GAS SUPPLY &TRANSPORTATION

Markets in the U.S.

Exploring the New Energy Highway

Sixth National Green Power Marketing Conference
Portland, Oregon

Bill McAleb, Principal-Natural Gas

RDI Consulting
Boulder, CO
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The Vision Erodes in the Face of Reality

- **The year 2000**
  - **May be remembered as the most volatile year ever for natural gas markets.**
  - **The clear role that natural gas was going to play as the "Fuel of the Future" is now mired in uncertainty.**
  - **Industry claims of continuous growth in gas supply at moderate to declining prices now rings hollow in the face of tremendous volatility**
    - ***brought on in large measure by the convergence of gas and electric markets.***

Welcome to:

The New Energy Highway

And the role natural gas will play in the advancing convergence of gas and electric markets.

Key Issues for the New Energy Highway

- **The Changing Industry**
  - **Operational & Technical Issues**
    - ***Production equipment improvements***
    - ***Improved metering technologies***
  - **Impact of Electric Generation**
    - ***The regional gas technology mix (ST, CC or CT) and and the associated capacity factors are key drivers of actual gas load***
    - ***Displacement of older gas units by new technologies***
    - ***Gas demand will potentially increase as prices drop to a level where gas can compete with baseload coal generation***
- **Regulatory Issues**
  - **Pipeline Contracting and Siting –**
    - ***Expansions are planned but will they be certified, approved & built?***
  - **New transportation services**
    - ***Hourly Rates***
    - ***Enhanced commodity services***
  - **Order 637 Impacts: *"…allowing capacity to be allocated more efficiently during peak periods to those who need it most"***
- **Regional Pipeline Constraint Analysis**
  - ***Limited gas infrastructure in need of repair, replacement, & remediation***
  - ***Large winter-time space heating needs***

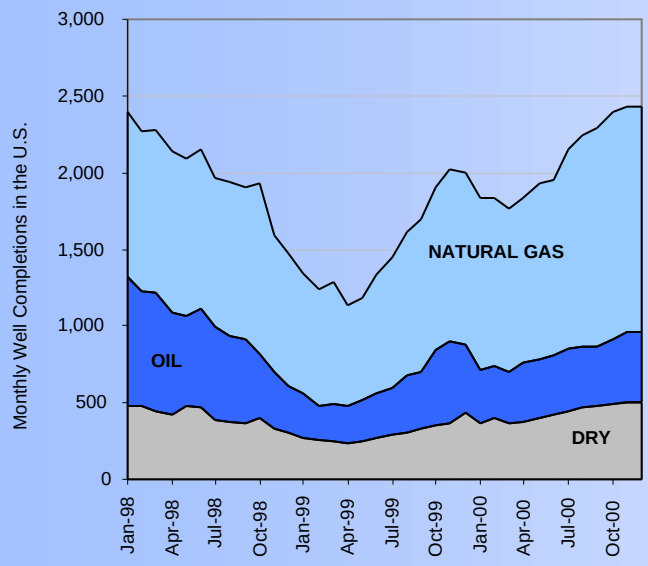
What happened last winter?

- **Gas prices to most end-users doubled or tripled;**
- **Many western locations saw physical spot prices at $20/MMBtu for sustained periods and peak prices in excess of $61/MMBtu;**
- **Examination of the specifics shows how the market fundamentals set the stage for the price "run-ups"**

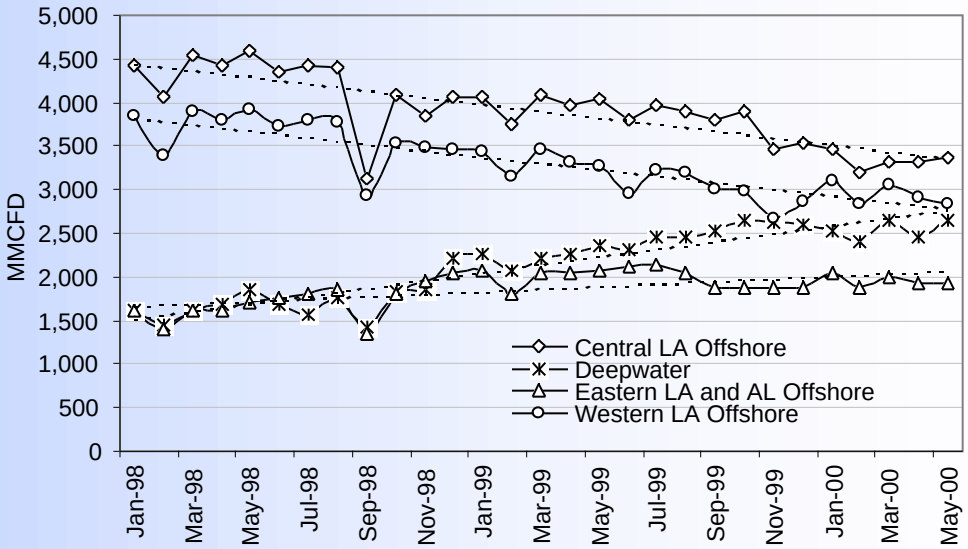
A confluence of factors

- A fall off in drilling in 1999 creates a gas supply "squeeze".
  - Well completions dropped 13% from 1998.
- Data show more than a 1 Billion Cubic feet per day (Bcfd) drop off in Gulf-offshore production.
  - By comparison, production from the entire Gulf-offshore region totals more than 14 Bcfd and accounts for about 23% of U.S. supply.

U.S. WELL DRILLLING



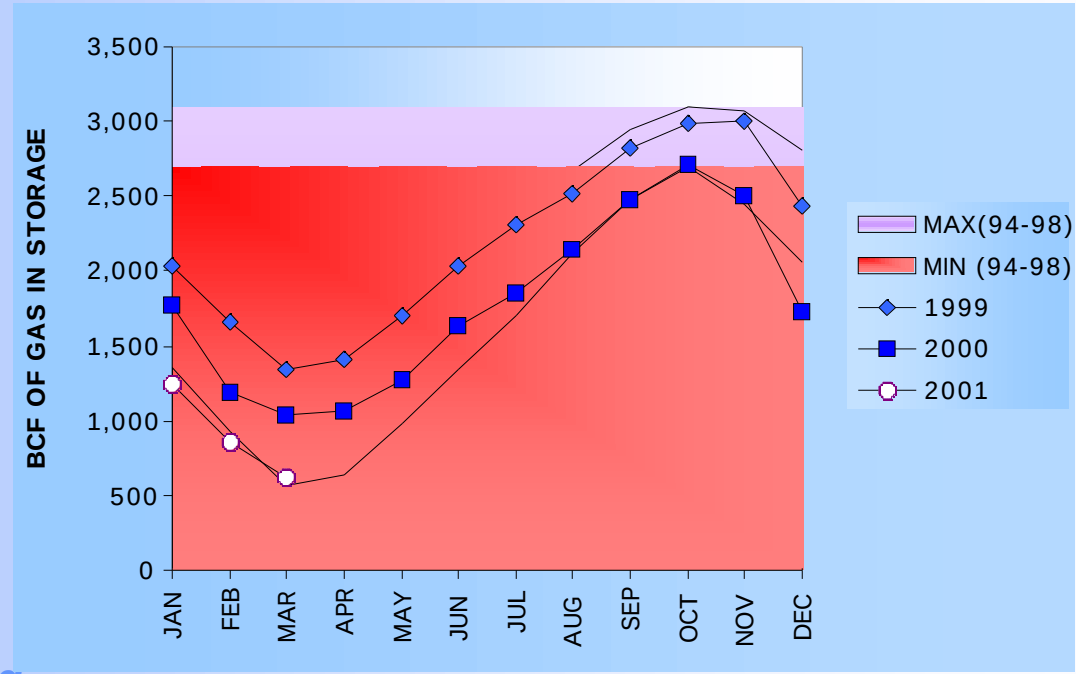
GULF OF MEXICO PRODUCTION - LOUSIANA REGION



A confluence of factors *(continued)*

- **In the spring of 2000, markets begin to react to a significant draw-down of gas storage in spite of a relatively mild winter in 1999/2000.**
- **Gas demand grew as new gas-fired generation came on-line.**
- **Initial basis price shocks at the Southern California border in July 2000 were a precursor to the upward spiral in western markets.**

