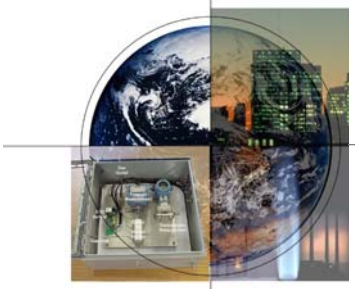
SECTION 2.0

Plenary Session: Presentations

This section provides the presentations given by DOE/NETL Product and Project Managers in the workshop's plenary session. These presentations provide an overview the gas storage technology areas, partnership approaches, and successes. In addition, there were five presentations by industry executives that provide a variety of perspectives on the future demand and requirements for natural gas storage. Please note that one of the industry speakers did not use any slides, so his presentation cannot be duplicated herein.

National Energy Technology Laboratory
Strategic Center for Natural Gas

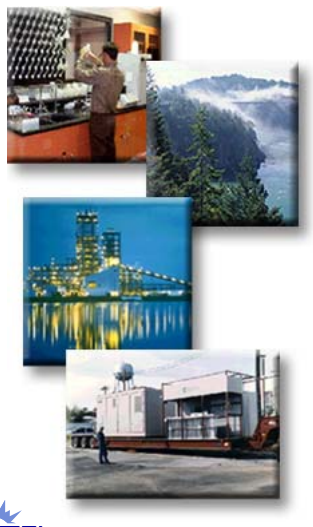


Natural Gas Storage R&D Planning Workshop

Hyatt Regency
Pittsburgh, PA
November 29, 2001

Brad Tomer, Product Manager
Gas Exploration, Production & Storage

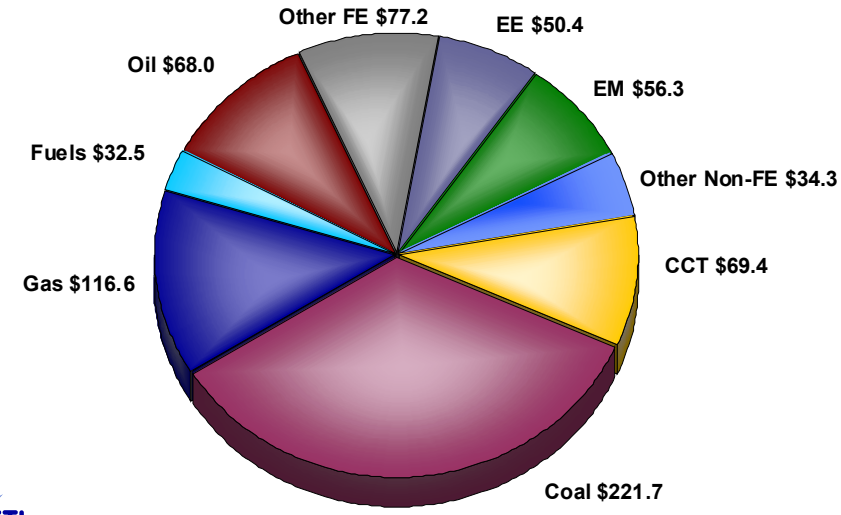
NETL



- One of DOE's 15 national laboratories
- Government owned and operated
- Sites in Oklahoma, Pennsylvania, West Virginia
- 1150 federal and support contractor employees
- Primary focus is managing external Fossil Energy R&D

NETL FY01 BUDGET

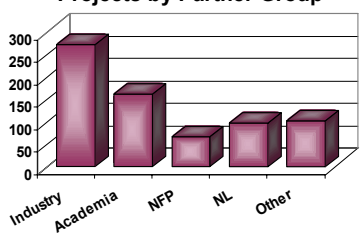
($726.6 Million)



Shape, Fund, and Manage Extramural RD&D

- **Over 800 research activities in all 50 states and 16 countries**
- **Total award value of $7.3 billion**
- **Research performers include:**
  - Private industry
  - Universities/colleges
  - Not-for-profit labs
  - Other DOE national labs
  - Others
- **Private sector cost sharing of $3.9 billion**
  - Leverages DOE funding
  - Ensures relevance
  - Mission accomplishment only through commercialization
- **55 active MOU's and MOA's**

Projects by Partner Group



2K-2345 BJT 12/00

Strategic Center for Natural Gas

Five RD&D Activity Clusters

Strategic Center for Natural Gas
Borehole to Burner Tip

Electric Power Using Coal
Mining to Light Switch

Energy Policy Support
A Key Issue in Use of Fossil Energy

NETL

Environmental Quality/ Defense Programs
Supporting the DOE Complex

Oil Supply **Fuels**
Supply and Delivery of Clean Fuels for Transportation/Other End Use Sectors

NETL

2K-2345 BJT 12/00

Strategic Center for Natural Gas

Strategic Center for Natural Gas

Vision:

By 2020, U.S. public is enjoying benefits from an increase in gas use:

- Affordable supply
- Reliable delivery
- Environmental protection

Mission:

Be the focal point for an integrated gas program:

- Spearhead annual DOE-wide gas RD&D planning and program assessment
- Shape, fund, and manage extramural RD&D
- Provide science and technology advances through NETL's on-site programs
- Conduct studies to support policy development

NETL

2K-2345 BJT 12/00

Strategic Center for Natural Gas

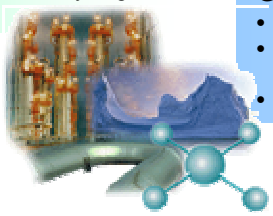
SCNG's Technology Portfolio

Borehole to Burner Tip

Next Generation Gas Turbines for Large Industries / Utilities
- Flexible 30-300 MW turbine systems
- RAM improvements
- Supporting R&D

Distributed Generation
- PAFC - entering commercial market
- MCFC - high efficiency
- SOFC/SECA - low cost
- Hybrid turbine/fuel cell - ultimate efficiency
- Reciprocating engines - lowest cost

Gas Infrastructure Reliability
- Enhance pipeline safety and reliability
- Increase gas deliverability
- Increase operational flexibility of gas storage facilities



Gas Exploration & Production
- Resource and reserve assessments
- Improved diagnostic, imaging, drilling and completion technologies
- Hydrates, deep gas, off-shore

NETL

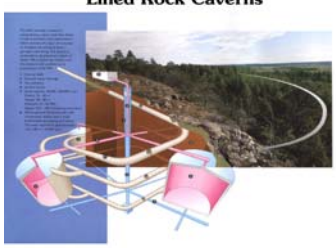
2K-2345 BJT 12/00

Strategic Center for Natural Gas

Gas Storage Technology Areas

- **Conventional Storage Reservoirs**
  - Deliverability enhancement
  - Gas measurement
  - Reservoir management
- **Advanced Storage Concepts**
  - Lined Rock Caverns
  - Hydrates
  - Salt Caverns
  - Basalt Aquifers

Lined Rock Caverns



NETL

2K-2345 BJT 12/00

Strategic Center for Natural Gas

Gas Storage R&D Planning Workshop

- **Purpose**
  - Obtain industry perspective
  - Identify key barriers & R&D opportunities
  - Develop collaborative R&D action plan for next 2-5, 5-10, 10-15 yrs
- **Breakout Sessions**
  - Conventional A&B: Deliverability enhancement, reservoir & facility mgmt, inventory control from aquifers, depleted oil & gas reservoirs, salt caverns
  - Power/Distributed Generation: Gas storage to meet electric generation needs including alternative storage technologies
- **R&D Challenge**
  - Meet industry needs -Collaborative in nature
  - System mindset -Product focused

NETL

2K-2345 BJT 12/00

Strategic Center for Natural Gas

Options for Continued Industry Participation

- **Advisory Panel**
  - Hydrates program
- **Roadmapping**
  - Infrastructure, hydrates, and many others
- **Cooperative Agreements**
  - Joint industry projects, individual firms, etc.
- **Industry-Driven Consortium**
  - Advanced turbines, carbon products, SWC
- **National laboratory partnership**
  - NGOTP, hydrates, ultra-clean fuels

