3. Deliverability on the Interstate Network

The United States has a complex, extensive pipeline infrastructure for transporting natural gas from production areas to ultimate consumers. More than 85 U.S. interstate pipeline companies operate almost 200,000 miles of transmission lines, hundreds of compressor stations, and numerous storage facilities, allowing gas delivery throughout the lower 48 States. The importance of the network is reflected in the fact that 27 of the lower 48 States are almost totally dependent upon the interstate system for their gas supplies (Appendix C, Table C2).

Fifty of the interstate pipeline companies are classified as "major" systems by the Federal Energy Regulatory Commission (FERC), in that they each transported more than 50 million dekatherms (equivalent to about 66 billion cubic feet (Bcf)) of natural gas in each of the past 3 years. During January 1996, the month of greatest gas consumption that year, deliveries to end-use customers averaged 77 Bcf per day, with much of the gas moving along these same pipelines.[38] The smaller interstate pipeline companies and the intrastate network (more than 200 systems) are also important, although their services are regional in nature. In fact, some of the intrastate pipeline systems in Texas and Louisiana rival some of the interstate systems in capacity, volumes transported, and revenue generation.

This chapter examines the capability of the interstate pipeline system to link production and market areas, focusing on pipeline operations along 10 distinct corridors: 5 of which extend from the Southwest, 3 from Canada, and 2 from the Rocky Mountains. It identifies the various pipeline companies operating in each corridor and discusses the changes in capacity and usage that have occurred since 1990. It also briefly describes how some of the changes that have occurred as a result of industry restructuring have affected the way gas moves along the pipeline network.

The natural gas pipeline network has grown substantially since 1990, with more than 11.4 Bcf per day of interregional capacity (a 15-percent increase) added through the end of 1997. Meanwhile, the network has become more interconnected, its routings more complex, and its business operations more fluid. New types of facilities, such as market centers, and established operations, such as underground storage facilities, have become further interwoven into the national pipeline grid, allowing the system to operate in a much smoother manner.

Although a few natural gas transportation corridors are operating at close to full utilization year round, the pipeline network in North America has demonstrated its capability to meet the current level of demand. In addition, several expansions are planned to alleviate those cases where limitations exist, especially along those corridors transporting Canadian gas into the United States. In fact some excess capacity could develop along several corridors, although there probably will be some local areas where available pipeline capacity will not match demand.

Recent Changes Affecting the Pipeline Network

Pipeline system operations have changed radically during the past 10 years, particularly since 1992 when FERC issued Order 636. The order formalized the transition of interstate pipeline companies from sellers of natural gas to nondiscriminatory transporters and mandated open access to interstate storage facilities. The resulting restructuring of the industry changed how network resources were being used and caused some shifts in transportation routes and trading and shipping arrangements.

- **The increased competitiveness of the marketplace has led to several new pipeline interconnections as end users sought access to the least expensive gas supplies**. With pipeline companies no longer owning the gas they transport, end users became responsible for making their own arrangements for purchasing and transporting natural gas. Sometimes the traditional pipeline link could not accommodate the consumers' needs directly and consequently several new transportation relationships (interconnections) developed.

- **Storage has become an increasingly important component of overall pipeline and network operations.** The interstate pipeline network depends upon a large number of underground storage sites to provide storage services to pipeline shippers and as a means for maintaining system balances and backup. Underground storage provides the mechanism through which a pipeline company can maintain control over its throughput levels in an environment where it no longer has total control over its receipts and deliveries. Of the 410 underground storage sites operating in the United

[38]Based on total gas delivered to residential, commercial, industrial and electric utility customers in the United States. Energy Information Administration, *Natural Gas Monthly*, DOE/EIA-0130(97/12) (Washington, DC, December 1997).

States in 1996, almost half (190), representing more than 52 billion cubic feet of peak-day deliverability, were owned by interstate pipeline companies or their affiliates.[39] Another 39 of the 400 storage sites serve the interstate market although they are owned by independent operators or large local natural gas distribution companies. The majority of sites owned by independent operators are linked to natural gas market centers.

- **Market centers have proliferated during the 1990s and are becoming increasingly integrated into the transportation network**. Natural gas market centers are a recent development in North America. Prior to 1990, only the Henry Hub site in southern Louisiana loosely fit the current profile of a market center.[40] Today, at least 38 market centers are operating in the United States and Canada, providing numerous interconnections and routes to enhance transfers and movements of gas from production areas to markets. These centers provide a number of services formerly provided by pipeline companies and also offer many of the new services needed in today's market, such as short-term gas loans or temporary gas parking. The types of flexibility demanded of market center services is predicated upon the use of high-deliverability (mostly salt cavern) underground storage facilities. Practically all of the high-deliverability storage located in North America is accessible through or linked directly to market centers. More than two-thirds of market centers have some form of storage access, accounting for about 47 percent of the working gas in North America, or more than 2 trillion cubic feet. Market centers also offer transportation (wheeling) services, balancing, title transfer, gas trading, electronic trading, and administrative services needed to complete transactions on behalf of the parties.

