A Look at Western Natural Gas Infrastructure During the Recent El Paso Pipeline Disruption

This analysis examines the impact of the August 2000 El Paso Natural Gas Pipeline system disruption upon the ability of the natural gas pipeline network in the Western United States to meet market needs. The reaction to this problem demonstrated the potential capability of the system to respond to a sudden drop in supply from any single source with a combination of market adjustments, alternate transportation routing, gas from storage, and other non-natural gas remedies such as customer switching to other fuels to supplement the loss of natural gas supplies.

The recent disruption in natural gas pipeline service brought on by the August 19th explosion on the southern portion of the El Paso Natural Gas pipeline system[1] was a major shock to supplies of natural gas in the Western region, particularly in California, Arizona and New Mexico. As population and the economy of the region increased steadily during the past 20 years, natural gas consumption has grown by about 4 percent annually. During the 1980's, Nevada and Arizona were the fastest growing States in the Nation, sustaining population increases of 51 and 35 percent, respectively. During the 1990's, the Census Bureau estimates that these two States continued to grow at average annual rates of 4.7 and 3.2 percent, respectively. These rates are considerably higher than for other States. In addition, California, already heavily populated, grew by 26 percent during the same period.[2]

California dominates the regional market for natural gas because of its large population and heavy reliance on gas in the industrial and electric generation segments, but Nevada and Arizona are also heavily dependent on natural gas to support their growing electric power generation market and expanding industrial/commercial operations.

Although California produces about 15 percent of the gas consumed within its borders, Arizona and Nevada are almost totally dependent upon the interstate pipeline network for their gas. The gas-producing States of Colorado, New Mexico, Texas, and Wyoming supplied about 72 percent of the gas consumed in Arizona, California, and Nevada during 1998 (the last year with complete consumption data).

Interstate Pipeline Service

Eight interstate[3] and several major intrastate pipeline companies provide service to and within the States under discussion (Figure 1). Pipeline capacity entering the area is approximately 10.3 billion cubic feet per day (Bcf/d). Approximately 35 percent of that capacity comes on pipeline systems that access Canadian supplies at the British Columbia-Idaho and

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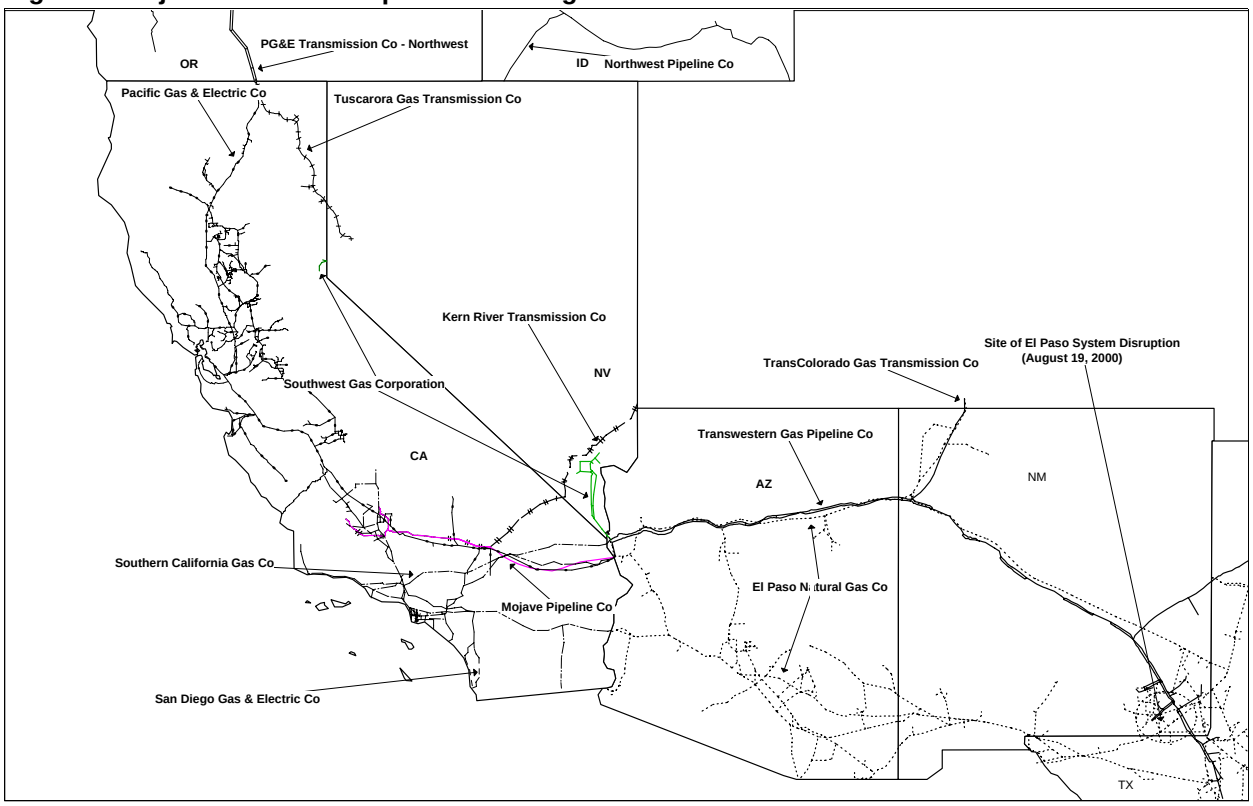
[1] The incident occurred at the El Paso Natural Gas Company's Pecos River crossing located in the southeast corner of New Mexico where three lines (two 30 inch and one 26 inch pipeline) cross the river. While only one 30 inch line blew, the other two lines were also shut down. As a result, 1.2 billion cubic feet per day, out of a normal 2.0 billion cubic feet per day, of natural gas flowing along El Paso's southern route to its Arizona and California markets, was affected for several weeks. In fact, two months after the incident the blown pipeline segment had yet to be replaced. The company reports, however, that flow through the site approximates about 85 percent of previous levels, and customer needs have not been impaired.