NETL

2K-2345 BJT 12/00

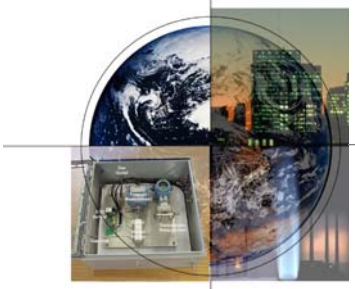
Strategic Center for Natural Gas

Internet Location: **netl.doe.gov/scng/index.html**

Natural Gas Storage R&D Planning Workshop

Thank You For Participating

Natural Gas Storage R&D Program



Natural Gas Storage Workshop

November 29, 2001

James R. Ammer, Project Manager
Gas Supply Projects Division

Future Needs for Storage

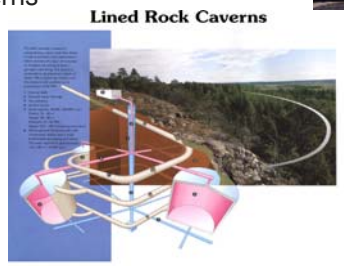
- **1999 NPC Study predicts that by 2015**
  - 38,000 miles of new transmission line
  - 263,000 miles of distribution mains
  - 0.8 Tcf of new working gas storage capacity
- **Tremendous growth in electric generation**
  - larger off-peak swing loads
  - peak-day requirements will increase from 111 Bcf/d to 152 Bcf/d
- **Growth in areas without conventional storage**
  - Northeast
  - South Atlantic

National Petroleum Council, Dec 1999

Strategic Center for Natural Gas

Gas Storage Technology Areas

- **Conventional Storage Reservoirs**
  - Deliverability enhancement
  - Gas measurement
  - Reservoir management
- **Advanced Storage Concepts**
  - Lined Rock Caverns
  - Hydrates
  - Salt Caverns
  - Basalt Aquifers



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Strategic Center for Natural Gas

Partnership Approach

- **R&D conducted with various partners**
  - Industry (Bay Gas Storage,Furness-Newburge)
  - Other research organizations (Gas Technology Institute, Southwest Research Institute)
  - National labs, universities and industry associations
- **Cost shared projects are common**
  - Field tests (National Fuel Gas, Kinder Morgan, NiGas)
  - Development of technologies (Baker Atlas)
- **Technology transfer**
  - Cooperative agreements with commercializing partner
  - Successful field demonstrations
  - Petroleum Technology Transfer Council

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Strategic Center for Natural Gas

Conventional Storage Reservoirs

Deliverability Enhancement

Deliverability RD&D Timeline

- **1993 GRI - Maurer study set stage**
  - 5% annual deliverability decline; $60 million to $100 million remediation costs
- **GRI/DOE co-funded Halliburton project completed in 1998 identified major damage mechanisms**
- **DOE/GRI co-funded project completed in 1999 introduced novel stimulation treatments**
  - 29 treatments conducted in 8 fields
  - documented water sensitivity and candidate selection
- **DOE research investigating new remedial technologies**
  - sonic tool for scale removal
  - carbon dioxide treatments for HOPS damage

Strategic Center for Natural Gas

Conventional Storage Reservoirs

Gas Measurement

Energy Meter Retrofit Module Prototype

- Low cost retrofit module
- Inferential approach uses gas properties
- Transmission tariff gas
- Accuracy equivalent to gas chromatograph
- Use with any flow meter

Strategic Center for Natural Gas

Energy Meter Retrofit Module Prototype
Status

- **Developed algorithm for energy meter**
  - extended diluent concentrations to 20%
- **Designed and constructed prototype module**
- **Conducted initial testing at MRF**
- **Complete refinement in 2001**
- **Complete MRF and field testing by 2002**
- **Desired accuracy - 1 Btu**
- **Pursue commercialization**

Strategic Center for Natural Gas

Conventional Storage Reservoirs

Reservoir Management

DOE Simulation Studies

- **Demonstrate the importance of geologic modeling and reservoir simulation for improved storage efficiency with an emphasis on horizontal wells**
- **Initiated in 1992**
  - no horizontal wells in storage (reported)
  - little to no use of simulation
- **Today**
  - >40 horizontal well
  - mix of simulation use
- **Published 3 SPE papers, 2 DOE reports**

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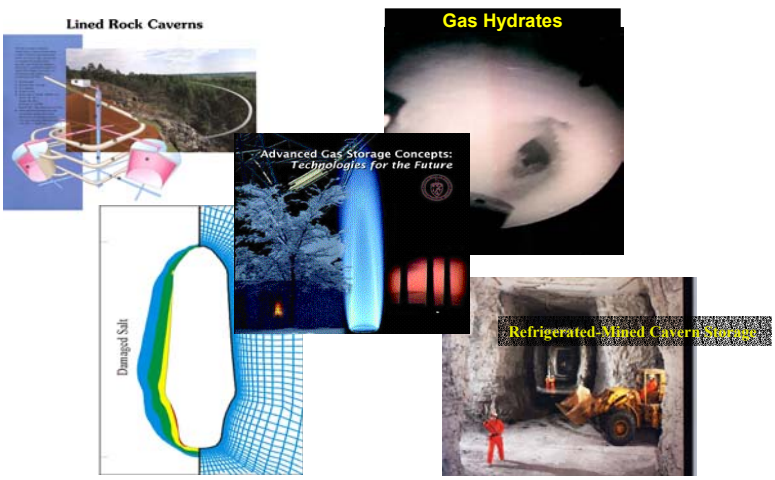
Advanced Storage Concepts



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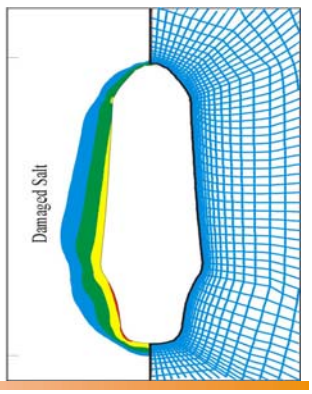
Strategic Center for Natural Gas

Strategic Center for Natural Gas

Advanced Design For Salt Caverns Proof-of-Concept

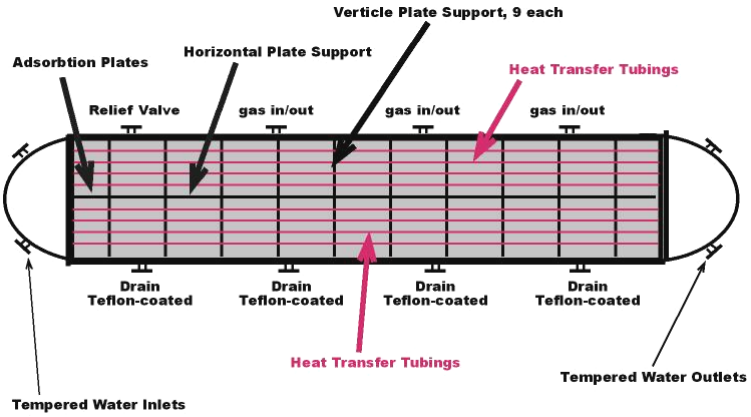
- Field-scale application of advanced design criteria
- Existing and new salt storage cavern
- McIntosh Salt Dome
- Mobile, Alabama
- RESPEC
- Bay Gas Storage Company



Strategic Center for Natural Gas

Hydrate Gas Storage - Scale Up

- Initial testing conducted in 39 cc cell
- New work will scale to 20 gallon tank



Strategic Center for Natural Gas

LRC Design Review

- **Technical review of Lined Rock Cavern concept and design methodology**
  - Independent review
  - Itasca Consulting Group, Inc.
- ***Mechanical Response of Rock Mass*** **completed September 2001**
- ***Steel Lining: Fatigue and Crack Growth*** **to be completed by June 2002**

Strategic Center for Natural Gas

Gas Storage in Basalt Aquifers
Columbia River Basalts

- **Columbia Basin spans 63,000 sq. mi**
  - nearly 13,000 ft of layered Miocene lava flows
  - individual flows covering over 27,000 sq. mi
- **Regional aquifers are confined between lava flows**
- **Flow tops are vesicular and very porous**
- **Anticlinal structures provide excellent targets for gas storage**

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Strategic Center for Natural Gas