- **The emergence of natural gas trading centers or trading points is also a recent development within the natural gas marketplace.** Trading centers, which sometimes represent the same physical points as a market center or hub, have emerged with the growth of electronic gas trading. Many centers also represent trading points that evolved from the natural gas spot market that first arose during the mid-1980's. At first, commercial electronic gas trading systems were associated with and available only through a few market centers, but now their marketability has been expanded as subscribers are being offered the opportunity to enact trading at strategic points throughout the North American pipeline grid. Most of the points are located in production areas, reflecting the selling of gas by producers at various gathering and pooling points. However, the number of points within market areas is growing as shippers demand more trading flexibility to handle imbalance situations during peak transportation periods.[41] Currently, there are almost 150 trading points defined on these electronic trading services. In addition, many of these same points, and some others, are tracked in the industry trade press. For instance, *Gas Daily*, a widely circulated industry newsletter, publishes a daily price index of natural gas trades based upon transactions reported at approximately 120 points in North America.

Market centers and electronic trading centers/points are rapidly becoming vital components in maintaining an efficient and smooth pipeline network operation in North America. The vast majority of market and trading centers are located at either end of most of the transportation corridors discussed in the following sections. Future growth, or lack thereof, within these corridors will become a function of how much activity develops at these sites. Conversely, growth in demand within individual corridors would be necessary to support any additional market and trading centers.

System Growth Since 1990

The accommodations to change in the restructured industry brought about significant shifts in natural gas receipt, transport, and deliverability along the pipeline network. Since 1990, several new pipelines have been constructed that have improved customer access to production sources (Figure 10). But, for the most part, much of the new capacity added on the network was an expansion to existing systems in order to increase access to new production sources or to new markets.

Between 1990 and the end of 1997, capacity additions on the long-haul corridors alone, which link production and market areas, totaled approximately 12.4 billion cubic feet per day, an increase of about 17 percent.[42] Capacity and deliverability additions made during the period fall into several categories:

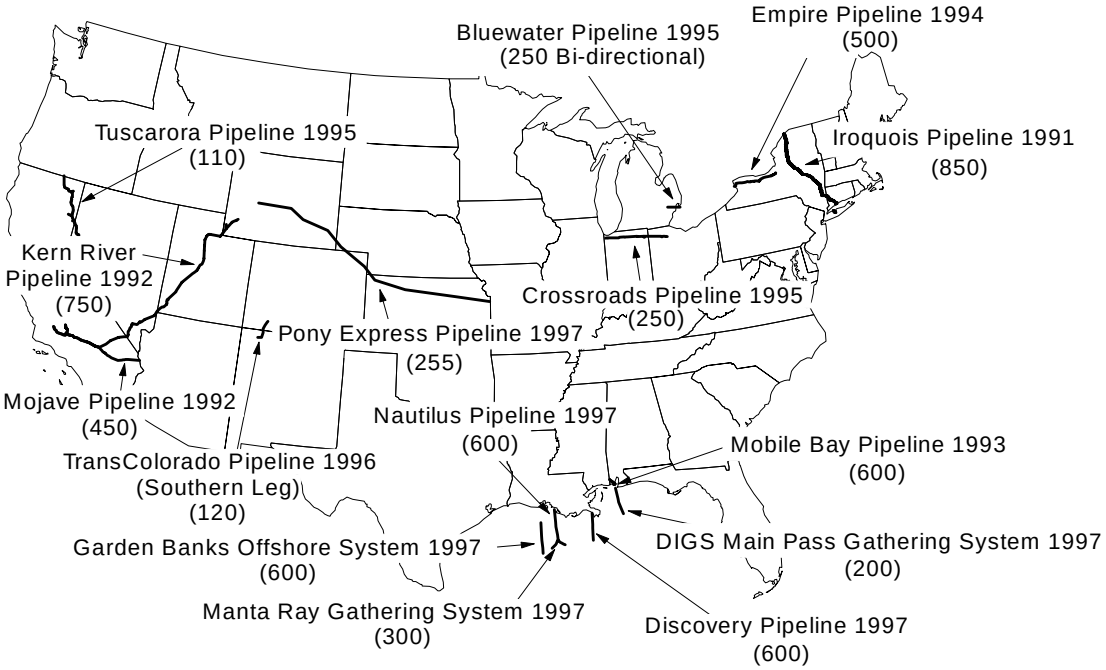
[39]Energy Information Administration, Form EIA-191, "Underground Gas Storage Report."

[40]Energy Information Administration, *Natural Gas 1996: Issues and* Trends, DOE/EIA-0560(96) (Washington, DC, December 1996), Chapter 3.

[41]In fact, according to Quicktrade L.L.C., one of the largest of the electronic trading companies in volume traded, the Chicago trading point, in 1996 transacted six times more business than the largest traded production area point, NGPL Texas/Oklahoma.

[42]Energy Information Administration, EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity, as of December 1997.

Figure 10. Capacity of New Natural Gas Pipeline Systems Placed in Service in the United States Between 1990 and 1997
(Volumes in Million Cubic Feet per Day)



Note: Crossroads and Pony Express pipelines were conversions of existing oil pipelines to natural gas usage.
Source: Energy Information Administration, EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity and Natural Gas Proposed Pipeline Construction Database, as of December 1997.

- New pipeline systems built either to transport gas from expanding production areas or to service new market areas
- Expansion of existing systems to accommodate growing customer demand but accessing supplies already linked to the network
- Expansion of an existing system to accommodate shipper supplies transported via other pipeline systems
- Expansions of short-haul local delivery lines to link with new customers who bypass local natural gas distribution companies
- Expansions of pipeline systems in areas where productive capacity was greater than existing transportation capacity.