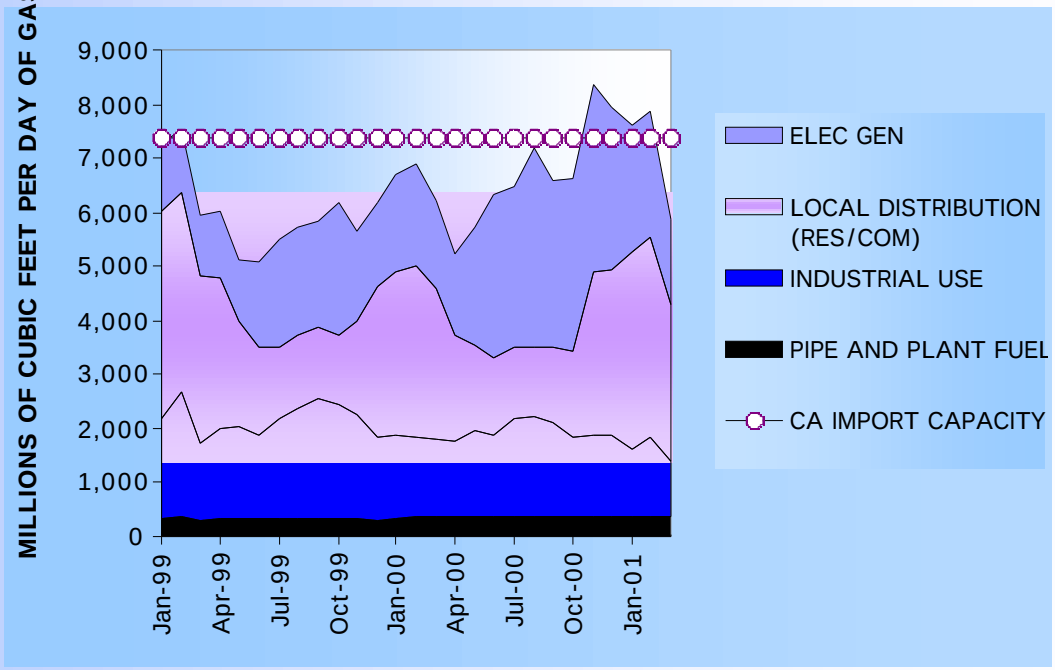
U.S. GAS IN STORAGE



A confluence of factors *(continued)*

- **The California crisis was a result of:**
  - **Excessive generation outages;**
  - **Lack of hydro-power;**
  - **Unseasonable cold temperatures; and**
  - **A variety of gas transmission and storage issues**
- **That all aligned to create the "Perfect Storm", causing the highest prices ever seen in natural gas markets.**

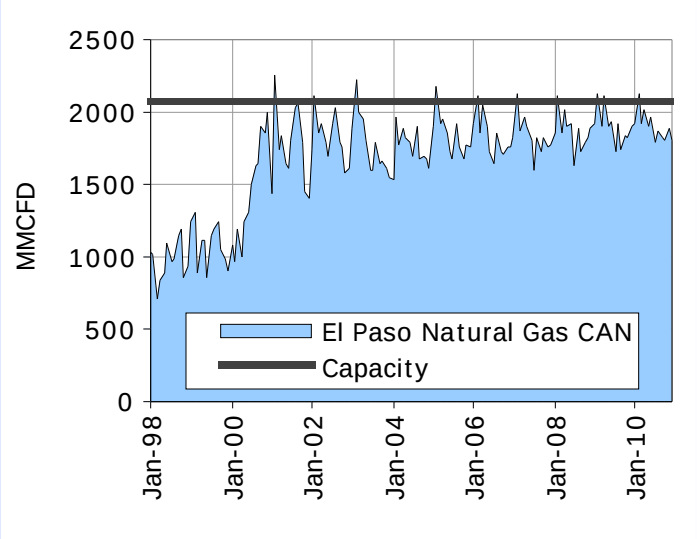
CALIFORNIA GAS DEMAND and DELIVERABILITY



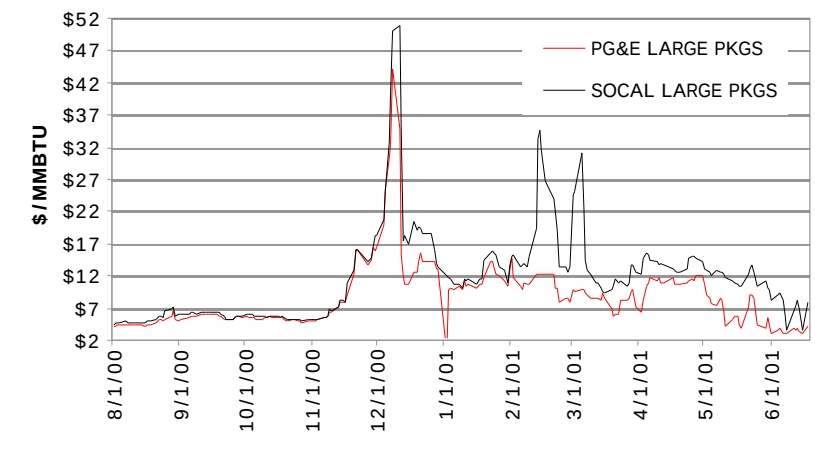
California

- Fundamental factors played a critical role in setting up the conditions for market price spikes.
- It is clear that gas sellers were able to "bid up" the price of gas to generators
  - Incremental gas supplies captured an unprecedented portion of the "spark spread"
- This was possible because the spot electricity prices were already extraordinarily high.
- Transmission inadequacies within California exacerbated market pressure and pushed both electric and gas prices to unprecedented levels.

El Paso North



Cal Border Prices



Lessons Learned

- **The convergence between gas and electricity markets is likely to substantially increase gas market volatility when both gas infrastructure and electricity supply is constrained.**

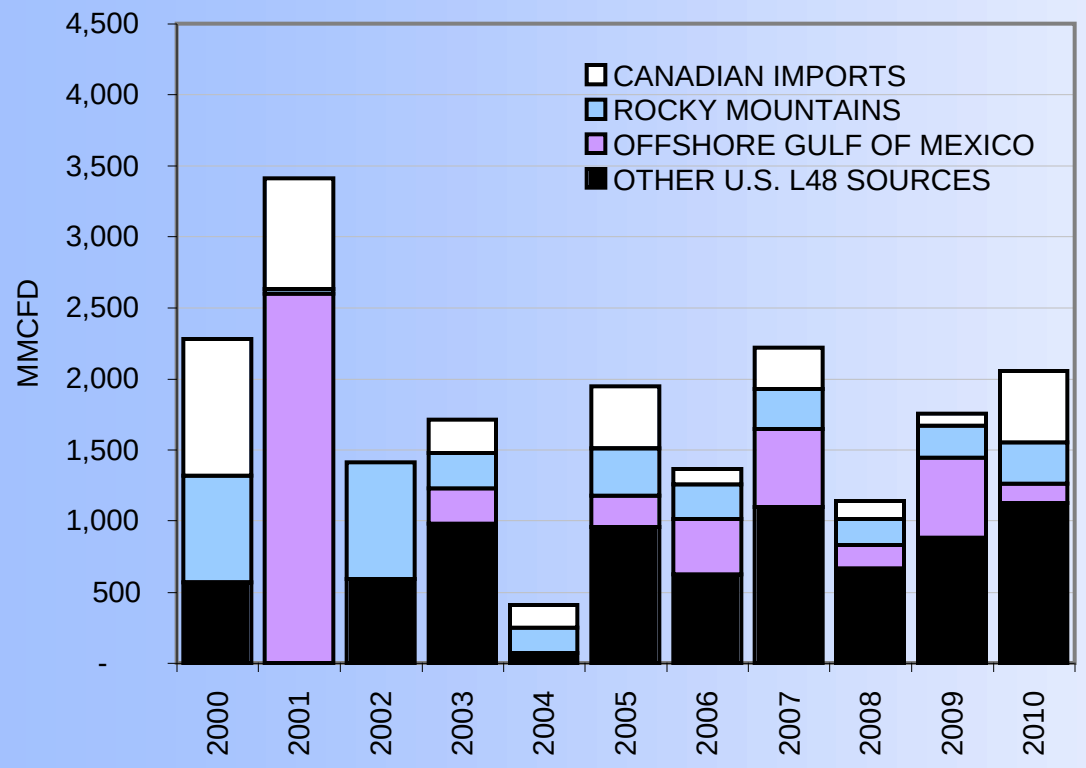
- **Gas markets are tightly interconnected. The California crisis has likely had a “ripple effect” across the U.S. providing support for the entire gas market.**

Gas Supply - Discussion Points

- **The impact of decline rates - Will they continue to increase?**
  - **Technology v. Geology Balance**
- **People are paranoid about gas supply**
  - **The resource base is vast. (+ 60 years @ projected demand)**
- **Why would we not see increases in incremental supply?**
  - **Technically Recoverable v. Economically Recoverable**
- **LNG - Does it really make sense?**
  - **Yes, in strategic demand locations**
  - **International oversupply**
- **Coal Gasification**
  - **Only with gas prices north of $4.00/mmBtu**
- **Probable Canadian Frontier or Arctic Resources**

Key Uncertainty - Where will future gas supplies come from?