Basalt Characterization

- **Drilled the 100 Circles # 1 Well July 1999**
  - drill samples collected and analyzed
  - geophysical logs run
- **Drilled second borehole**
  - Approximately 150 feet from 100 Circles #1 Well
  - Conducted well to well flow tests
- **Acquired and processed 2-D seismic**
  - structural closure and areal extent
- **Hydrologic testing and groundwater chemistry**
- **Final Report and data sets due June 2002**

NETL

Strategic Center for Natural Gas

Successes

- **Deliverability Enhancement**
  - Introduced novel stimulation technologies
  - Developed a prototype Sonic Tool for scale removal
- **Advanced Storage**
  - Completed feasibility study of 4 advanced concepts
  - Completed design review for LRC: *Mechanical Response of Rock Mass*
- **Gas Measurement**
  - Developed energy meter algorithms, initiated testing, commercialization likely
- **Reservoir Management**
  - Published 3 SPE papers, 2 DOE reports

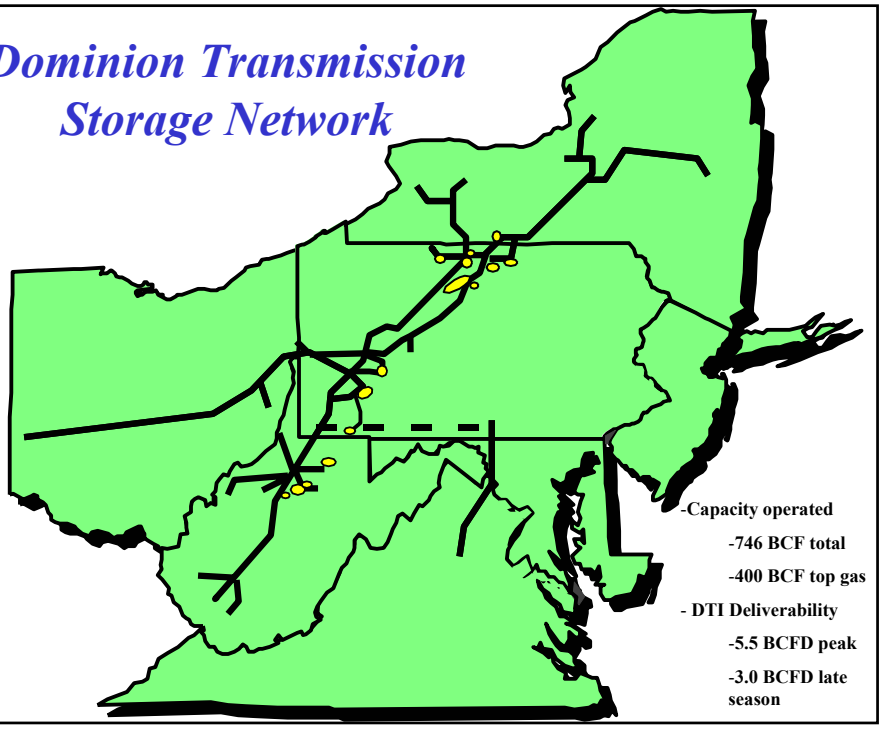
Strategic Center for Natural Gas

Department of Energy Natural Gas Storage R&D Workshop

Dominion Transmission
Gary L. Sypolt
Sr. Vice President
November 29, 2001

Dominion
It all starts here:

Dominion Transmission Storage Network



Dominion Transmission Storage Stats

- Total wells 1508
- Average depths 1400 ft-7000 ft
- Reservoir Pressures 500psi-4200psi
- Storage HP 207,265

Perspectives of Future Gas Storage needs within the Industry

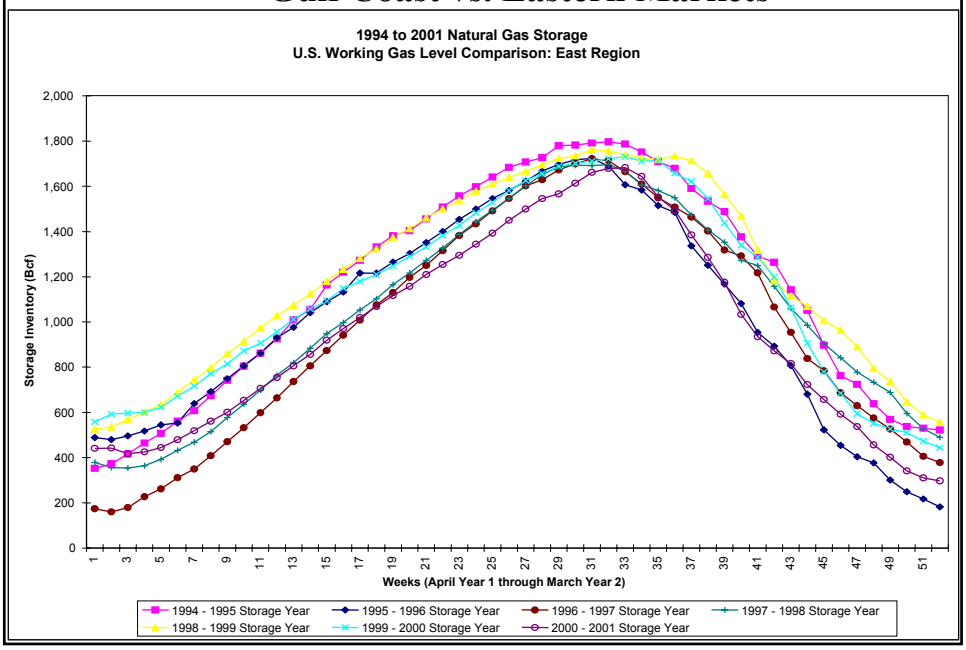
Perspectives of the future are shaped by knowledge of ***what's worked in the past*** connected to the ***creative possibility of the future*** and tempered with the realities of the ***competitive options in the marketplace***.

DOE Workshop Issue

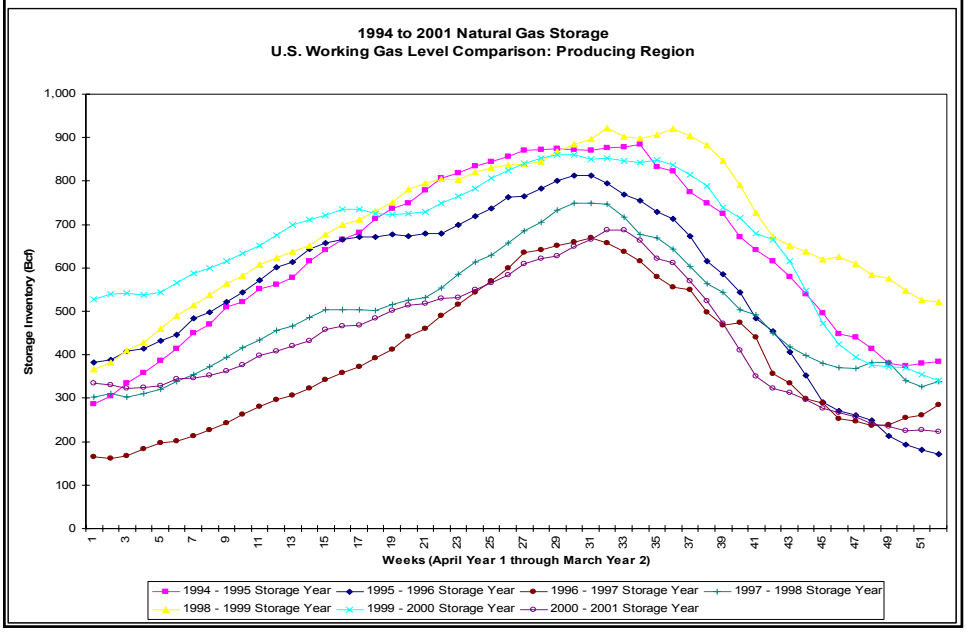
Is the the existing natural gas storage infrastructure adequate to meet current needs?