Most of the pipeline expansions since 1990 took place between 1991 and 1993, when approximately 17.2 billion cubic feet (Bcf) per day of additional interstate pipeline capacity was brought into service.[43] In 1994, 1995, and 1996, new capacity additions fell off dramatically (totaling only 4.9 Bcf per day over the 3 years). The low level of pipeline expansions in those years reflects decisions made as far back as 1992 and earlier, just as the natural gas marketplace was undergoing a major restructuring and expanding deregulation. Uncertainty about the needs of this new market most likely kept the number of proposed projects to a minimum. In addition, as market conditions changed so did some project plans.

In 1997, more than 40 pipeline projects were completed, the largest number since 1993, adding 6.3 Bcf per day of capacity overall while adding 0.5 Bcf per day to interregional deliverability and 3.9 Bcf to intraregional deliverability. A major portion of the new pipeline capacity represented increased receipt capability in expanding supply areas. For instance, the largest projects were in the Gulf of Mexico (3.2 Bcf per day) as offshore and deep-water development efforts in the area continue to expand. In addition, several

[43]The total capacity represented by the major interstate pipeline construction projects during the period tabulated on a per project basis.

major projects were completed that expanded access to the Wind River and Powder River basins of the Rocky Mountain area by more than 0.5 Bcf per day. The first new export lines to Mexico to be completed in 5 years were also placed in service during 1997.

The greatest increase in capacity since 1990 occurred on those routes between Canada and the U.S. Northeast, 1.9 Bcf per day, or 412 percent (Table 7). This was brought about with the completion of several new pipelines and expansions to several import stations, almost exclusively in New York State (Figure 11). The largest increase in domestic capacity was between the Southwestern and Southeastern States, 1.0 Bcf per day. This increase was driven primarily by the growth in electric power and industrial demand for natural gas in the Southeast, particularly in Florida.[44]

The magnitude of pipeline expansion since 1990 can best be illustrated in conjunction with the natural gas pipeline transportation patterns that have emerged in North America over the years (Figure 12). In the early 1990s, three geographic regions were the primary focus of capacity expansion: the Western, Midwest, and Northeast regions. All three regions shared one common element, greater access to Canadian supplies. In addition, the Western Region was the target of expansions out of the Southwest Region, as new production sources were developed in the San Juan Basin of New Mexico and demand for natural gas in California was expected to grow substantially during the decade.

Through the year 2000, U.S. access to Canadian production is expected to continue to expand at a rate never before seen, while major service expansion to the Western Region appears to have ended. During the next several years, the emphasis will shift to expanding natural gas transportation capabilities from the Rocky Mountain, New Mexico, and West Texas areas eastward to link with pipeline systems reaching the Midwest and Northeast markets. With the completion of this effort, the interstate natural gas pipeline network will come closer to being a national grid where production from almost any part of the country can find a route to customers in almost any area. It will fill the gap in the national network that to some extent has left the Rocky Mountain and Western natural gas producers isolated from certain markets (see Chapter 2).

Major Transportation Corridors

The national natural gas delivery network is quite intricate and expansive, but most of the major transportation routes can be broadly categorized into 10 distinct corridors. Five major routes extend from the producing areas of the Southwest, three routes enter the United States from Canada, and two originate in the Rocky Mountains. For this analysis the 10 corridors have been roughly delineated as follows (Figure 12):

From the Southwest

① **Southwest–Southeast:** from the area of East Texas, Louisiana, Gulf of Mexico, and Mississippi to the Southeastern States.

② **Southwest–Northeast:** from the area of East Texas, Louisiana, Gulf of Mexico, and Mississippi to the U.S. Northeast (via the Southeast Region).

③ **Southwest–Midwest:** from the area of East Texas, Louisiana, Gulf of Mexico, and Arkansas to the Midwest.

④ **Southwest Panhandle–Midwest:** from the area of southwestern Texas, the Texas and Oklahoma panhandles, western Arkansas, and southwestern Kansas to the Midwest.

⑤ **Southwest–Western:** from the area of southwestern Texas (Permian Basin) and northern New Mexico (San Juan Basin) to the Western States, primarily California.

From Canada

⑥ **Canada–Midwest:** from the area of Western Canada to Midwestern markets in the United States.

⑦ **Canada–Northeast:** from the area of Western Canada to Northeastern markets in the United States.

⑧ **Canada–Western:** from the area of Western Canada to Western markets in the United States.

From the Rocky Mountains

⑨ **Rocky Mountains–Western:** From the Rocky Mountain area of Utah, Colorado, and Wyoming to the Western States, primarily Nevada and California with support for markets in Oregon and Washington.

⑩ **Rocky Mountains–Midwest:** From the Rocky Mountain area to the Midwest, including markets in Iowa, Missouri, and eastern Kansas.

[44]Only a small part of this additional capacity, 342 MMcf per day, represented capacity that continued on to the Northeast or Midwest regions.