Sources of incremental gas supply - MMCFD



RDI APRIL 2001 BASE SUPPLY FORECAST

- **Incremental growth in gas supply from Canada, the Rocky Mountains, and the Gulf of Mexico could potentially climb well above the base forecast;**
- **Incremental supply additions of nearly 2 Bcfd are necessary every year;**
- **This level of supply addition requires a sustained exploration and drilling effort;**
- **Depressed gas prices will negatively impact reserve development & ultimately deliverability.**

Probable Reserves by Cost Interval

Gulf Onshore Region

USGS REGION/BASIN	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
Western Gulf (TX)	34,733	13,482	20,196	70%	0%	0%	0%
Louisiana-Miss. Salt Basins	11,040	9,622	14,943	58%	49%	2%	3%
Black Warrior Basin (AL)	231	1,809	2,292	47%	0%	66%	48%
Florida Peninsula	24	4	12	70%	0%	0%	0%
REGIONAL TOTAL (BCF)	46,028	24,917	37,443				

Mid-Continent Region

USGS REGION/BASIN	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
Anadarko Basin	5,720	3,281	5,205	63%	0%	0%	0%
Arkoma Basin	1,631	2,224	1,280	75%	16%	83%	41%
Southern Oklahoma	155	251	608	40%	0%	0%	0%
Cambridge Arch-C. Kansas	51	227	136	67%	0%	0%	0%
Nemaha Uplift	65	168	242	49%	0%	0%	0%
Sedgwick Basin	46	123	130	57%	0%	0%	0%
Superior	52	86	281	33%	0%	0%	0%
Cherokee Basin	35	57	2,007	4%	0%	0%	95%
Forest City Basin	0	4	514	1%	0%	0%	88%
REGIONAL TOTAL (BCF)	**7,755**	**6,421**	**10,403**				

Appalachian Region

Basin	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
Appalachian Basin	2,800	4,029	71,645	9%	91%	88%	98%
Michigan Basin	705	885	4,557	26%	0%	0%	0%
Illinois Basin	29	88	3,904	3%	0%	0%	90%
Cincinnati Arch	0	0	1,407	0%	0%	0%	99%
Blue Ridge Thrust Belt	0	0	30	0%	0%	0%	0%
Piedmont	0	0	390	0%	0%	0%	0%
Regional Totals	3,534	5,002	81,933				

source: RDI, EIA, USGS

Probable Reserves by Cost Interval

Permian Region

Basin	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
Permian Basin	8,803	3,101	4,498	73%	0%	0%	0%
Bend Arch-Ft. Worth Basin	267	835	1,050	51%	0%	0%	0%
Palo Duro Basin	0	0	9	0%	0%	0%	0%
Marathon Thrust Belt	0	0	149	0%	0%	0%	0%
Regional Totals	9,070	3,936	5,706				

San Juan Region

Basin	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
San Juan Basin	15,167	4,493	9,887	67%	97%	94%	98%
Raton B.-Sierra Grande Uplif	782	927	108	94%	100%	100%	61%
Las Animas Arch	352	90	89	83%	0%	0%	0%
Albuquerque-Santa Fe Rift	0	23	330	7%	0%	0%	0%
N. Arizona	0	17	157	10%	0%	0%	0%
S. Ariz.-S.W. New Mexico	0	0	205	0%	0%	0%	0%
Regional Totals	16,301	5,550	10,776				

Rocky Mountain Region

USGS REGION/BASIN	Gas Rec. @ $2	Gas Rec. @ $3.34	Gas Tech. Rec.	% Rec. < $3.34	% Uncon. <$2	% Uncon. <$3.34	% Uncon. Tech. Rec
Powder River Basin	23,400	12,434	30,787	54%	98%	97%	97%
Uinta-Piceance Basin	8,581	5,580	17,785	44%	71%	82%	94%
Wyoming Thrust Belt	8,631	868	1,182	89%	0%	0%	0%
S.W. Wyoming	1,250	4,446	118,939	5%	87%	90%	99%
Central Montana	5,116	541	36,459	13%	98%	42%	99%
Montana Thrust Belt	914	341	668	65%	0%	0%	0%
Williston Basin	416	529	2,672	26%	0%	0%	71%
Wind River Basin	267	675	723	57%	0%	59%	4%
Paradox Basin	440	494	1,050	47%	0%	0%	0%
Denver Basin	5	813	768	52%	0%	78%	26%
Big Horn Basin	136	200	286	54%	0%	0%	0%
E. Great Basin	80	62	197	42%	0%	0%	0%
S.W. Montana	0	0	407	0%	0%	0%	0%
Park Basins	0	0	19	0%	0%	0%	0%
REGIONAL TOTAL (BCF)	49,236	26,983	211,942				

RDI Natural Gas Consulting

source: RDI, EIA, USGS

So what is RDI's view of future natural gas prices?

Approach for Analysis of Gas Transportation Markets

- **Overall price level for *natural gas is driven by the macro-level supply and demand balance;***

- ***Basis differentials and regional pricing are often driven by capacity issues.***

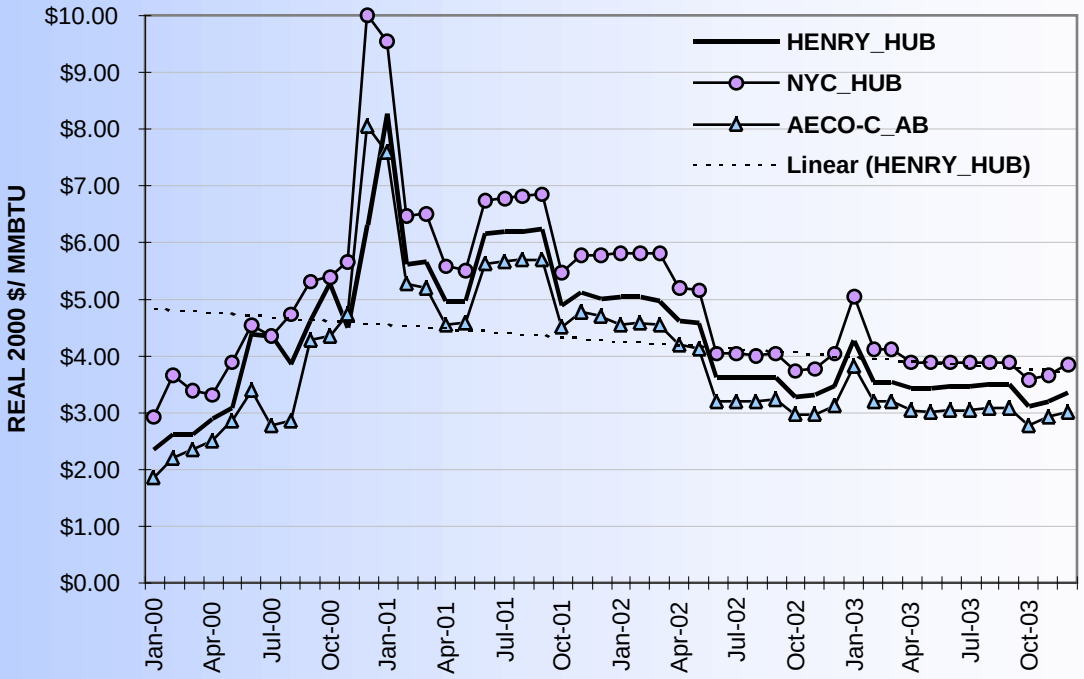
- **RDI's study approach:**
  - **Examine the detailed historic consumption and pipeline data in *GASdat* to understand current market dynamics.**
  - **Explicit knowledge of generating additions and pipeline expansions along with other key drivers are incorporated**
  - **Fundamental based supply and demand modeling using the *GPCM®* *Natural Gas Forecasting System***

Short-term Price Outlook

- **Tight gas supplies and growing demand should support pricing in the $3.00 to $5.00 range over the next three years;**
- **Overall gas price levels are primarily responding to supply-based factors, while transmission events provide the "juice" that amplify regional prices dramatically.**