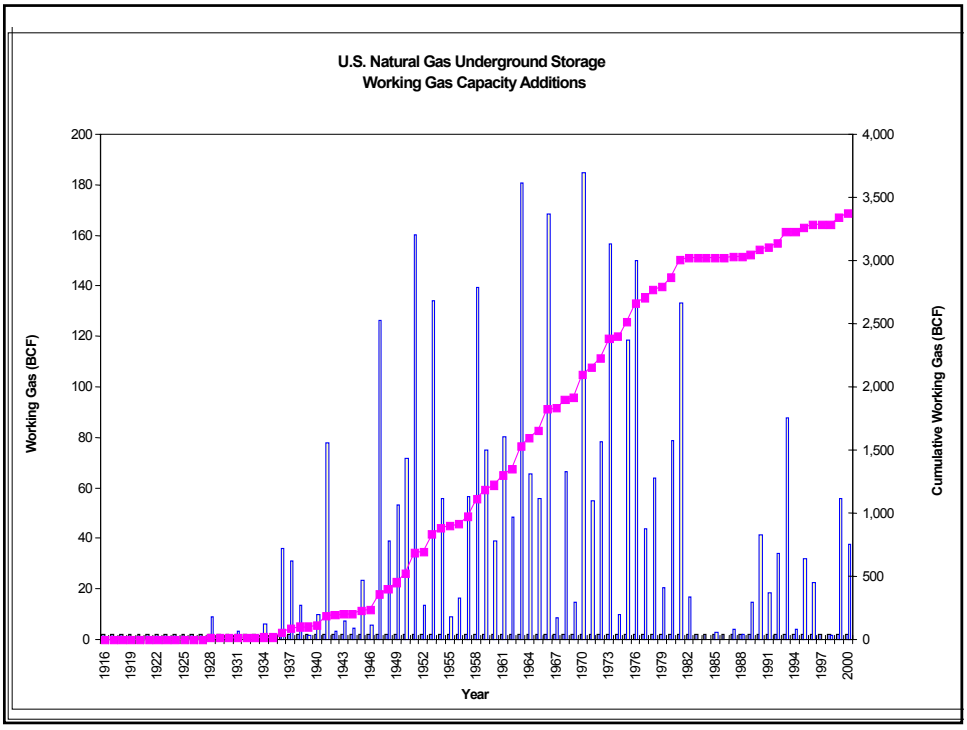
Dominion
It all starts here:

Gas Storage Utilization within the Industry
Gulf Coast vs. Eastern Markets



Gas Storage Utilization within the Industry
Gulf Coast vs. Eastern Markets





Gas Storage Infrastructure

- **In total**
  - **444 storage projects**
  - **3.4 TCF capacity**
  - **82 BCF / day**
- **Since 1990**
  - **55 storage projects**
  - **440 BCF capacity (13%)**
  - **16.6 BCF / day (20%)**

DOE Workshop Issue

What market and technology trends are likely to change storage needs over the next ten years?

Market Trends
Dominion's View

- Market demands more flexibility in storage service
  - Asset managers
  - Marketing companies
  - LDC unbundling (shifting)
- Power Generation market will grow and will require gas storage for load balancing
- Clean air regulations will force fuel conversion creating more storage opportunities

Dominion
It all starts here:

Market Trends
Dominion's View

- Storage development activity will be driven by cost
- Customers continue to look at locational value of storage
  - alternative to holding firm transportation on long line pipelines from Supply area
  - Total delivered price is what matters
- Gas Storage further promotes the liquidity
  - Gulf Coast
  - Eastern Market
- Storage will help all customers capture value created by volatility in gas prices

Dominion
It all starts here:

Technology Trends
Dominion's View

- Storage developers will look to technology to help improve deliverability
  - Reengineering of reservoir storage
    - Existing
    - New
  - Salt storage
  - Mined storage
  - LNG
- Storage operators and developers will look to technology
  - Reduce operating costs
  - Maintain integrity of the infrastructure
  - Reduce storage gas loss

Potential Barrier

Cost to develop and operate

Potential Barrier

Regulation (uncertainty of Local, State and Federal)

Potential Barrier

Cost effective transportation capacity to market

Potential Barrier

Did I mention cost to develop and operate

Natural Gas Storage: Opportunities and Challenges

Rick Daniel
President, AEC Storage and Hub Services Inc.
for U.S Dept. of Energy workshop, Nov.29, 2001

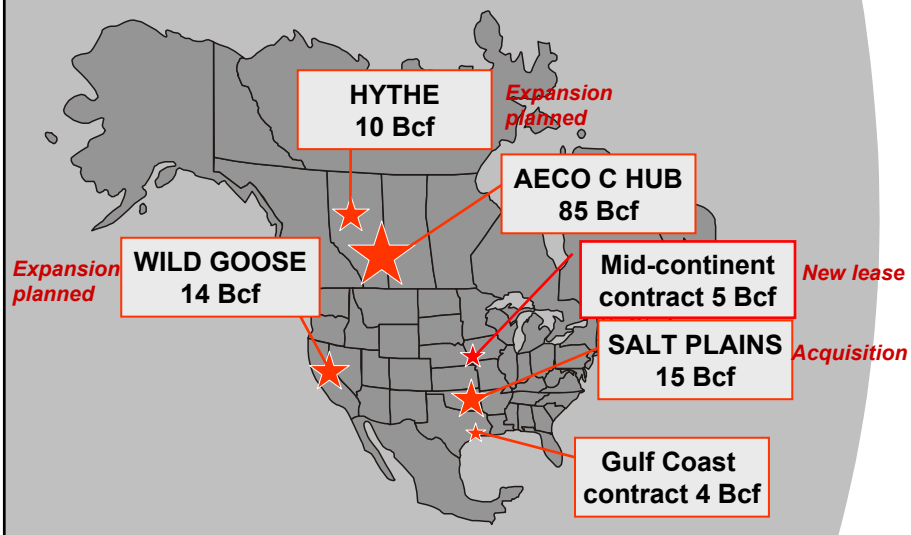
GROWTH VALUE PERFORMANCE

AEC Storage and Hub Services

- Business unit of Alberta Energy Company Ltd.
  - Largest producer of Canadian natural gas
  - Among the largest North American independents
    - 1.4-1.5 Bcf/day in 2001
- Committed to growth in independent gas storage business, through development, expansion, acquisition and contracting:
  - own and operate 124 Bcf WGV
  - 9 Bcf of contracted capacity

GROWTH VALUE PERFORMANCE

AEC Storage and Hub Services



GROWTH VALUE PERFORMANCE

Opportunities and Hurdles for Storage Developers

Opportunities:

- Tight supply, price volatility increases storage value
- Gas-fired power gen needs storage for reliability, flexibility
- Growing gas market
  - storage can be alternative to overbuilt pipeline system

Hurdles:

- Volatile cushion gas costs, fuel costs
- Most storage services still too highly regulated
- Urban sprawl, NIMBY issues

GROWTH VALUE PERFORMANCE

How Much New Capacity is Required?

- NPC study of market growth 1998-2015:

U.S. gas consumption +42% (22 Tcf to 31.3)

↓

Peak day demand +37% (111 Bcf to 152 Bcf)

↓

Storage capacity +25% (3.2 Tcf to 4 Tcf)

Actual storage needs difficult to forecast:

- competes with DSM, fuel switching, in meeting peak demand

GROWTH VALUE PERFORMANCE

Where will new storage capacity come from?

Probable economic ranking of opportunities:

- Optimization of existing facilities
  - commercial
  - technical
- Expansion of existing facilities
  - new pools, caverns
- Storage substitution: replace existing, inefficient facilities, with new capacity in same market
- New, incremental facilities

GROWTH VALUE PERFORMANCE

Salt Caverns or Reservoirs?