Table 7. Interregional Pipeline Export Capacity, Average Daily Flows, and Usage Rates, 1990 and 1996

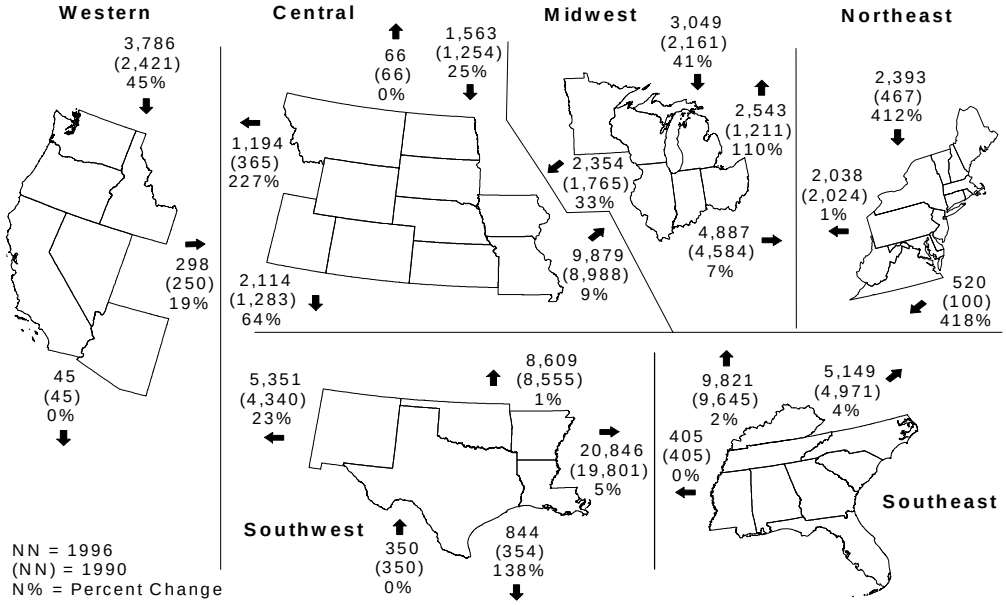
Sending Region	Receiving Region	Capacity (MMcf per Day)			Average Flow (MMcf per Day)			Usage Rate[1] (percent)		
		1990	1996	Percent Change	1990	1996	Percent Change	1990	1996	Change
Canada	Central	1,254	1,563	25	941	1,542	64	75	99	24
	Midwest	2,161	3,049	41	1,733	2,581	49	84	85	1
	Northeast	467	2,393	412	309	1,834	494	66	77	11
	Western	2,421	3,786	56	1,874	3,275	75	78	87	10
Total from Region		**6,303**	**10,791**	**69**	**4,857**	**9,233**	**90**	**78**	**86**	**8**
Mexico	Southwest	350	350	0	0	37	--	0	11	--
Total from Region		**350**	**350**	**0**	**0**	**37**	**--**	**0**	**11**	**--**
Central	Canada	66	66	0	44	4	-99	67	4	-63
	Midwest	8,988	9,879	10	5,684	7,714	36	63	78	15
	Southwest	1,283	2,114	64	572	1,267	122	68	70	2
	Western	365	1,194	227	196	713	264	54	95	41
Total from Region		**10,702**	**13,253**	**24**	**6,495**	**9,698**	**49**	**63**	**78**	**15**
Midwest	Canada	1,211	2,543	110	961	1,626	69	79	68	-11
	Central	1,765	2,354	33	974	1,564	61	86	94	8
	Northeast	4,584	4,887	7	3,474	4,220	21	76	86	11
Total from Region		**7,560**	**9,784**	**29**	**5,409**	**7,410**	**37**	**78**	**83**	**5**
Northeast	Midwest	2,024	2,038	1	714	910	27	45	45	0
	Southeast	100	520	417	63	15	-78	63	60	-3
Total from Region		**2,124**	**2,558**	**20**	**777**	**925**	**18**	**46**	**45**	**-1**
Southeast	Midwest	9,645	9,821	2	6,134	8,020	31	64	82	18
	Northeast	4,971	5,149	4	4,091	4,431	8	82	86	4
	Southwest	405	405	0	75	60	-20	79	86	-4
Total from Region		**15,021**	**15,375**	**2**	**10,300**	**12,511**	**22**	**70**	**83**	**13**
Southwest	Central	8,555	8,609	1	4,119	4,993	21	49	60	11
	Mexico	354	844	138	38	83	117	11	10	-1
	Southeast	19,801	20,846	5	14,613	16,063	10	74	77	3
	Western	4,340	5,351	23	3,910	2,415	-38	90	45	-45
Total from Region		**33,050**	**35,650**	**8**	**22,680**	**23,555**	**4**	**69**	**66**	**-3**
Western	Central	250	298	19	196	4	--	78	0	--
	Mexico	45	45	0	5	9	86	11	21	9
Total from Region		**295**	**343**	**16**	**201**	**13**	**-93**	**69**	**29**	**-40**

[1]Usage rate shown may not equal the average daily flows divided by capacity because in some cases no throughput volumes were reported for known border crossings. This capacity was not included in the computation of usage rate.

MMcf = Million cubic feet. -- = Not applicable.