[2] California customers account for about 59 percent of the energy consumed in the subject States (Arizona, California, Idaho, Nevada, New Mexico, Oregon, and Washington), and 74 percent of their natural gas use. One utility's deliveries, Pacific Gas and Electric, represented almost 5 percent of all of the natural gas delivered to end-use customers in the United States in 1998.

[3] They are: El Paso Natural Gas (with system capacity of 4,744 Mmcf per day), Kern River Transmission (765 Mmcf per day), Mojave Pipeline (550 Mmcf per day) , Northwest Pipeline (3,351 Mmcf per day), PG&E Gas Transmission Northwest (2,568 Mmcf per day), TransColorado Gas Pipeline (350 Mmcf per day), Transwestern Gas Pipeline (2,640 Mmcf per day), and the Tuscarora Gas Transmission (110 Mmcf per day).

Figure 1. Major Natural Gas Pipelines Serving the Western United States



Source: Energy Information Administration: EIAGIS-NG Geographic Information System.

Washington State border crossings. Two pipeline systems predominate in this part of the region: Northwest Pipeline Company and PG&E Gas Transmission Northwest. The former provides transportation service to Washington, Oregon, Idaho, Utah, and Colorado, while PG&E primarily links Canadian supply sources with the State of California, which accounts for about 73 percent of its total system capacity. PG&E's link with its California affiliate, Pacific Gas & Electric Company (1,970 million cubic feet per day (MMcf/d)), and the Tuscarora Pipeline Company (110 MMcf/d) at California's northern border, represent about 28 percent of all gas pipeline capacity into the State (Table 1).

Nearly two-thirds of the 10.3 Bcf/d capacity into the region is on pipeline systems that carry gas from the Rocky Mountains area and the Permian and San Juan basins. Kern River Gas Transmission brings in supplies from the Rocky Mountains area, mainly supplying the enhanced oil recovery (EOR) fields in southern California and commercial customers in the Las Vegas, Nevada area. The Transwestern Gas Company and El Paso Natural Gas Company are the two principal transporters of natural gas in the region, representing about 49 percent of overall regional natural gas pipeline capacity, and more significantly, more than 60 percent of the transportation capacity serving the southern portion of the region (Arizona, California,[4] and New Mexico). They also account for all of the region's natural gas pipeline transport capacity from east Texas and the San Juan Basin. The El Paso Natural Gas Pipeline is also the principal provider of gas transportation for exports to Mexico, at border crossings west from El