- Perception that salt caverns can best meet the needs of the market:
  - high deliverability
  - low ratio of cushion gas to working gas
- Reservoir storage developed with current upstream technology can provide similar service at lower cost:
  - identification of high quality reservoirs
  - horizontal wells
  - 3D seismic
  - reservoir, facility optimization

GROWTH VALUE PERFORMANCE

Too Much Capital Tied Up in Cushion Gas

- Ratio of Cushion Gas to Working Gas:
  - Salt Cavern facilities 0.37
  - AEC's reservoir storage 0.36
  - All other US storage 1.10
- Over 4 Tcf of cushion gas in older reservoir, acquifer facilities
- Opportunities:
  - blow down, replace with more efficient facilities
  - re-develop with modern upstream technologies

GROWTH VALUE PERFORMANCE

Further De-regulation of Utility Storage Required

- Owners of utility storage assets need incentives to optimize
- Utility shareholders must benefit from:
  - a) innovative services that more fully utilize existing capacity
  - b) technical optimization of capacity
  - c) reduction of cushion gas
- More timely regulatory processes
- Alternative: divestment of storage assets, contracting for storage services

AEC

GROWTH VALUE PERFORMANCE

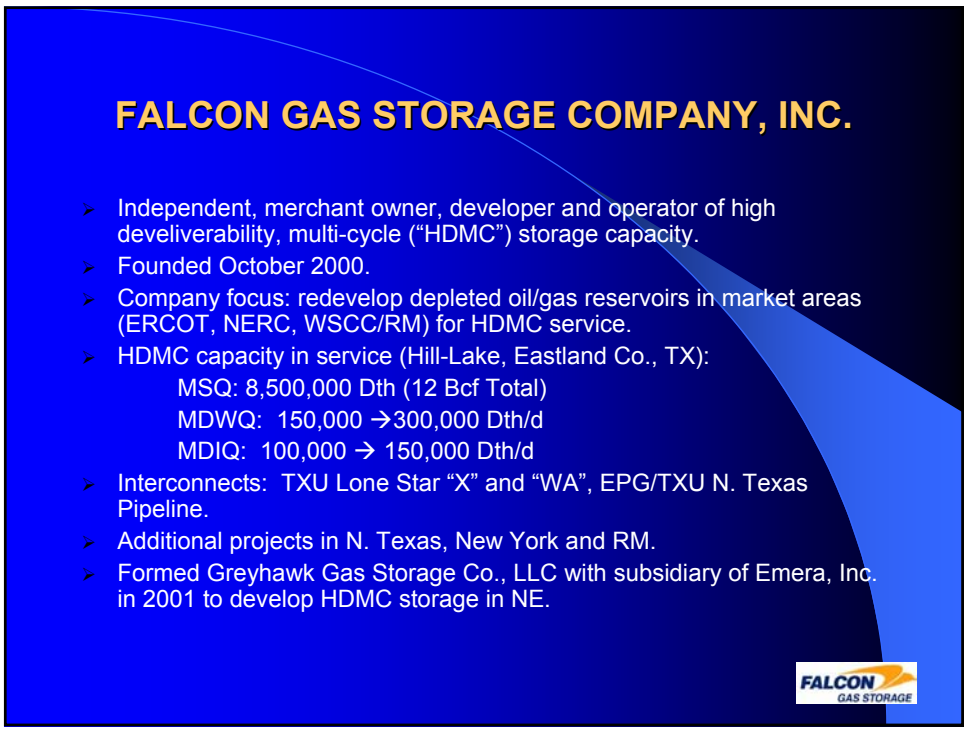
Gas Storage Development Conclusions

- Storage values increasing, but few new projects
- High M&A activity in independent storage
- Storage development increasingly a 'technology' play
  - no "low hanging fruit"
- Storage 're-development' has potential
- Over-regulation discouraging investment, rationalization of capacity
- Capacity additions likely to lag demand

AEC

GROWTH VALUE PERFORMANCE


FALCON
GAS STORAGE
Perspective on the Future of the US Natural Gas Storage Market
Presented to:
U.S. Department of Energy
National Energy Technology Laboratory
Natural Gas Storage R&D Workshop
Pittsburg, PA
November 29, 2001


FALCON GAS STORAGE COMPANY, INC.
Independent, merchant owner, developer and operator of high deliverability, multi-cycle ("HDMC") storage capacity.
Founded October 2000.
Company focus: redevelop depleted oil/gas reservoirs in market areas (ERCOT, NERC, WSCC/RM) for HDMC service.
HDMC capacity in service (Hill-Lake, Eastland Co., TX):
MSQ: 8,500,000 Dth (12 Bcf Total)
MDWQ: 150,000 →300,000 Dth/d
MDIQ: 100,000 → 150,000 Dth/d
Interconnects: TXU Lone Star "X" and "WA", EPG/TXU N. Texas Pipeline.
Additional projects in N. Texas, New York and RM.
Formed Greyhawk Gas Storage Co., LLC with subsidiary of Emera, Inc. in 2001 to develop HDMC storage in NE.
FALCON
GAS STORAGE

Trends Impacting US Gas Storage

- Growth in GFEG → incremental load profile will be "spikier" at the margin.
- Domestic reserve replacement slowing . . .
- Growing Canadian imports → shifting "null points".
- Mismatch in incremental supply and demand volatility → increased price volatility at the margin.
- Tightness in midstream capacity → higher weather sensitivity.
- Daily balancing → deliverability and injection vs. working gas.
- EFM and similar technology → ability to match gas and power dispatch more closely (but can the reservoirs respond?).
- Consolidation of mid-stream asset ownership → lower cost of capital, but less customer choice (?)
- Lots of announcements, not many projects.

FALCON GAS STORAGE

Market Needs

- **Needs vary significantly within market segments.**
  - LDCs, Marketers, Pipelines, Power Gen, Producers
- **More withdrawal capacity needed for peak hours.**
  - Human needs, arbitrage, pipeline balancing, power dispatch.
- **More injection capacity needed for off-peak hours.**
  - Dispatch at a loss or shut down?
- **Proximity to market area.**
  - Balancing pressure swings vs. locational optionality.
- **Cost vs. Utilization** (HDMC reservoir vs. Salt).
  - What's optimal? For whom?
  - 4x – 6x in the market area offers optimum capacity for diverse needs (seasonal, arbitrage and balancing).

FALCON GAS STORAGE

Existing Barriers to Development

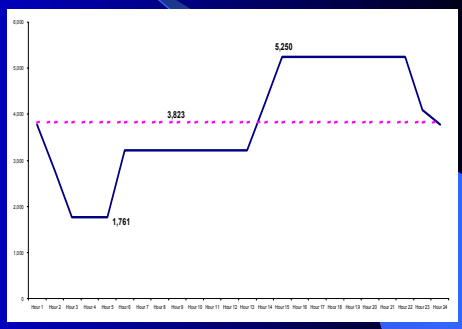
- **Market Apathy, Uncertainty:**
  - "It's worked so far."
  - Market's sense of urgency related to last season's weather.
  - Lack of GFEG interest (background, economy, "free swing").
  - Cost center vs. profit center mentality.
  - Contract terms (short vs. long, fixed vs. variable).
  - Shifting null points on the grid.
  - Regulatory uncertainty.
- **Constraints on new supply:**
  - Scarce, finite supply of suitable reservoirs.
  - Profit center vs. cost center mentality ("Show me the money").
  - Lack of risk capital.
  - Low asset turnover.
  - NIMBY political power.
- **Result**: Expansions vs. New Projects.

FALCON GAS STORAGE

New GFEG Demand

What the incremental customer is asking for. . .

- Expected Load Profile: 5 x 16.
- 750 MW @ 7,000 heat rate = 5,250 Dth/hour.
- Base load supply @ 3,823 Dth/hour.
- Seeks intra-day (hourly) balancing.
- Pipeline unable to provide firm balancing – charging penalties for interruptible service.
- "How much do I need ??"
- "How much does that cost?"



FALCON GAS STORAGE

Capacity Math

Question: How much optionality desired?
(daily, monthly, seasonal)

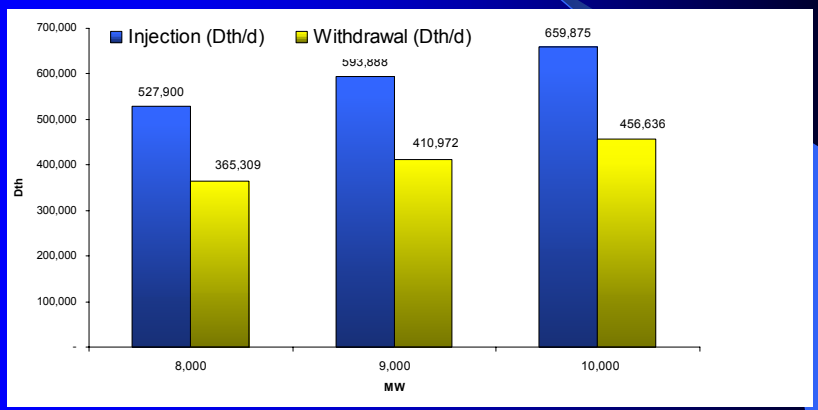
MDIQ = (Hourly Baseload – Minimum Hourly Burn) x 24
MDWQ = (Max Hourly Burn – Hourly Baseload) x 24
MinSQ = Sum of injection (or withdrawal) over 24 hr period.