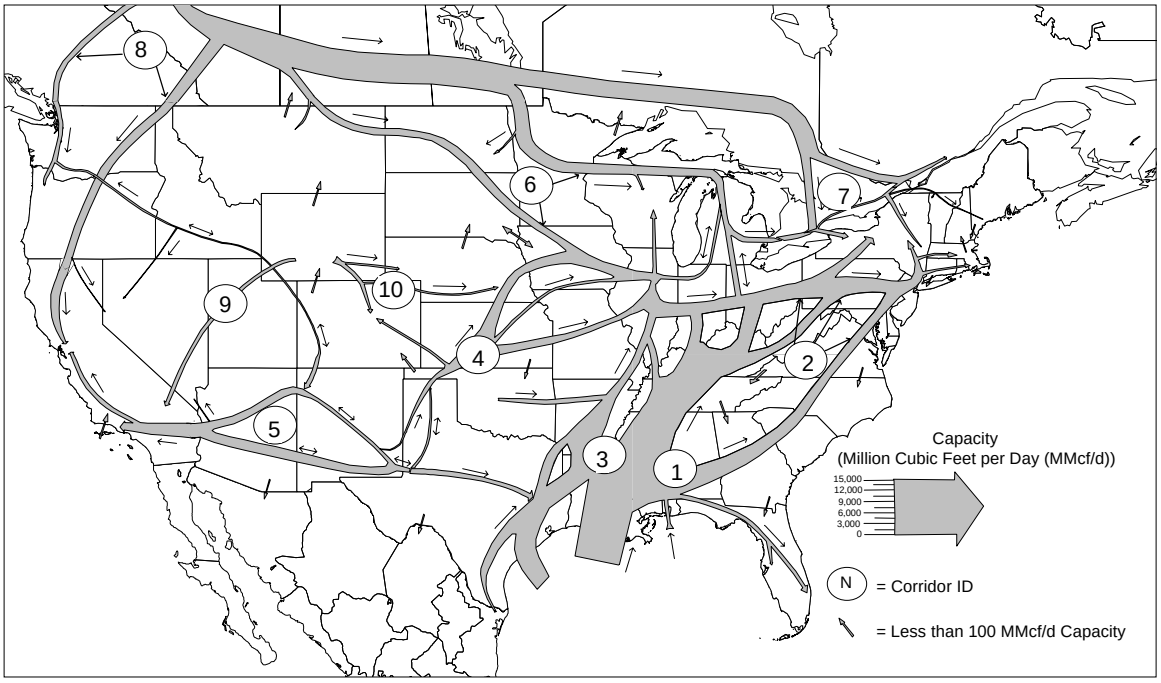
Sources: Energy Information Administration (EIA). **Pipeline Capacity:** EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997. **Average Flow:** Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition." **Usage Rate:** Office of Oil and Gas, derived from Pipeline Capacity and Average Flow.

Figure 11. Region-to-Region Natural Gas Pipeline Capacity, 1990 and 1996
(Volumes in Million Cubic Feet per Day)



Source: Energy Information Administration (EIA), EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997.

Figure 12. Major Natural Gas Transportation Corridors in the United States and Canada, 1997



Note: The 10 transportation corridors are: (1) Southwest–Southeast, (2) Southwest–Northeast, (3) Southwest–Midwest, (4) Southwest Panhandle–Midwest, (5) Southwest–Western, (6) Canada–Midwest, (7) Canada–Northeast, (8) Canada–Western, (9) Rocky Mountains–Western, and (10) Rocky Mountains–Midwest.

Source: Energy Information Administration, EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997.

While these 10 corridors constitute the bulk of the long-distance transportation routes, a number of regional pipeline systems also serve markets within either the supply region itself or the major market areas. For instance, one of the largest pipeline systems within the Southwest supply region is NORAM Gas Transmission Company; within the Northeast market region, Columbia Gas Transmission Company is a major interstate transporter/distributor of natural gas (see Chapter 4 for a regional breakout of pipeline service areas).

Originating Regions

The largest amount of natural gas pipeline capacity exists on those systems that link the production areas of the U.S. Southwest with the other regions of the country. Capacity exiting the region in 1996 was nearly 36 billion cubic feet (Bcf) per day. Between 1990 and the end of 1996, total export capacity from the region grew by 8 percent or 2.6 Bcf per day (Table 7). Export capacity from the Central Region, which includes the Rocky Mountain production areas, was slightly more than 13.3 Bcf per day in 1996, most of which is directed to the U.S. Midwest (9.9 Bcf per day). About 86 percent of this latter figure, however, represents capacity that originates outside the region (from the Southwestern States or at the Canadian border) and merely traverses the region. Canadian export capacity into the United States in 1996 stood at about 10.8 Bcf per day. That figure represents a growth of 69 percent (4.5 Bcf per day) since 1990, with much of the additional export capacity reaching into the U.S. Northeast.

The motivation behind many of the expansion projects completed in these exporting regions from 1991 through 1996 was to improve deliverability from capacity-constrained production areas and/or provide alternative routing opportunities to shippers seeking access to new markets.

More than 20 of the major interstate pipelines originate in the Southwest. Some extend to the Southeast through Louisiana and Mississippi, others to the Central and Midwestern States through Texas, Oklahoma, and Arkansas, and to the Western States through New Mexico. This area of the country exports about 60 percent (8.6 trillion cubic feet in 1996) of its production, which is 58 percent of the total natural gas consumed elsewhere in the lower 48 States.[45] Pipelines exiting the region have the capacity to accommodate as much as 35.7 Bcf per day: 58 percent to the Southeast Region, 24 percent to the Central Region, 15 percent to the Western Region, and the rest to Mexico (Figure 11). Much of the pipeline capacity directed toward the Southeast traverses the region en route to Midwestern and Northeastern markets. To a lesser degree, this is also true for the pipeline capacity exiting to the midsection of the country, much of which is ultimately destined for the Midwestern States.