[4] Total capacity into California from the El Paso pipeline system is roughly 3.3 billion cubic feet per day (Bcf/d)–with 2.1 Bcf/d deliverability in the 'north' (at the Arizona/California border, just below Nevada), and 1.2 Bcf/d in the south. Transwestern's is 1.1 Bcf/d. The Transwestern and El Paso systems also provide deliveries to Mojave Pipeline in Arizona. Mojave can transport up to .55 Bcf/d into California. The El Paso northern system also provides up to .22 Bcf/d of deliverability to Southwest Gas Company at the Nevada border.

Table 1. Key Natural Gas Pipeline Capacity Levels into the State of California

Region/ Delivering Pipeline	Receiving Pipeline (Location)	Capacity*
Southern California		
El Paso Natural Gas Co	SoCal Gas Co (Ehrenberg, AZ)	1,210 Mmcf/d
El Paso Natural Gas Co	SoCal Gas Co (Topock, AZ)	540 Mmcf/d
El Paso Natural Gas Co	PG&E Gas Co (Topock, AZ)	1,140 Mmcf/d
El Paso Natural Gas Co	Mojave Pipeline Co (Topock, AZ)	400 Mmcf/d
Transwestern Pipeline	SoCal Gas Co (Needles, CA)	750 Mmcf/d
Transwestern Pipeline	PG&E Gas Co (Topock, AZ)	225 Mmcf/d
Transwestern Pipeline	SoCal Gas Co (Topock, AZ)	190 Mmcf/d
Transwestern Pipeline	Mojave Pipeline Co (Topock, AZ)	150 Mmcf/d
Kern River Transmission Co	Kern River Transmission (Nevada Stateline)	750 Mmcf/d
Mojave Pipeline Co	Mojave (Topock, AZ)	(550 Included in the above)

		5,355 Mmcf/d
Northern California		
PG&E Gas Transmission - NW	Pacific Gas & Electric Co (Malin OR)	1,970 Mmcf/d
PG&E Gas Transmission - NW	Tuscarora Pipeline (Malin OR)	110 Mmcf/d
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		2,080 Mmcf/d
	Total California	7,435 Mmcf/d

* Summer capacity levels

Source: Energy Information Administration, EIAGIS-NG Geographic Information System, State Border Capacity Database.

Paso, Texas, to San Diego, California.[5]

Since 1990, capacity into the region has grown by more than 50 percent, or 4.1 billion cubic feet per day. The majority of this increase occurred on routes transporting gas from Canada, where 75 percent more capacity, or 1.8 billion cubic feet per day, was installed. PG&E Gas Transmission-Northwest, and Northwest Pipeline Company, accounted for almost all of these capacity additions. In spite of a general economic downturn in the region during the early 1990's, particularly in California, average capacity usage rates on these pipelines now match or exceed their 1990 average rates. Today, Canadian sources represent about 35 percent of all natural gas consumed in California.[6]

In contrast to capacity developments to the north, in the southern section of the region there has not been any significant expansion of capacity on the pipeline systems that transport natural gas from the Rocky Mountains area and the Permian (Texas) and San Juan basins (Colorado and New Mexico) since 1993.[7] As a consequence, and as the natural gas markets

[5] San Diego Gas & Electric Company, which operates a 350 MMcf/d border crossing in California, receives a major portion of its supplies from El Paso Natural Gas Pipeline via the Southern California Gas Company system.

[6] The three States comprising the northern portion of the region, Washington, Oregon, and Idaho, rely on Canadian sources for more than 95 percent of their natural gas supplies.