- Desired ratio of injection and withdrawal to working gas is extremely high.
- Customer sees little incentive to carry "extra" inventory.
- Fuel managers may have different incentives.

FALCON GAS STORAGE

Example Market in Texas

8,000 - 10,000 Incremental MW Growth @ 7,000 Heat Rate



FALCON GAS STORAGE

How much does that cost?

- 9,000 new GFEG MWs @ 7,000 heat rate.
- Injection/withdrawal capacity required:
  - MDIQ: 600,000 Dth/d
  - MDWQ: 400,000 Dth/d
  - MSQ: ???
- @ $300 - 400/Dth/d = Capital Investment of $120 - 240 MM (does not include the cost of capital).
- Note: Assumes suitable reservoirs are available close to relevant pipelines exist.

FALCON GAS STORAGE

Summary

Conclusions:

- Latent demand for storage cycling capacity is growing.
- Latent demand is being masked by transient conditions.
- Uncertainty, lack of incentives, regulation and Mother Nature will restrain new development of injection and deliverability as long as demand remains latent.
- Required investment is very large and will be a surprise to many.

Open Questions:

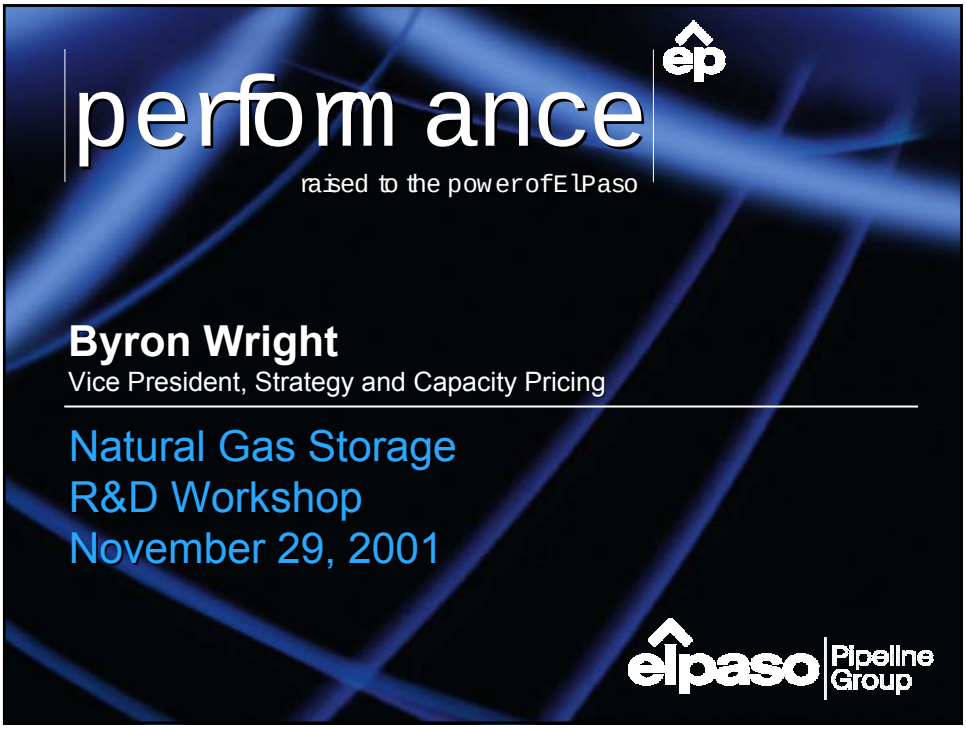
- Supply and Demand *will* balance, but at what price?
- When does capital begin to flow into the storage segment and at what cost?
- How will the risks of high fixed costs be allocated among developers, operators and customers?
- Who has better ability to lower the risk/cost of capital?

FALCON GAS STORAGE

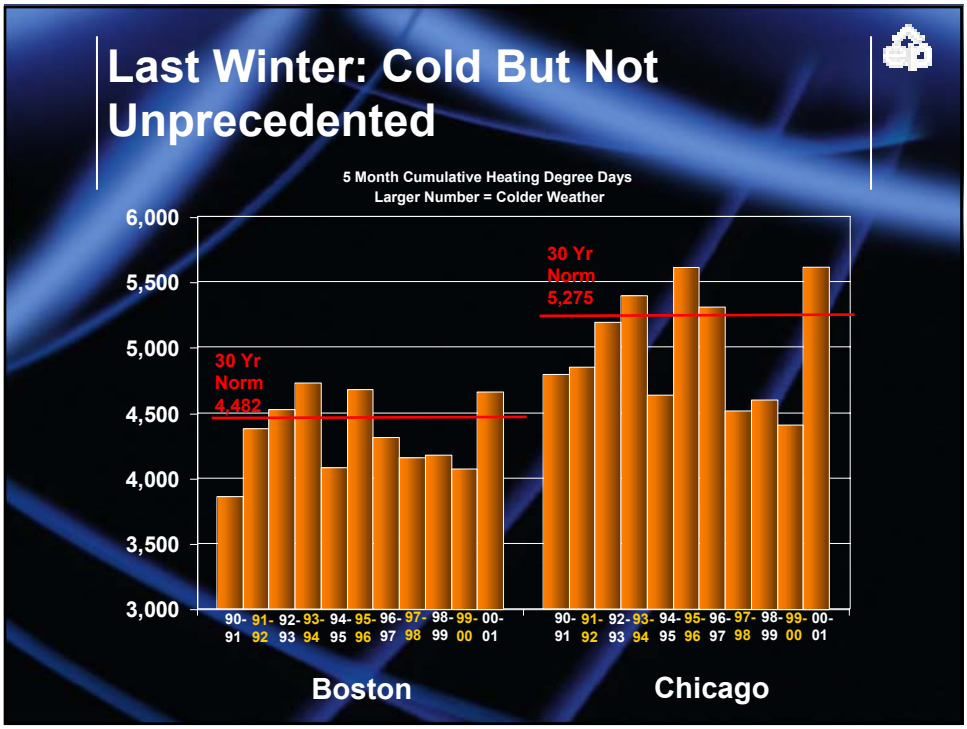
Predictions

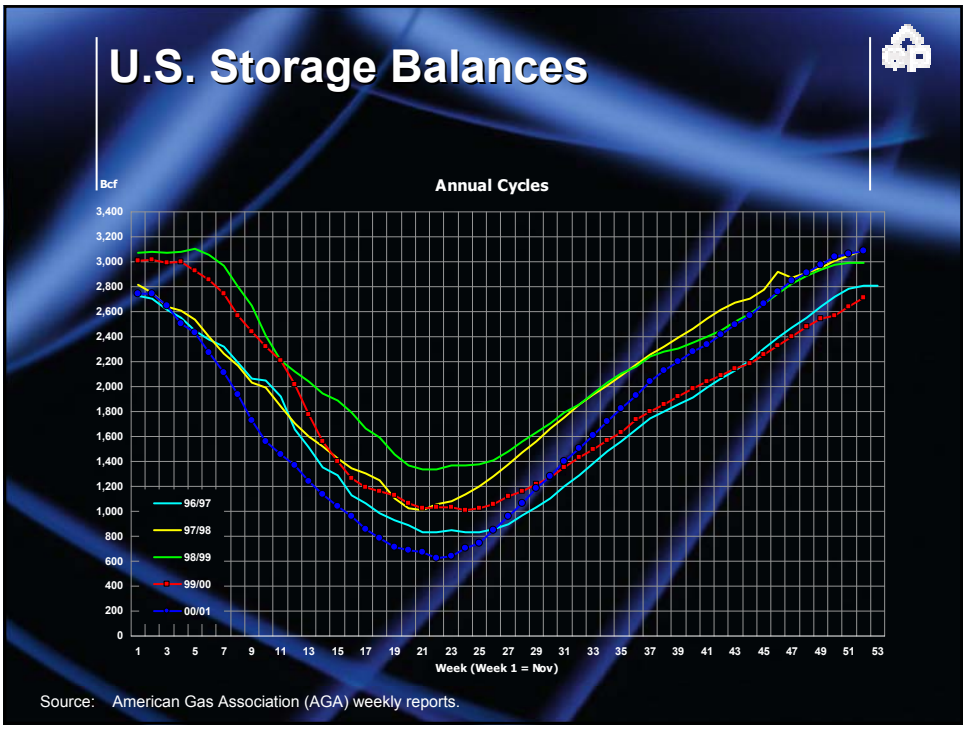
- Expansion projects will supply majority of incremental capacity through 2005.
- New long-haul transport capacity will not solve the problem.
- Many new storage projects will be announced, very few will be built.
- Greater % of GFEG will effectively become peakers.
- GFEG capital providers will require LT FSS.
- More joint-ventures, sale/lease-back deals.