RDI APRIL 2001

BASE PRICE FORECAST



Long-term Price Outlook

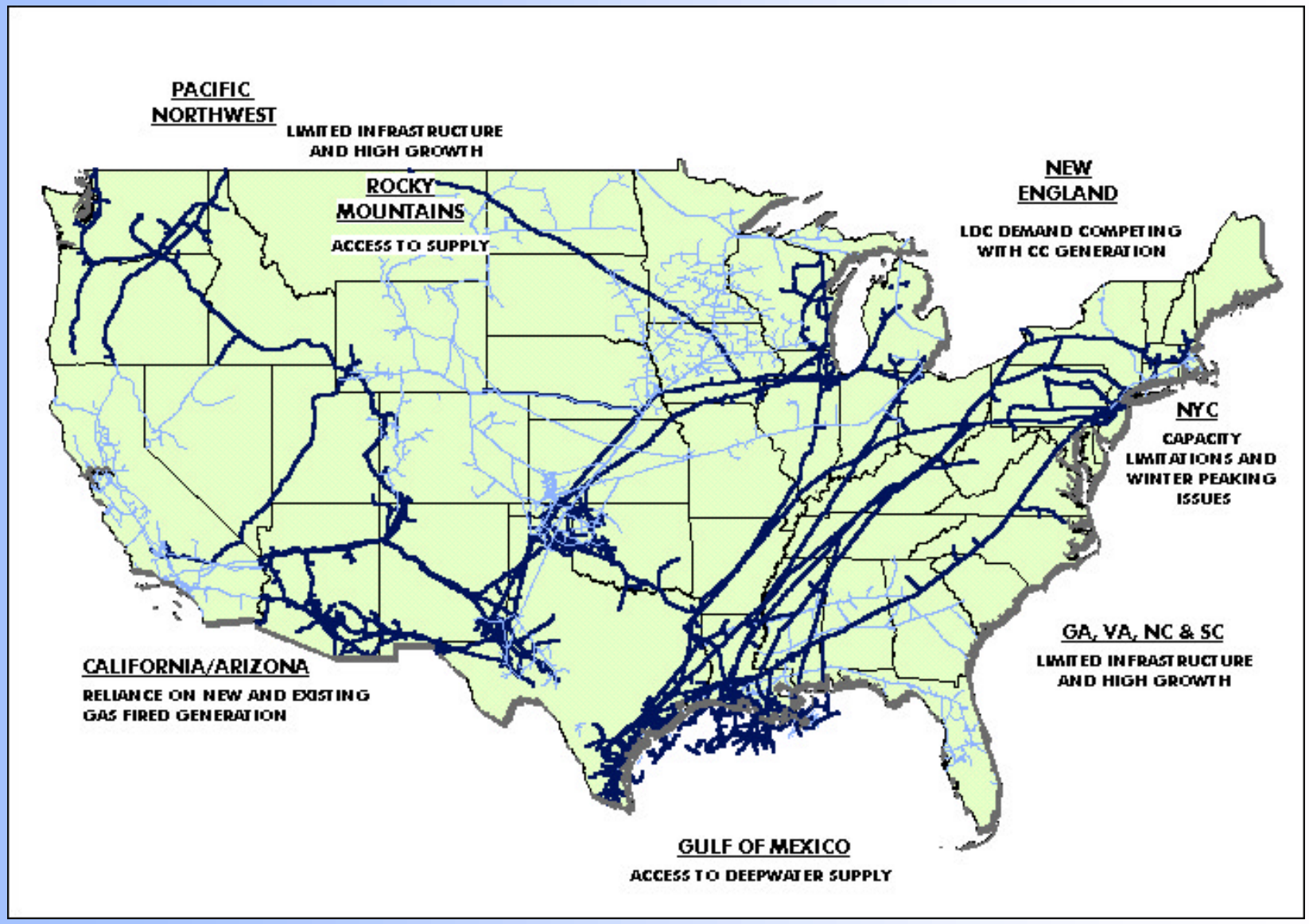
- **In our Base Scenario, total annual gas demand is forecast to reach 29 Trillion Cubic Feet (TCF) by 2010.**
  - **This results in prices in the $3.00 to range after the gas market comes back into balance after 2003;**
  - **If demand follows a lower trajectory (ie, 27 Tcf in 2010), prices could be 20% lower. Could cause demand destruction in the Industrial sector.**
- **Long-term prices are not expected to stay at the current levels.**
  - **Prices above $4.00/mmBtu erode demand and make a variety of marginal gas sources like coal-gas and new LNG projects viable.**

RDI APRIL 2001

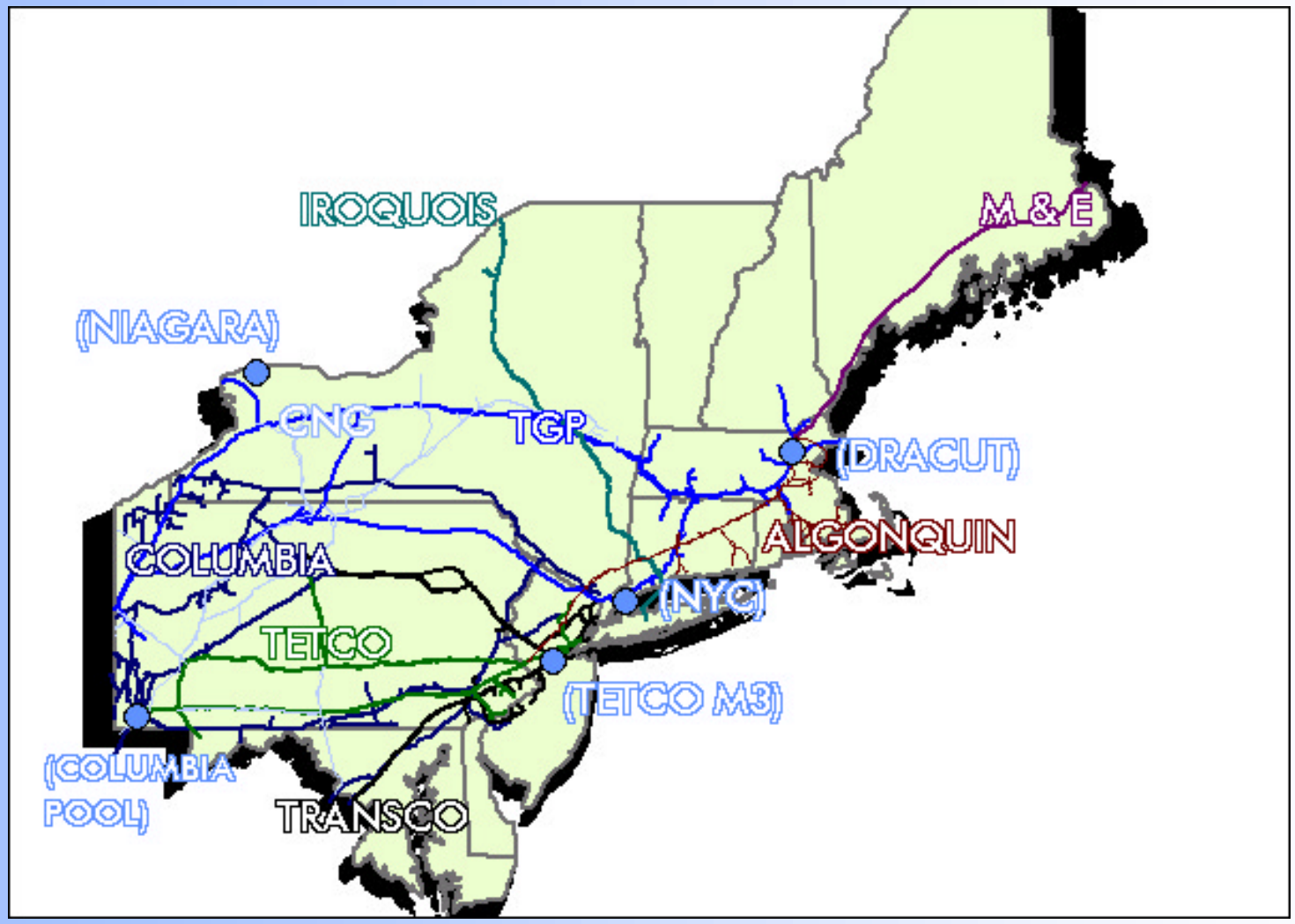
BASE PRICE FORECAST

YEAR	Henry Hub	New York City HUB	CHICAGO HUB	Sumas, WA	AECO-C, AB	TOPOCK, AZ	OPAL
1998	$2.00	$2.35	$2.12	$1.27	$1.21	$2.13	$1.78
1999	$2.15	$2.52	$2.22	$1.65	$1.71	$2.31	$1.99
2000	$4.07	$5.87	$4.15	$4.32	$3.40	$4.29	$3.68
2001	$5.62	$6.32	$5.73	$5.41	$5.23	$5.98	$5.32
2002	$3.95	$4.49	$4.04	$3.71	$3.58	$4.15	$3.57
2003	$3.32	$3.79	$3.42	$3.09	$2.98	$3.46	$2.97
2004	$3.18	$3.61	$3.27	$2.93	$2.83	$3.30	$2.85
2005	$3.17	$3.62	$3.27	$2.89	$2.79	$3.28	$2.79
2006	$3.07	$3.54	$3.17	$2.79	$2.70	$3.15	$2.67
2007	$3.09	$3.57	$3.20	$2.77	$2.68	$3.18	$2.72
2008	$3.08	$3.54	$3.19	$2.75	$2.66	$3.17	$2.70
2009	$3.16	$3.65	$3.29	$2.80	$2.72	$3.27	$2.77
2010	$3.22	$3.73	$3.35	$2.84	$2.78	$3.33	$2.81