The Southwestern States also have a large number of underground storage facilities, most of which were once used to store excess natural gas production during months of low consumption.[46] While still true, production storage service is now only one of the functions provided by these sites. A growing amount of the storage in the region is high-deliverability (salt dome) storage, which allows a rapid drawdown of inventory (within 10 days or once a month) and quick shifts from injection to withdrawal mode. This type of storage is highly complementary of the needs of shippers, who under today's rules must manage their own accounts and avoid costly pipeline imbalance penalties and the other vagaries of a more competitive marketplace. Total working gas storage capacity in the Southwest (over 982 billion cubic feet) is the second highest of the six regions (Appendix C, Table C1).

In the Central Region, only one major interstate pipeline provides transportation services directly to another region, Kern River Transmission Company. All the others operate primarily within the Central Region itself. Shippers using these lines to move supplies outside the region take advantage of the interconnections these lines have with the interstate pipelines traversing the region, principally those coming out of the Southwest Region.

Transportation Corridors

① *Southwest-Southeast*

Two routes extend from the Southwest to the Southeast

Two fairly distinct subcorridors extend into the Southeast Region from the Southwest: one goes eastward into Mississippi and continues further east, and the second goes northward into Tennessee and Kentucky (Figure 12). Along the first route, there are three major interstate pipeline companies that operate almost exclusively within the Southeast Region—Florida Gas Transmission Company (FGT), Koch Gateway Pipeline Company (Koch), and Southern Natural Gas Company (SONAT) (Table 8). Together they can handle at least 4.9 billion cubic feet (Bcf) per day for shippers in the region.

[45]For purposes of this discussion, exports pertain to all volumes leaving a region for another region or country.

[46]Energy Information Administration, "U.S. Underground Storage of Natural Gas in 1997: Existing and Proposed," *Natural Gas Monthly*, DOE/EIA-0130(97/09) (Washington, DC, September 1997).

Table 8. Natural Gas Transportation Corridors and Associated Major Pipeline Systems, 1996

Corridor / Pipeline Name	Other Regions Crossed	Number of Delivery Points[1]	Number of Interconnect Points[1]	Average Day Utilization Rate[2]	Capacity (MMcf/d) Wide Point[3]
1 - Southwest-Southeast					
Florida Gas Transmission Co	None	181	3	71	1,475
Koch Gateway Pipeline Co	None	33	44	40	1,134
Southern Natural Gas Co	None	323	10	67	2,250
Texas Gas Transmission Corp	None	215	8	81	2,163
Transcontinental Gas Pipeline Co	None	121	10	84	3,467
2 - Southwest-Northeast					
Columbia Gulf Transmission Co	Southeast	0	4	87	2,063
Tennessee Gas Pipeline Co	Southeast	116	61	90	2,671
Texas Eastern Transmission Corp	Southeast	69	23	84	2,850
Transcontinental Gas Pipeline Co	Southeast	124	16	83	2,587
3 - Southwest-Midwest					
ANR Pipeline Co	Southeast	259	18	70	2,013
Midwestern Gas Transmission Co	Southeast	18	10	59	665
Natural Gas Pipeline Co of America	Central	165	9	61	1,893
Texas Gas Transmission Corp	Southeast	102	20	79	1,509
Texas Eastern Transmission Corp	Southeast	50	13	84	324
Trunkline Gas Co	Southeast	53	8	74	1,853
4 - Southwest Panhandle-Midwest					
ANR Pipeline Co	Central	259	18	70	853
Natural Gas Pipeline Co of America	Central	165	8	61	1,765
Northern Natural Gas Co	Central	129	4	45	2,500
Panhandle Eastern Pipeline Co	Central	67	6	78	1,573
5 - Southwest-Western					
El Paso Natural Gas Co	None	339	2	51	4,261
Transwestern Gas Pipeline Co	None	6	1	36	1,225
6 - Canada-Midwest					
Foothills Pipeline Co LTD (Canada)	None	0	1	NA	1,675
Great Lakes Gas Transmission Co (U.S.)	None	206	30	88	2,286
Northern Border Pipeline Co (U.S.)	Central	2	2	102	1,675
TransCanada Pipeline LTD (Canada)	None	0	2	NA	7,100
Viking Gas Transmission Co (U.S.)	None	42	7	45	425
7 - Canada-Northeast					
Empire Pipeline Co (U.S.)	None	NA	NA	NA	500
Granite State Gas Transmission Co (U.S.)	None	NA	NA	52	62
Iroquois Gas Pipeline Co (U.S.)	None	10	8	90	858
Tennessee Gas Pipeline Co (U.S.)	None	31	25	90	843
TransCanada Pipeline LTD (Canada)	None	4	3	NA	3,950
8 - Canada-Western					
Alberta Natural Gas LTD (Canada)	None	0	1	NA	1,360
Foothills Pipeline Co LTD (Canada)	None	0	1	NA	1,094
Northwest Pipeline Corp (U.S.)	None	282	4	56	1,289
Pacific Gas Transmission Co (U.S.)	None	190	2	93	2,454
Tuscarora Gas Transmission Co. (U.S.)	None	5	1	NA	110
Westcoast Gas Transmission LTD	None	1	1	NA	1,066
9 - Rocky Mountains-Western					
Kern River Gas Transmission Co	None	30	1	95	750
10 - Rocky Mountains-Midwest					
Trailblazer Pipeline System	None	0	4	127	411
KN Interstate Gas Co	None	0	12	32	120
Williams Natural Gas Co	None	0	24	47	186

[1]Represents the number of delivery points or major pipeline interconnections along the section(s) of the pipeline systems associated with and within the respective corridor.