[7] Except for the interstate Mojave and Kern River Gas Transmission systems, which primarily serve the cogeneration/power plant and enhanced oil recovery (EOR) markets in southern California, most gas pipeline transportation service within California is dominated by Pacific Gas and Electric Company and Southern California Gas Company, two of the largest LDC's in the nation. The two companies play dual roles as local distribution companies for their core customers, and open-access transporters for major shippers, such as industrial users and electric utilities, within their respective service territories. They also serve as intrastate pipelines with interconnections to the other local distribution companies

in the area continue to grow, there are signs that during peak demand periods little incremental capacity is available to handle increased demand swings. New pipeline capacity— 90 MMcf/d, in the form of the new Southern Trails (converted oil) pipeline system from the San Juan Basin area to the Los Angeles, California, market—is scheduled for completion in 2001. Additionally, Kern River Gas Transmission Company will soon file a proposal to expand its system by 120 MMcf/d with the Federal Energy Regulatory Commission (FERC), while it is studying the feasibility of building an extension to its system (which currently ends in Kern County, California) to Long Beach, California. Interestingly, the El Paso Company has recently filed with FERC for approval of a plan to convert and integrate an unused oil pipeline[8] into its existing system to enhance its system's integrity and efficiency, but the project entails no increase in capacity.

The need for improved capability extends beyond the interstate pipeline system. For instance, although the physical capabilities of the delivery point at El Paso Natural Gas's Ehrenberg, Arizona (southern system) station could permit 1,410 MMcf/d to be delivered, the Southern California Gas Company (SoCal) system is capable of receiving only 1,210 MMcf/d. Expansion of the SoCal system, and maybe the Pacific Gas & Electric system that receives supplies in southern California, may also be necessary if the State's natural gas markets continue to grow.

During periods of disruptions, markets in southern California benefit from supply diversity.[9] In New Mexico, where natural gas production exceeds consumption by a factor of five, any disruption in service owing to a pipeline failure probably would have a major impact on consumers only if it occurred close to one of the few populace areas. In Arizona, most of the high natural gas demand areas (for example, metropolitan Phoenix) are served by alternative pipeline routes, although a few, such as Tucson in the southern portion of the State, are more vulnerable. Arizona customers, unlike California's, do not have access to service from local underground storage sites which could be used to supplement supplies lost as a result of service disruptions. On the other hand, Arizona customers could benefit from California storage if California's pipelines drew displacement system supplies from their storage facilities while permitting El Paso and Transwestern Pipeline systems to divert supplies normally directed to the California market.

Availability of Underground Storage

The region has a relatively moderate-to-warm weather pattern, which means that storage is not required for meeting large seasonal heating demand. However, a constantly growing air-conditioning load in the region has made underground natural gas storage into an ever-increasing summer-time peaking supply. Much of the underground storage in the region,[10] especially in California (71 percent of total regional working gas capacity), is used primarily to provide market support for the several large gas distribution companies in the region, most notably, Southern California Gas Company and Pacific Gas and Electric Company. The availability of this storage is one of the reasons why the utilization rates on connecting