Regional Analysis - Areas to Watch



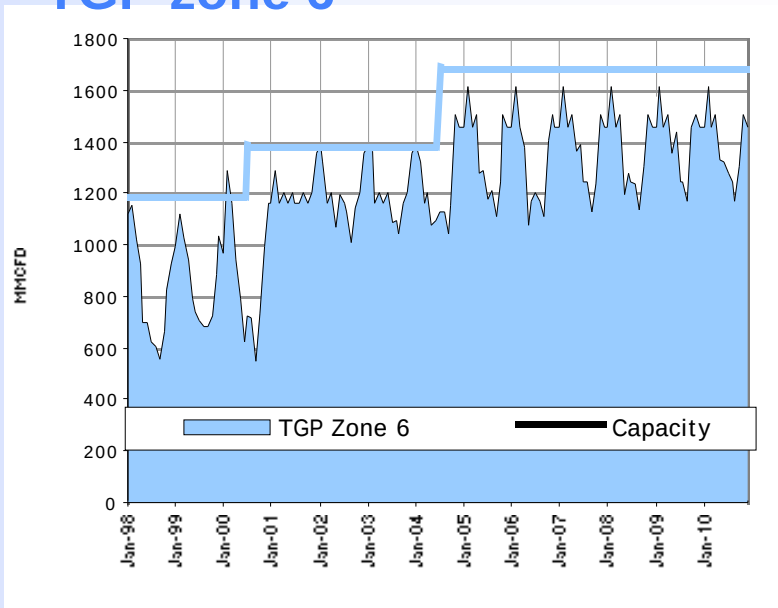
Northeast


IROQUOIS
M & E
(NIAGARA)
CNG
TGP
(DRACUT)
COLUMBIA
ALGONQUIN
(NYC)
TETCO
(TETCO M3)
(COLUMBIA POOL)
TRANSCO

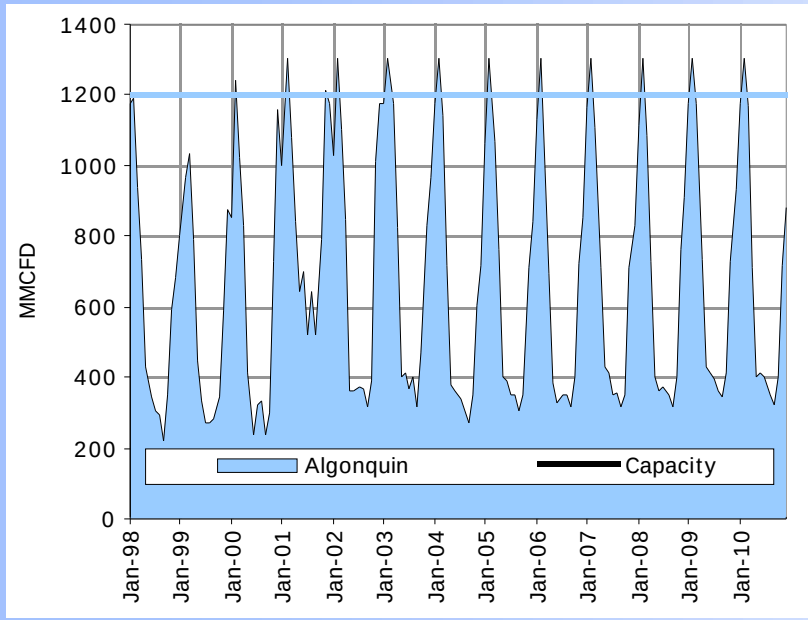
New England

- **High Pipeline Utilization and the potential for price spikes in the next few years depending on the timing of new capacity.**

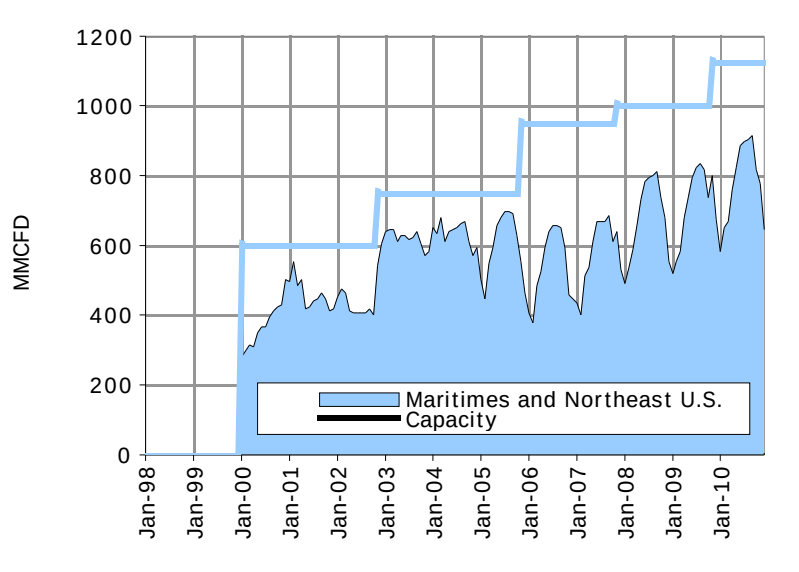
TGP zone 6



ALGONQUIN



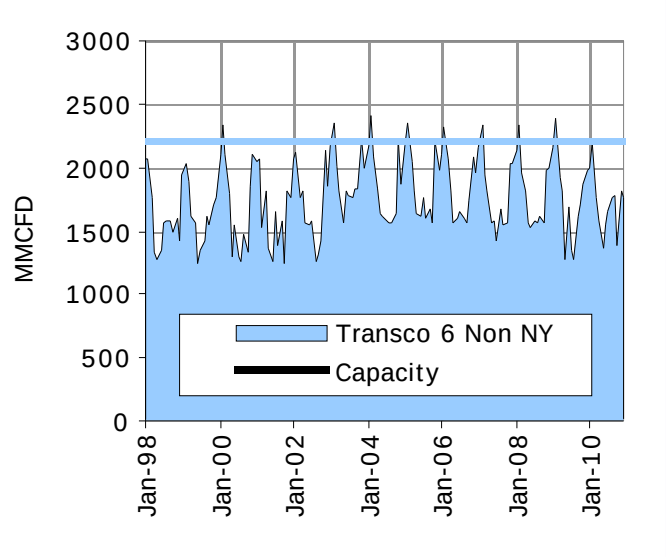
M&NE U.S. segment



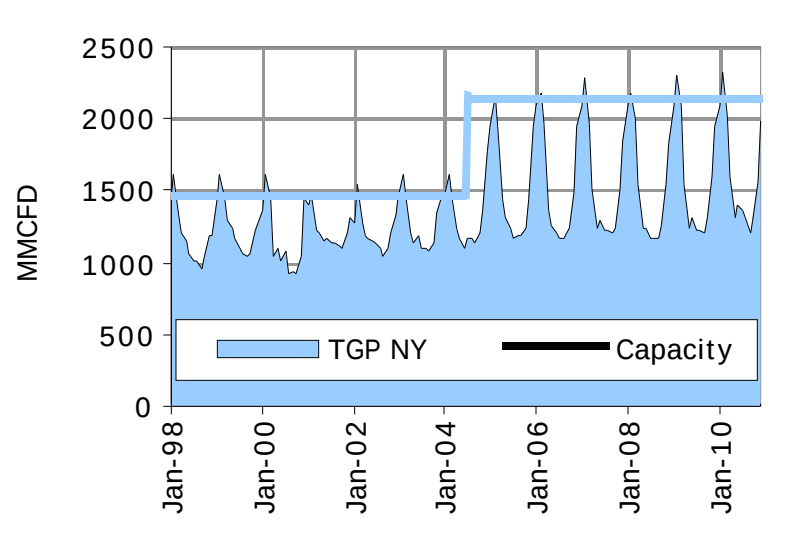
Mid-Atlantic

- **Similar to New England in terms of winter peaking.**
- **Solid Baseload growth drives utilization of new pipes in the region.**