[2]Based on the sum of the State crossing point capacities of the respective pipeline divided by the sum of average daily flows at the same points.

[3]Represents the capacity (throughput capability) of the pipeline system at its maximum within the corridor.

NA = Not available. MMcf/d = Million cubic feet per day.

Sources: Federal Energy Regulatory Commission, FERC 567 Capacity Report, “System Flow Diagram.” Energy Information Administration (EIA), EIAGIS-NG Geographic Information System, Natural Gas Pipeline State Border Capacity Database, as of December 1997.

Varying amounts of capacity on several other large interstate pipelines that follow this subcorridor also serve limited markets in the region. For instance, Transcontinental Gas Pipeline Company (Transco) serves customers in Georgia, South Carolina, and North Carolina as it continues along its route up the east coast (Appendix A, Figure A4). However, this service only represents about 1.1 Bcf per day, or 30 percent, of the 3.5 Bcf per day found on the Transco system as it enters the region. Yet, in North Carolina it is essentially the only source of natural gas supplies to the State.

Along the second subcorridor, one pipeline company predominates, at least in terms of delivery points, Texas Gas Transmission Company (TGT). While this system extends into the Midwest Region, more than 70 percent of its delivery points are located in the States of Kentucky and Tennessee. TGT provides substantial deliveries to underground storage facilities in northern Kentucky that supplement supplies to the local market and to the Midwest Region during the heating season.

Tennessee Gas Pipeline Company (Tenneco) and Texas Eastern Transmission Company (TETCO) are two additional systems operating along this subcorridor, but most of their delivery points are outside the Southeast Region. Tenneco, however, is the principal supplier of gas to two regional interstate pipelines: MidCoast Pipeline (formerly the Alabama-Tennessee Natural Gas Company) mostly operating in northern Alabama, and the East Tennessee Gas Company (Tennessee and Virginia). Nevertheless, these deliveries represent only about 0.6 Bcf (peak-day) out of a total 2.3 Bcf deliverability available per day on the Tenneco system.

Capacity along the eastern subcorridor increased by about 5 percent between 1991 and 1996, primarily because of a substantial expansion on a major part of the Florida Gas Transmission system (up to 80 percent). In addition, while the Transcontinental Gas Pipeline system is not primarily a regional supplier, a major portion of its expansions during this period were directed toward service along this corridor rather than on its Northeast regional section. Transco's expansion during the period included a large capacity addition (0.4 Bcf per day) to new customers in northern North Carolina. The addition actually brought service southward, out of Virginia, from Transco's northbound mainline.

One new pipeline, the Mobile Bay Pipeline system (600 million cubic feet (MMcf) per day), was added within this corridor in 1993. It was only the second pipeline built in the Gulf of Mexico that terminates in the Southeast Region (the first being the Chandeleur Pipeline, 275 MMcf per day). The system interconnects with both the Transcontinental Gas Pipeline (Transco) and Florida Gas Transmission (FGT) systems located in Alabama. The completion of this pipeline coincided with the 655 MMcf per day expansion of the FGT system and the multi-phased expansion on the southern portion of the Transco system, totaling 220 MMcf per day.

FGT expanded its system to provide additional service to the State's electric power generation sector and to a growing industrial sector; natural gas use in these sectors grew at an annual rate of 9.8 and 8.7 percent, respectively, between 1990 and 1996. Capacity utilization on the FGT system on its peak day in 1995 was 102 percent (Figure 17, Chapter 4). During its month of greatest throughput (July), average utilization was 97 percent, while during its lowest month (February) it fell to only 66 percent. FGT is unique in that its highest usage rates occur during the summer months, reflecting the strong electric generation (for air conditioning) needs within this warm region.

Tennessee Gas Pipeline Company (Tenneco) added capacity within this corridor to improve its overall capability to serve customers in the Northeast. While its several mainlines were already quite large in 1990, the added capacity represented a sizeable percentage increase to overall capacity along the corridor. Tenneco increased its capacity on the route by 19 percent (126 MMcf per day) leaving the production area of the Southwest (Appendix A, Table A4).

Average daily utilization rates on other pipelines in this corridor in 1995 ranged between 40 and 84 percent. The most highly utilized was the FGT system, which had a 66-percent usage rate during the off-peak periods and close to full capacity during its peak service period. The Transco system operated at about 83 percent on average, while during its peak periods operated at about 99 percent and 81 percent during the summer off-peak period (see Chapter 4).

The underground storage facilities located along this corridor are defined by their location. Those facilities at the corridor's southern end in Louisiana, Mississippi, and Alabama are mainly high-deliverability salt storage sites to support shippers and traders who want to acquire supplies for shipment to market (Appendix C, Table C1). Of the 9.3 Bcf of daily storage deliverability (withdrawal) available in the area, 46 percent is from salt cavern sites. This feature provides shippers using these corridors access to very flexible storage, which can be used to enhance their deliverability schedule, avoid transportation imbalances, and support any gas trading or hedging activities they may wish to engage in.

In northwestern Kentucky, along the western subcorridor, storage facilities are devoted primarily to providing seasonal supplies. They are supported, for the most part, by deliveries from the Texas Gas Transmission system. The majority of the storage in Mississippi and Alabama is available to shippers using either subcorridor.