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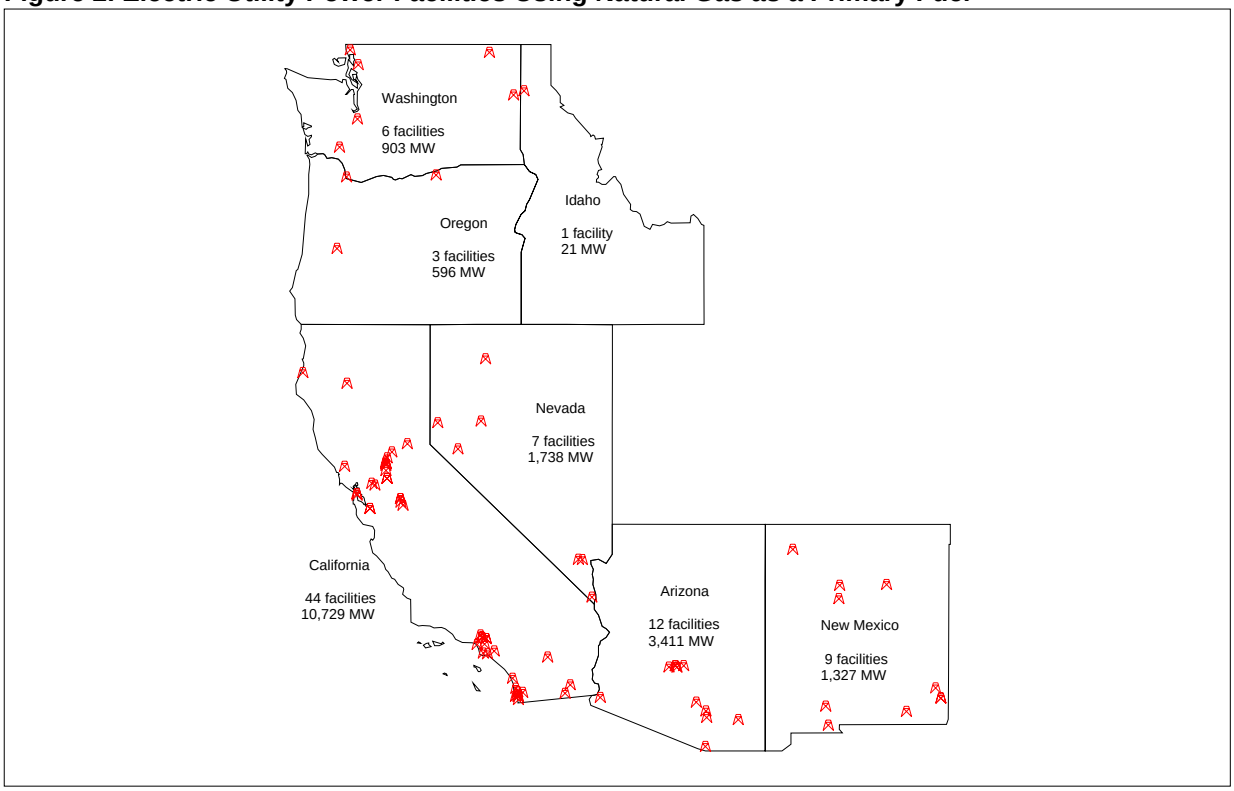
serving the State. Southern California Gas Company provides distribution service in southern California, including transport of supplies to San Diego Gas & Electric Company and Southwest Gas Company, a major LDC in the area. Pacific Gas and Electric claims northern California as its service territory but acts also as a vehicle to move some Canadian gas supplies to southern California.

[8]The project would integrate the All American (oil) Pipeline, which runs from southeast New Mexico to the California border, in with the southern part of the current El Paso Natural Gas Pipeline system. An outcome of the conversion/integration would be the closing of five compressor stations that would no longer be needed.

[9]The relative scarcity of supplies in southern California seems to have lessened as indicated by a regional price comparison. Spot prices for large volume deliveries along the SoCal system had been about 40 cents above prices at the Henry Hub in mid August. The price differential peaked at roughly $2.00 per MMBtu for the week of August 28-September 1. As of the week ending October 6, the differential was about 80 cents.

[10]Including California (11 sites), New Mexico (3), Oregon (2), and Washington State (1).

Figure 2. Electric Utility Power Facilities Using Natural Gas as a Primary Fuel



Note: Number of symbols shown may not equal facility count due to overlapping of sites at scale shown.
Source: Energy Information Administration: EIAGIS-NG Geographic Information System, Electric Utility Plant Database.

interstate pipelines operate at such high and sustained rates. This storage allows regional operators to address the varying needs of their local customers and shippers, while maintaining a steady flow on their systems.