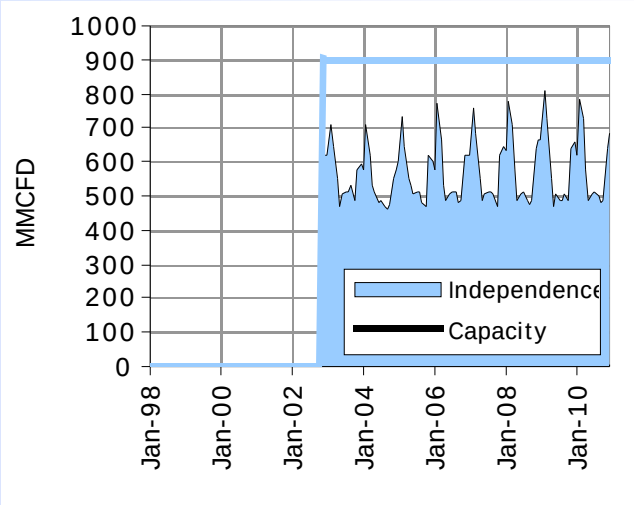
Transco Zone 6 Non NYC



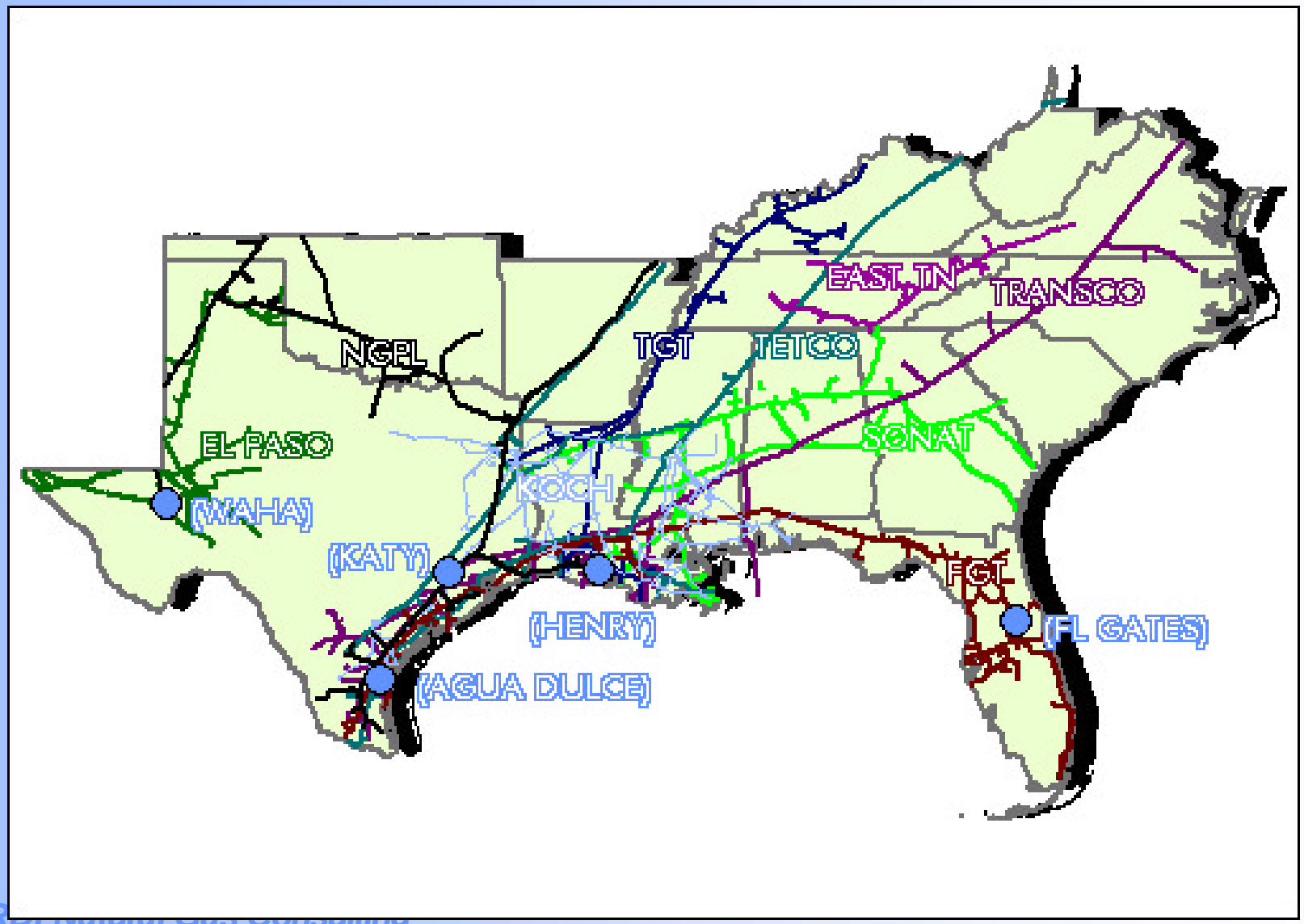
TGP NY Zone 5



Independence



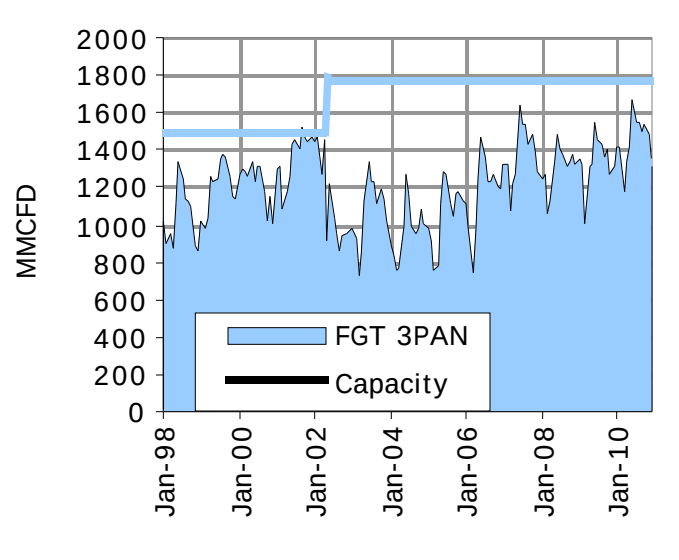
Southern Region



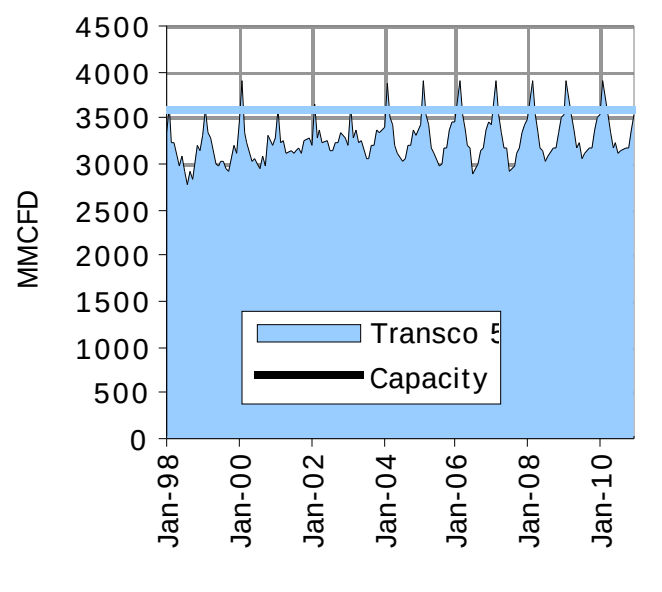
South-Atlantic

- Continued growth on Transco's system appears necessary.
- Oil switching and Gulfstream have impacts on FGT