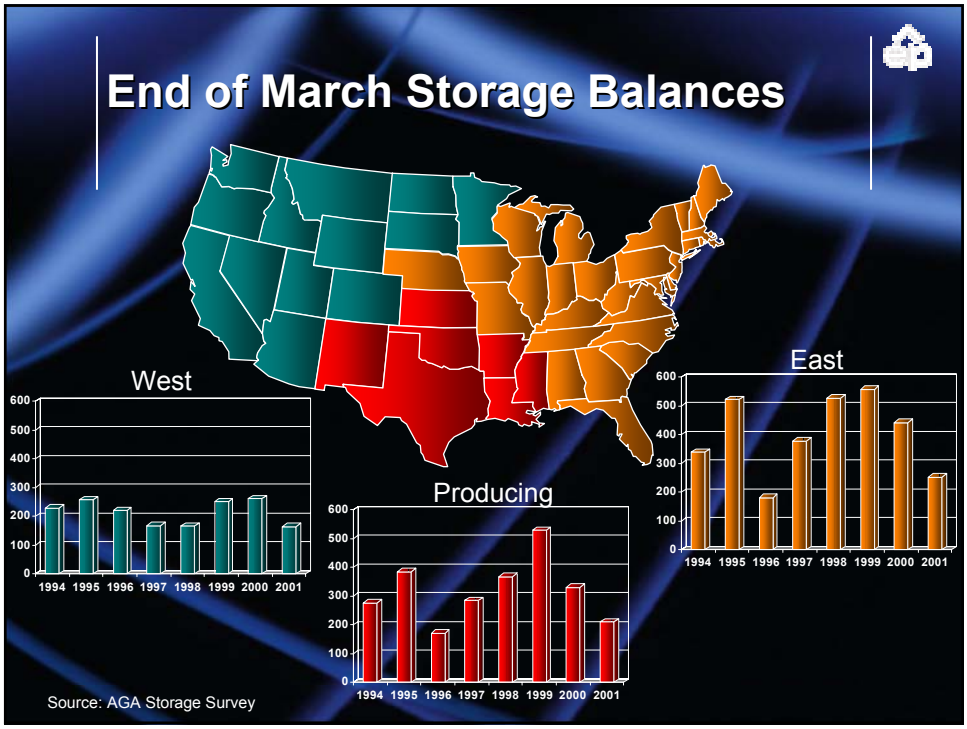
FALCON GAS STORAGE

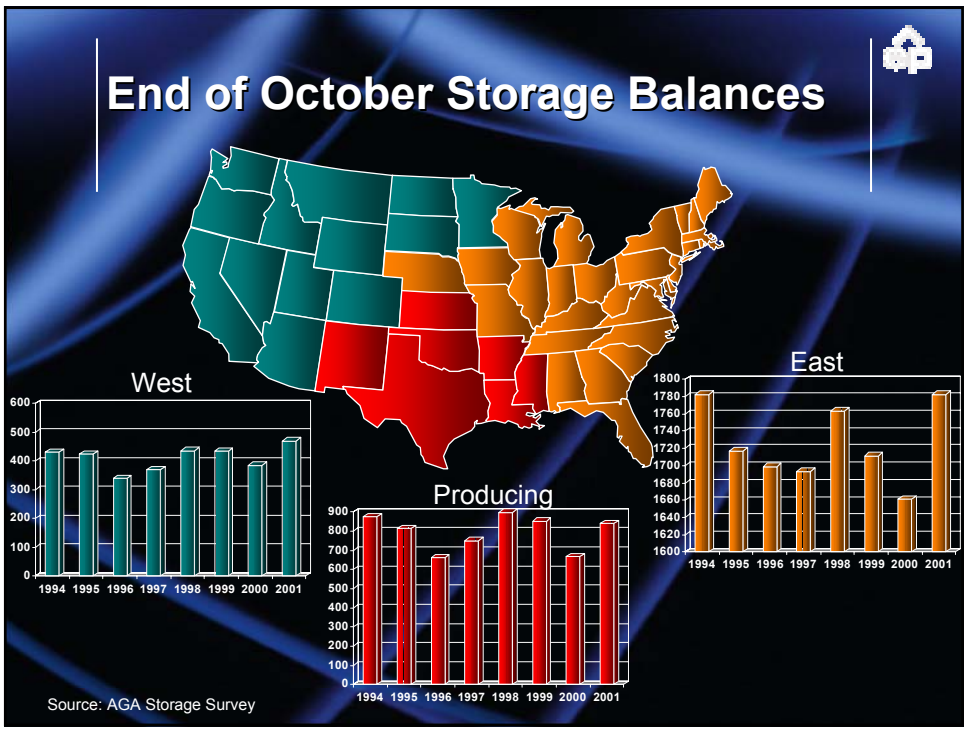

performance
raised to the power of El Paso
Byron Wright
Vice President, Strategy and Capacity Pricing
Natural Gas Storage
R&D Workshop
November 29, 2001
elpaso Pipeline Group

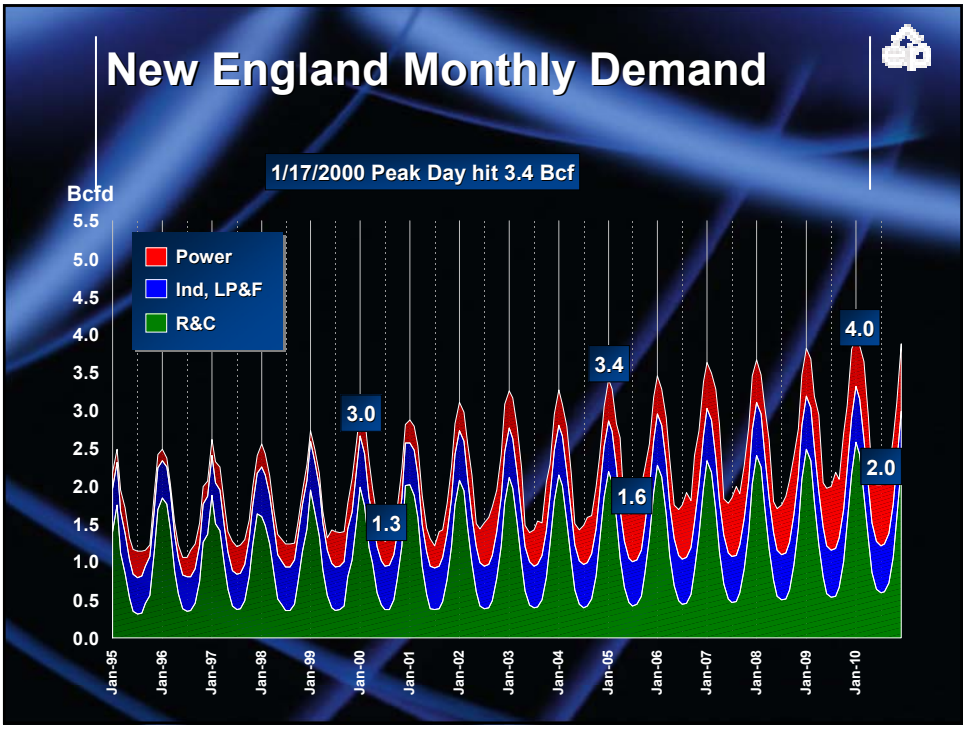

Agenda
2000-2001 Winter
Power Gen Demand vs. Storage Injection
Changing Nature of Storage
Regional Outlook
Future Expansion
Summary