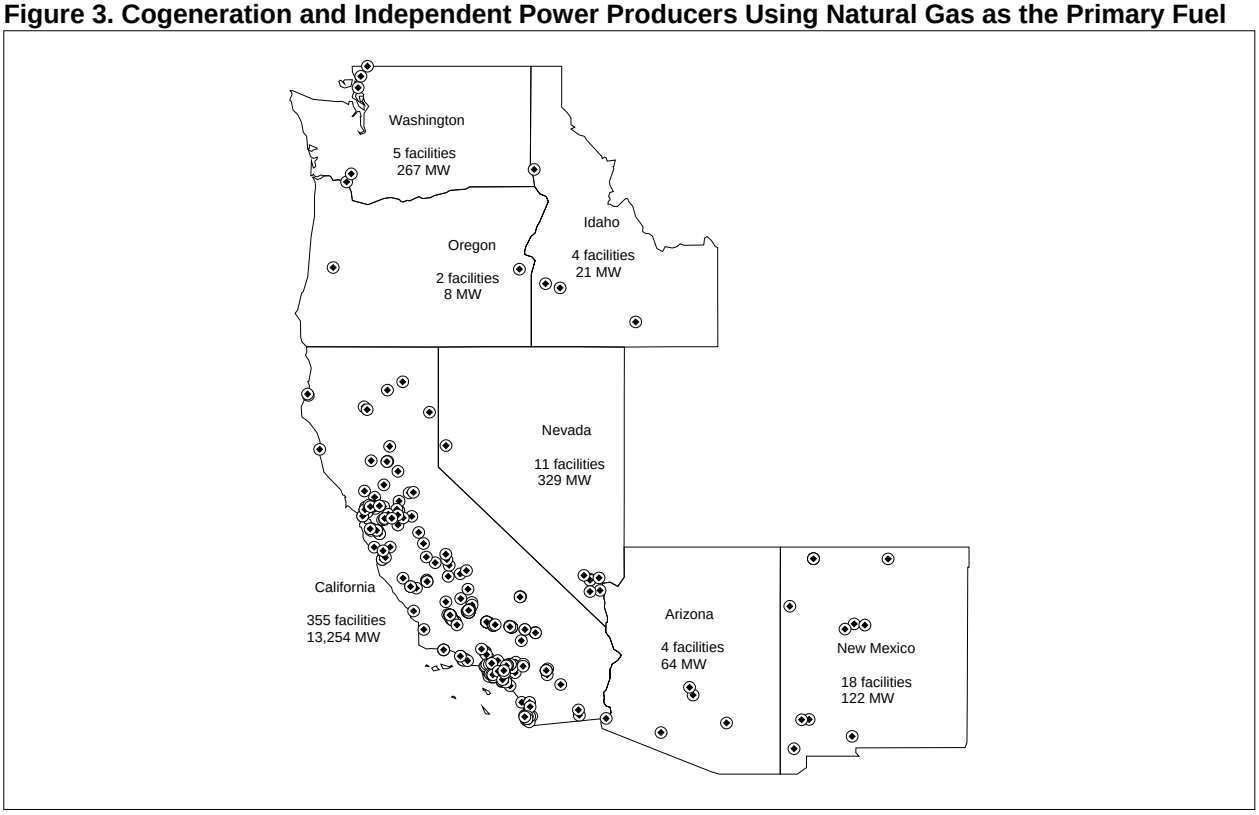
In addition, under deregulation, an increasing amount of this storage capacity has become available to other parties such as natural gas marketers, electric power generators, and large industrial end users. These parties, especially energy marketers, use storage inventory to balance their supply purchasing with their sales transactions. Storage inventories can also be used by them for price arbitrage purposes. The rise in natural gas prices in California and other parts of the region during the disruption on the El Paso Pipeline system provided an incentive for some users of storage to release a portion of their inventory to the marketplace, which helped make up some of the system loss. The level of this type of activity that actually occurred, however, is not readily discernible from available data.

Although the vast majority of storage (working gas) capacity is about evenly divided between the northern and southern portions of the State,[11] storage facilities in southern California (located in the Los Angeles area) have 4.93 Bcf/d deliverability versus only 1.79 Bcf/d for northern California. The States's 11 storage facilities hold the equivalent of 35 days of consumption of natural gas in the State at normal seasonal usage levels,[12] but a number of operational factors limit the actual deliverability of storage gas into the connecting pipelines.

[11] Northern California has 120 Bcf of working gas capacity versus 116 Bcf in southern California.

[12] The actual rate of deliverability depends upon the level of gas in storage at the beginning of the period and sustained contribution and capability of the individual storage sites being used.

Figure 3. Cogeneration and Independent Power Producers Using Natural Gas as the Primary Fuel



Note: Number of symbols shown may not equal facility count due to overlapping of sites at scale shown.
Source: Energy Information Administration: EIAGIS-NG Geographic Information System, Non-utility Power Plant Database.