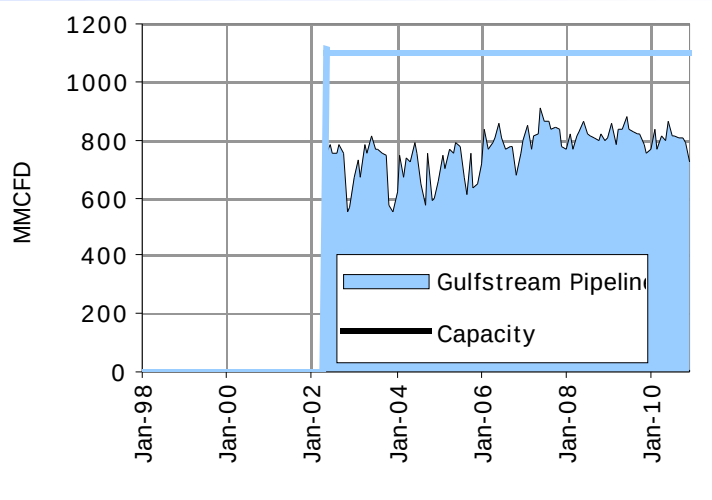
FGT



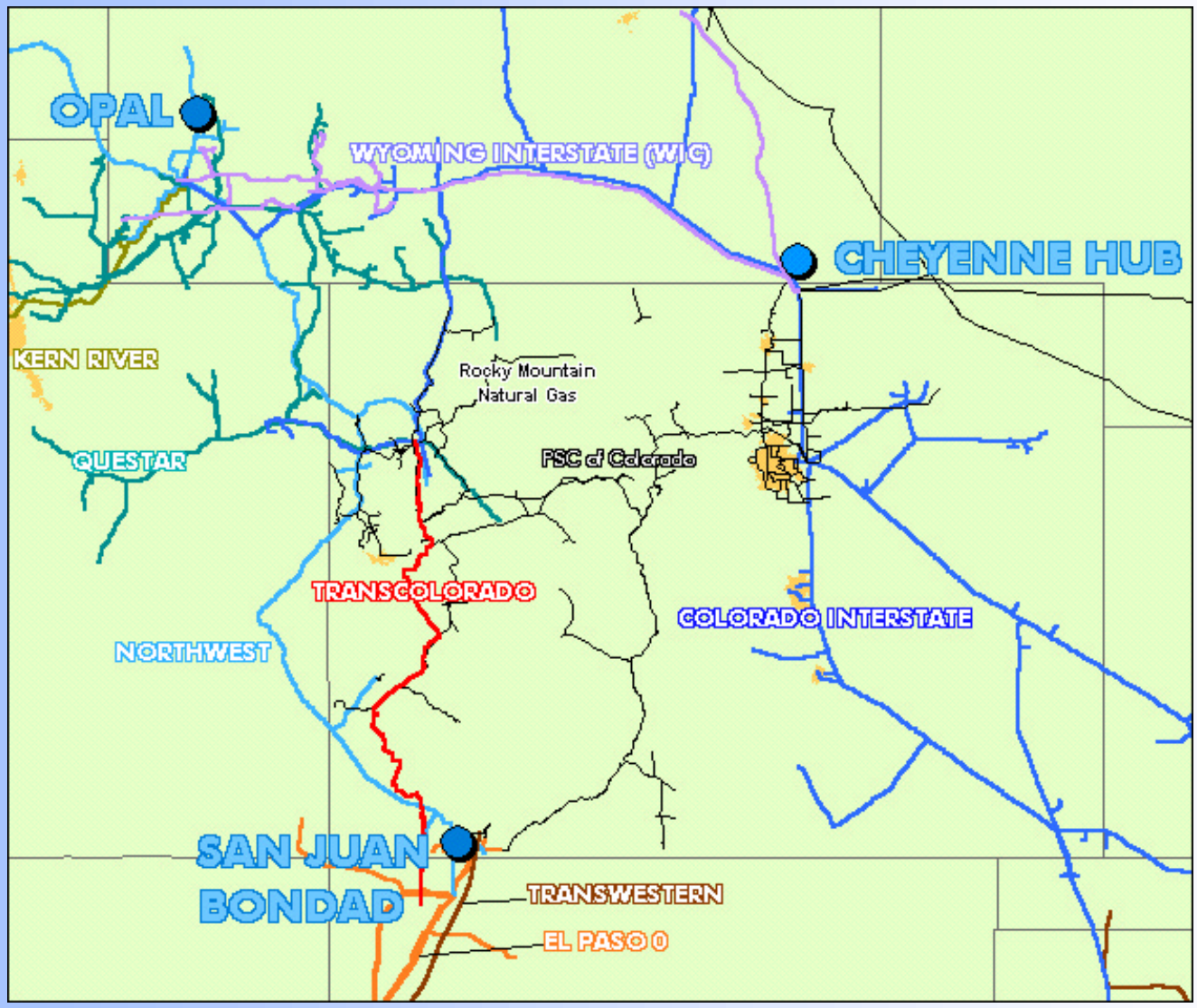
Transco Zone 5



Gulfstream

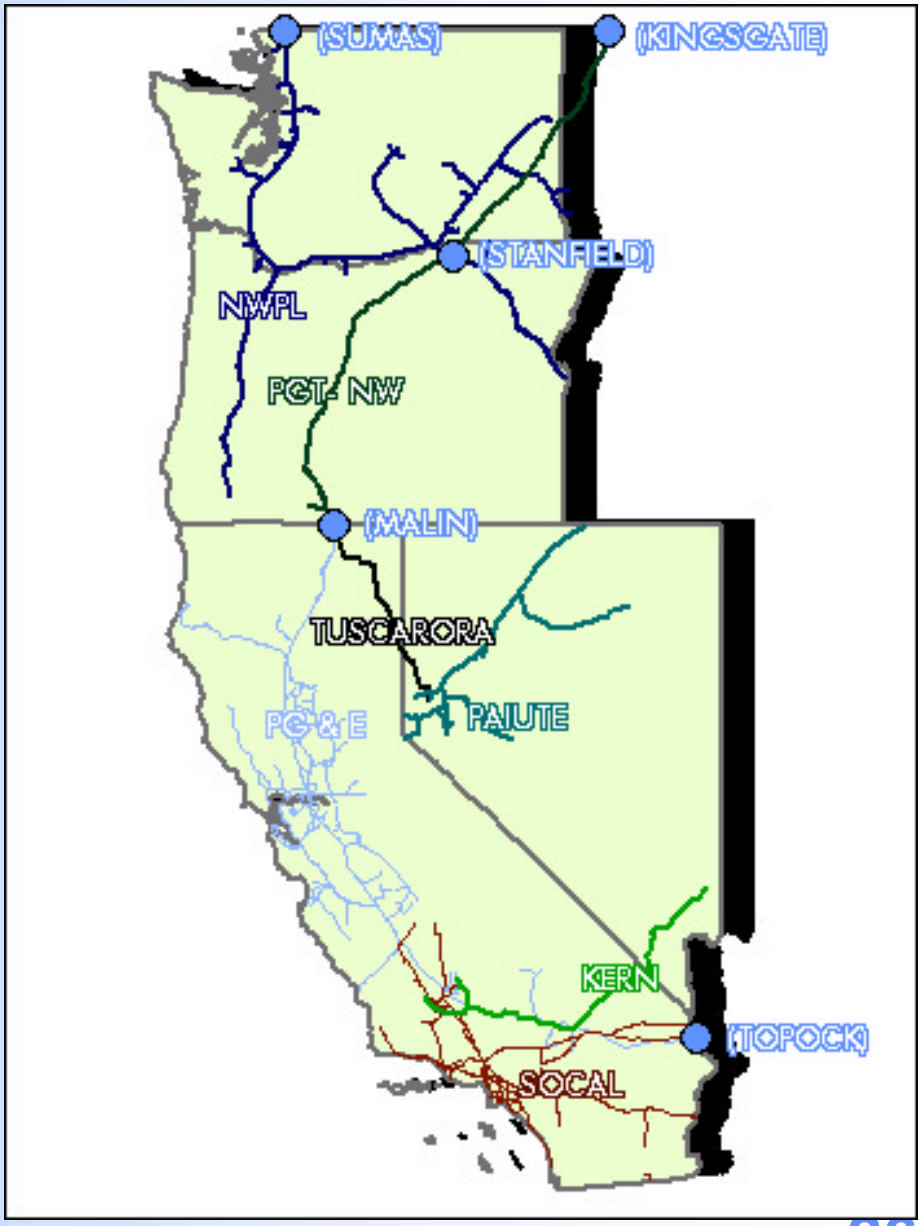


Rocky Mountain Region



Pacific Region

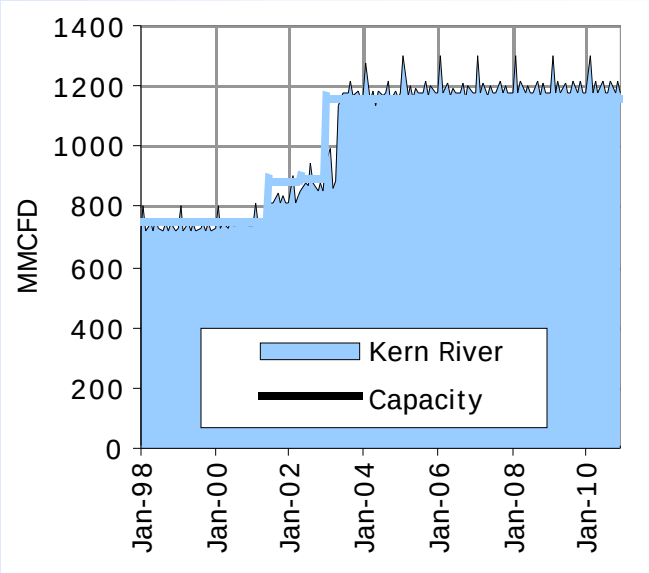
- The recent gas price spikes in the Pacific Northwest and California reflect the instability & lack of supply/demand balance in the California electric market in, due to
  - a lack of hydro-power resources,
  - strong heating demand from the coldest November in recent history,
  - and a variety of pipeline operational and storage issues.
- It is likely that gas demand in California during the month of November approached 9.0 Bcfd on certain days.