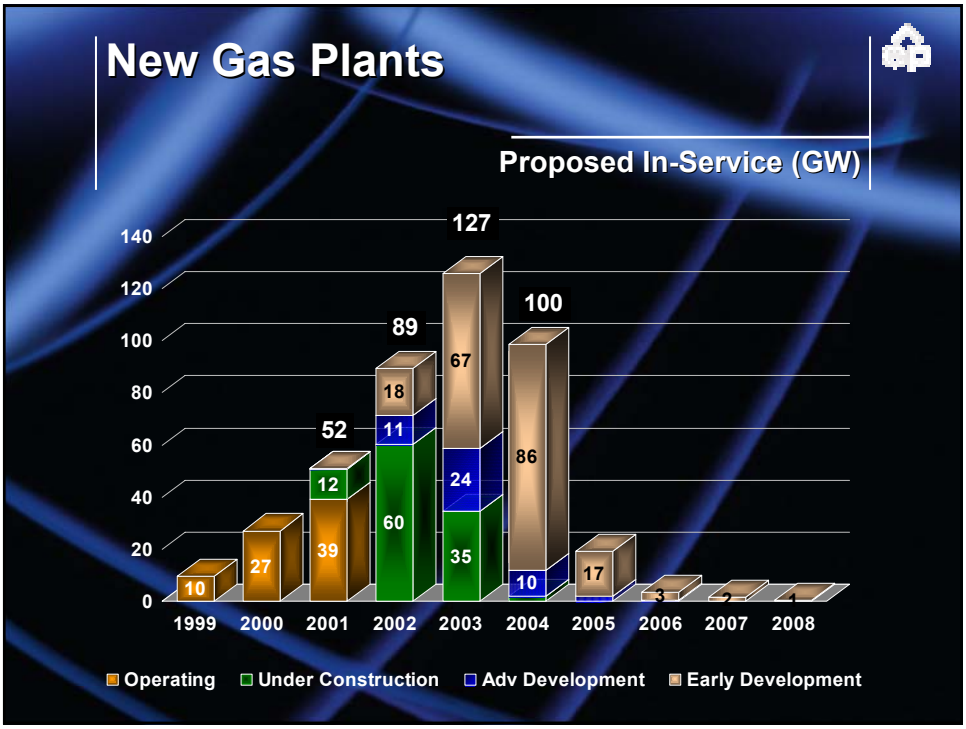

Last Winter: Cold But Not Unprecedented
5 Month Cumulative Heating Degree Days
Larger Number = Colder Weather
6,000
5,500
5,000
4,500
4,000
3,500
3,000
30 Yr Norm 4,482
30 Yr Norm 5,275
90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98 98-99 99-00 00-01
90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98 98-99 99-00 00-01
Boston
Chicago


U.S. Storage Balances
Bcf
Annual Cycles
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
96/97
97/98
98/99
99/00
00/01
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53
Week (Week 1 = Nov)
Source: American Gas Association (AGA) weekly reports.


End of March Storage Balances
West
East
Producing
1994 1995 1996 1997 1998 1999 2000 2001
Source: AGA Storage Survey


End of October Storage Balances
West
East
Producing
1994 1995 1996 1997 1998 1999 2000 2001
Source: AGA Storage Survey

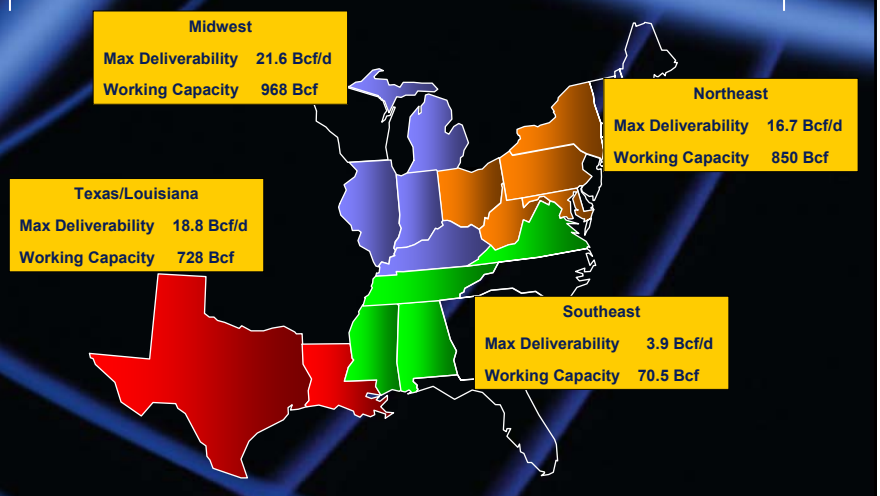

New England Monthly Demand
1/17/2000 Peak Day hit 3.4 Bcf
Bcfd
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Power
Ind, LP&F
R&C
3.0
1.3
3.4
1.6
4.0
2.0
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10


New Gas Plants
Proposed In-Service (GW)
140
120
100
80
60
40
20
0
10
27
39
12
52
60
11
18
89
35
24
67
127
10
86
100
17
3
2
1
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Operating
Under Construction
Adv Development
Early Development

Storage Product Dimension

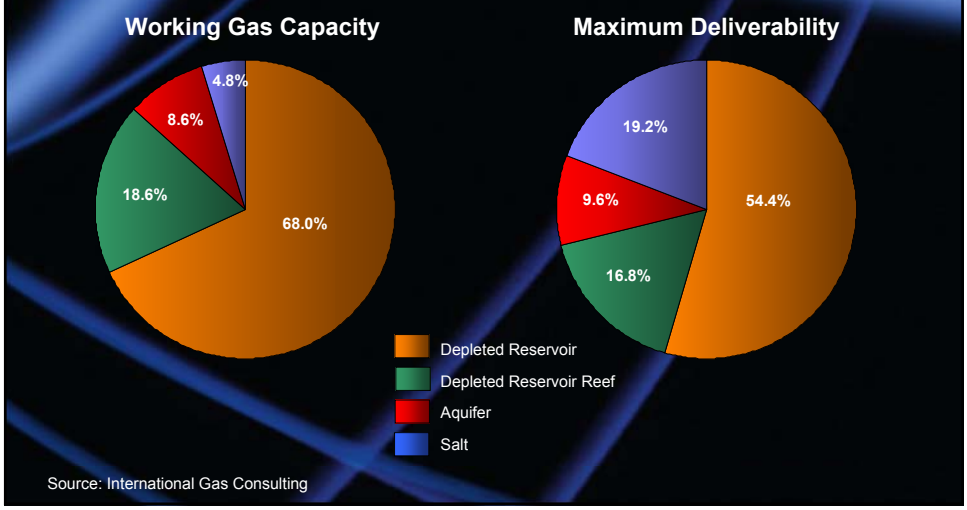
- Delivery Resource
- Transmission Surrogate
- Supply Insurance
- Seasonal Arbitrage
- Intra-seasonal Trading
- Trading Asset-Notional & Physical

Current Storage for Eastern US



Source: International Gas Consulting

Geological Types of Storage: Eastern US/Southern Ontario



Source: International Gas Consulting

Northeast Storage Expansion Projects

		Working Capacity (Bcf)	Delivery Rate (MMcf/d)
1 Honeoye	Dep Reservoir	1.80	15
2 Seneca Lake II	Bedded Salt	.75	75
3 Stagecoach	Dep Reservoir	13.0	500
4 Tioga	Bedded Salt	6.0	500
5 Northeast ConneXion	Dep Reservoir	3.0	300

Source: International Gas Consulting / El Paso

Summary

- Growing demand and “normal” winters will test storage infrastructure
- Demands of fueling power generation could strain summertime storage refills
- Storage has evolved from a strictly physical asset to both a physical and trading asset
- Emphasis on gaining more flexibility from storage (along with supply and transport contracts)
- Changing flows and load patterns will lead to distributed deliverability solutions