During the recent El Paso Natural Gas Pipeline disruption, a portion of incremental supplies for customers in the southern portion of California came from storage facilities located in northern California in the San Francisco area. These facilities, with interconnections to the PG&E system (three of the five facilities are owned by PG&E), were used to increase supplies to the local area, displacing supplies that normally would flow on the southern PG&E system that receives gas from Transwestern and El Paso pipeline systems at the southern California border. The only additional storage facility in the region that was available to support gas flows <u>into</u> southern California was the El Paso Washington Ranch site, located in southern New Mexico along El Paso's southern segment, just west of the incident site. This facility was used to make up about 200 million cubic feet daily (with about 8 Bcf in working gas) of the 1.2 Bcf/d lost as a result of the incident. The site possibly could maintain the rate for a month or more.

Small levels of liquefied natural gas (LNG) storage support is in place in the region, especially in market areas where the geologic makeup of the region precludes development of underground storage facilities. These six LNG facilities lessen the need for additional and expensive pipeline capacity when supplies are required only to meet an incremental short-term need. One LNG facility is located in California. The majority of sites (five) are located in the northern portion of the region.

Market Sectors and Usage Patterns

In 1998, California accounted for 59 percent of the energy consumed in the seven States and 70 percent of the natural gas. That year 27 percent of the total energy consumed in California was natural gas. Residential users accounted for 27 percent

of the natural gas consumed in California during that year while industrial users accounted for the largest share, 42 percent.[13] Commercial and electric utility users each accounted for 14 percent. Hydro-power electric generation is the major competitor of natural gas power generation in the State. In the States under discussion, there are 1,223 facilities that produce electricity, 481 of which consume natural gas as a primary fuel. Of the latter, 82 are classified as utility plants (owned by a major electric utility) while 399 are cogeneration facilities or independent power producers. The largest number of the gas-consuming facilities are located in California (44 utility plants - 10,729 MW generating capacity, 355 others - 13,254 MW) (Figures 2 and 3).[14] The electric utility power industry is also a major user of natural gas in Arizona, Nevada, and New Mexico, where the electric generation sector accounts for 24 percent or more of total natural gas deliveries to consumers. Between 1990 to 1998, gas-fired electric generation capacity in the region grew by 30 percent, 52 percent in California alone. Nevada, with its growing demands for electric power from the expanding casino (gambling) industry, is using more natural gas for that purpose. Gas-fired electric generating capacity in the State grew by 33 percent during the period.

Another reason the region increased its overall use of natural gas is the development of the enhanced oil recovery (EOR) market for gas. This market, which uses natural gas to generate steam for injection onto heavy-oil fields located primarily in southern California, accounts for about 200 billion cubic feet imported annually into the State. Reported as industrial use of natural gas, the EOR market accounts for the 2 percent per year growth in the industrial sector in California since 1993, when the Kern River Pipeline and Mojave Pipeline systems first entered this market.

Conclusion

The recent El Paso Natural Gas Pipeline system disruption placed an extreme burden on the region's pipeline network. The reaction to this problem demonstrated the potential capability of the system to respond to supply disruptions, at least in some instances. A key aspect of industry response to any supply disruption is supply diversity, which provides the opportunity for adjustments to accommodate a sudden drop in supply from any single source. With the disruption to flow along one segment of the El Paso system, gas prices in southern California soared at least temporarily, but a combination of market adjustments avoided the occurrence of widespread shortages. The system relied on alternate transportation, gas from storage, or other non-natural gas remedies such as switching to other fuels to supplement the loss of natural gas supplies. Although this is not a guarantee that the current network and supply system is adequate to meet the requirements under all scenarios, it does suggest a robustness at least in the short term that allows markets to avoid the harshest outcomes.

[13] Because natural gas volumes used for electric power cogeneration and non-utility generation are not reported as part of the electric utility sector, but rather as used within the industrial sector, the actual percentage of gas used in electric power generation is higher than the stated 14 percent. For 1998, when adjustments for estimates of non-utility and cogeneration natural gas usage are factored-in, the percentage for California rises to 17 percent, while use in the industrial decreases to 39 percent.

[14] Includes only facilities where natural gas is used as the primary fuel. For electric utility plants, only the nameplate capacity for generating units that burn natural gas as the primary fuel are included in the capacity level shown.