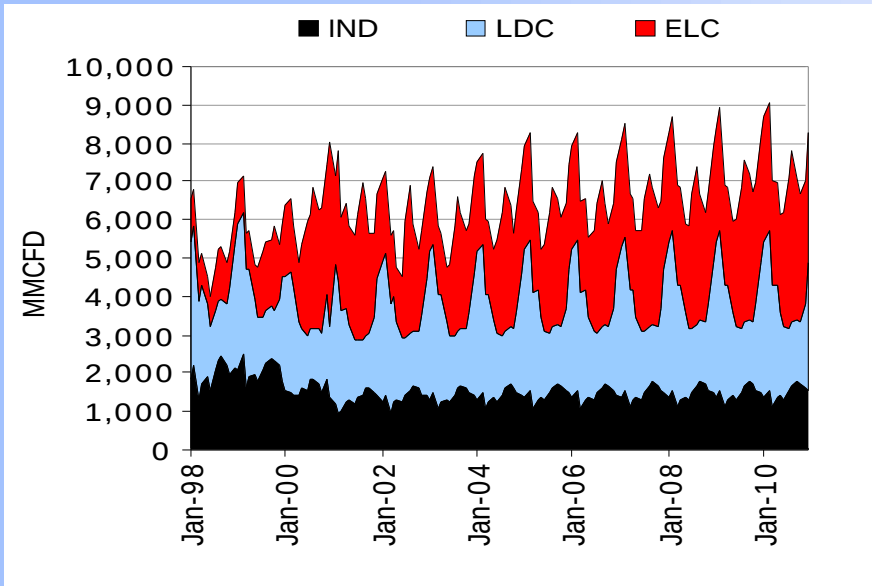
California

- **Projected gas consumption by California generators actually declines slightly in the early years of the forecast from year 2000 levels.**
  - **The result of <u>displacement of less efficient steam turbine generation with more efficient combined cycle facilities</u>.**

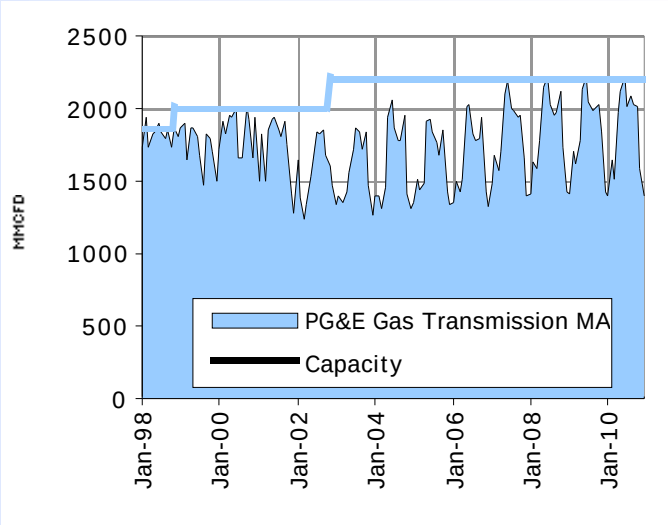
Kern River



CA Demand



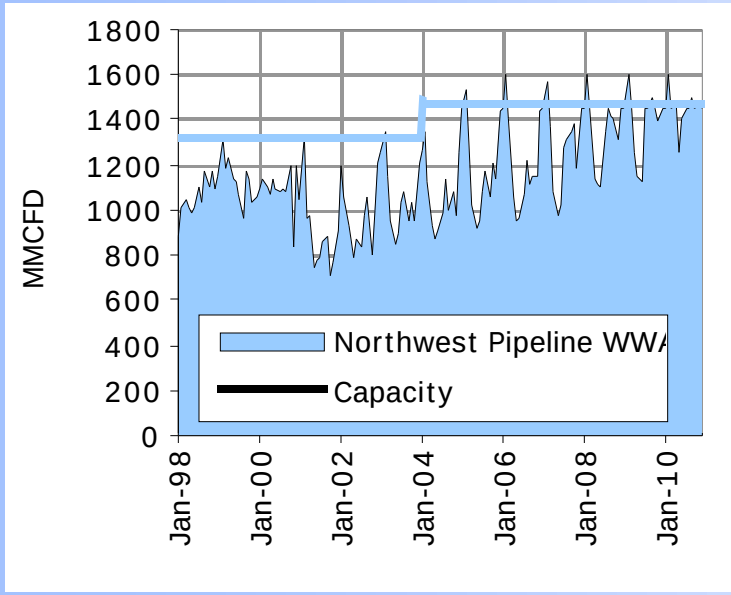
PG&E - NW



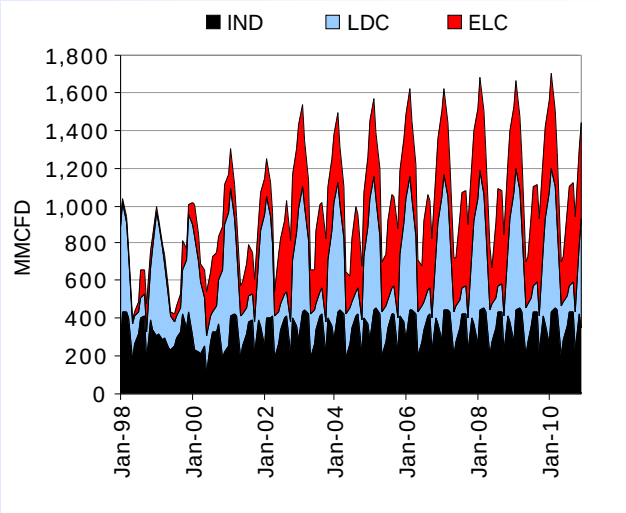
Pacific Northwest

- Pipeline capacity on NWPL in western Washington is projected to be tight.
- Reductions in industrial demand may ease market in the near term.

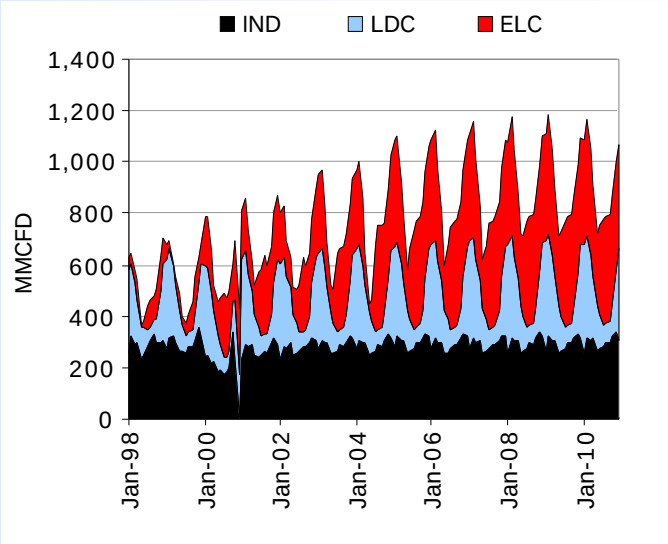
Transco Zone 5



WA Demand



OR Demand



LNG Implications

- **Drivers of the current LNG interest;**
  - **Price;**
  - **Pipeline Backfill;**
  - **International Oversupply.**

- **LNG Terminals;**
  - **Existing Terminals;**
  - **Proposed locations.**

Looking Forward - 36 Months

- **Gas prices should ease substantially over the next two years, but still remain well above the price levels seen in 1998 and 1999;**
- **The next six months will be difficult in the market as storage inventories will need to be refilled, and the needs of over 45,000 MW of new generation capacity will have to be met;**
- **Offsetting the demand growth will be the opportunity for extraordinary returns by gas producers who will be able to sell their product at well above production costs;**
- **Producer ability to get incremental gas supply to market in the face of steep decline rates on existing wells is a key uncertainty;**

Looking Forward - 36 Months *(continued)*

- **Transportation constraints are possible in the Pacific Northwest and potentially in the Mid-Atlantic and New England regions;**
- **Capacity will potentially be short in these markets when LDCs and generators are competing for supplies in the winter-time;**
- **The Rocky Mountains will likely need take-away capacity. However, most markets have expansion projects planned to address capacity shortages;**
- **Growing electric generation demand will likely cause a shift in how gas storage facilities are used;**
- **Storage injections should increase in the shoulder months.**

May I respond to any Questions?