CEC (Natural Gas Market Assessment 2003)

Prices – Section 5

Components of Natural gas prices – CEC 2003

Recent Price Volatility – EIA Short Term Energy Outlook 2003 and Historical Storage Data

Key Drivers of price volatility and mitigating factors

Demand Destruction

Near term and long term price forecasts – Northwest Power and Conservation Council Fuel Price Forecast in Fifth Power Plan, NPC & EIA

Pipeline & Storage Capability – Section 6

Information primarily came from a survey conducted by OTED. Companies were asked to provide information about the impact of new pipelines on its business, the ratio of gas from Canada versus the Rocky Mountains, major receipt points, largest shippers, capacity utilization, constraints, expansion plans, permitting process, storage and long-term plans.

The pipeline companies serving the NW and Canada include: Northwest Pipeline Corporation, National Energy & Gas' Gas transmission Northwest Corporation, and Duke Energy Gas Transmission. Each of the companies was profiled according to:

Background on the system
Customers
Operation and capacity of system
Constraints
Recent pipeline and storage capacity changes
Planned Pipeline expansions

NW Storage facilities were also given separate treatment