The principal pipeline expansions proposed along, or within, this corridor through 2000 represent greater access to Gulf of Mexico supplies and improvements to service within the Southeast Region (Appendix B, Table B2). Projects slated to provide new or improved access to Gulf of Mexico supplies amount to about 1.7 Bcf per day or 54 percent of the regional projects currently proposed. Strictly onshore, the SONAT system will add 141 MMcf per day to its northern section, while Transco will upgrade its system with a short-haul 400 MMcf per day pipeline link to a new liquefied natural gas facility in North Carolina. In addition, Transco plans to update its facilities along this route to support the development of two new regional pipeline systems, the Cardinal Pipeline in North Carolina (140 MMcf per day) and Cumberland Pipeline serving Tennessee and Georgia (200 MMcf per day).

② *Southwest-Northeast*

The main flow of U.S. gas is toward the Northeast

The Southwest-to-Northeast corridor consists of two routes. The first extends from East Texas and Louisiana northeastward through Mississippi, Tennessee, Kentucky, and parts of Ohio to enter the Northeast Region via West Virginia or Pennsylvania (Figure 12). The second route begins as the first but then extends northeastward from Mississippi via the east coast States and enters Virginia from the south.

The principal interstate pipeline systems operating along the corridor include Tennessee Gas, Columbia Gulf Transmission, and Texas Eastern Transmission on the western segment, and Transcontinental Gas Pipeline on the eastern segment. These four pipeline companies represent approximately 9.3 Bcf per day of total capacity, making this corridor the largest of the major transportation corridors in North America.

Since 1990, capacity on this corridor increased only slightly, about 500 MMcf per day. Most of that, 300 MMcf per day, occurred on the Texas Eastern Transmission system as improvements were made to the links between its eastern seaboard network and its Midwest interconnections. Transcontinental Gas Pipeline system increased its capacity by 310 MMcf per day, but little of this expansion affected its system north of Virginia.

The average utilization rates for the pipelines operating along this corridor ranged from 73 to 86 percent in 1996, for an overall average rate of 82 percent (Appendix A). That overall rate was the same as in 1990. With the exception of Transcontinental Gas Pipeline system, which had a slight drop in utilization between the two comparison years, usage on each of the pipeline systems increased marginally. The largest increase was on the Tennessee Gas Pipeline system, which rose from 80 to 86 percent.

During wintertime peak periods, each of the systems are almost fully utilized. During the summer months, however, usage rates for the pipeline systems operating along this corridor tend to drop substantially. Except for the Columbia Gulf Transmission system, which operated at close to 100 percent year-round during 1995, the summertime (system wide) usage rates ranged from 49 percent for Texas Eastern's system to 81 percent for Transco's system. The principal factor affecting summertime usage rates on several of these pipeline systems is the demand for gas to refill underground storage sites in the States of West Virginia and Pennsylvania, and, to some degree, Ohio and New York as well. During the past several years, the refill rate and level of total (storage) working gas inventory prior to the heating season has fallen as inventory management practices have changed. This trend is reflected in the lower off-peak usage rates on some of the affected pipeline systems.

The majority of the more than 190 underground storage sites located along this corridor are accessible to shippers. At the southwestern terminus of the corridor, more than 30 sites with a working gas capacity of at least 624 billion cubic feet and a daily withdrawal capability of 13 Bcf per day are located within 20 miles of the subject pipeline systems. Most of this capacity is used by producers, who use it to store short-term excess production, and by market centers.

Most of the same Southwestern market centers and associated storage discussed previously are also used by shippers on this corridor.[47] But, in addition, this corridor links with some of the most active market centers located outside the Southwestern production area. One of the most significant is the Ellisburg-Leidy center in Pennsylvania, which provides interconnections and transportation services between the pipelines comprising this corridor and the other major interstate pipelines operating primarily within the Northeast States. Shippers using the corridor may also utilize the services of the CNG/Sabine, Columbia Gas, and New York (Brooklyn Union Gas Company) market centers to expand their marketing and transportation options further.

Several expansions have been proposed that could affect the northwestern portion of this corridor, although they would originate in other areas. For the most part they focus upon expansions that could tranship some of the vast amount of proposed new Canadian import capacity slated for the Midwest to the Northeast Region (Appendix B, Table B2). For instance, ANR Pipeline Company and Transcontinental

[47]Storage capacity within each of the 10 corridors should not be summed to get a U.S. total because it would result in double counting.

Gas Pipeline Company have proposed the jointly owned Independence project, which could carry 1 Bcf per day from ANR's line in northwestern Ohio to a major interconnection with Transcontinental's line in Leidy, Pennsylvania. The new line would also be attractive to Canadian shippers seeking an alternative route to Northeast markets. It could also provide an alternative route and opportunity for shippers now moving gas from the Southwestern to the Midwestern areas of the country to reach customers in the Northeast.

Other projects that would affect this portion of the corridor and direct some of the new Midwestern pipeline supplies eastward include Tennessee Gas Pipeline Company's proposed Eastern Express project and Duke Energy Corporation's Spectrum project. These two projects alone represent a total of 1.2 Bcf per day of new capacity into the Northeastern United States.

The Spectrum project (0.5 Bcf per day) would extend from the Chicago, Illinois, area to New York and New England, mostly by using expanded facilities along Duke Energy's affiliated pipelines: Panhandle Eastern, Texas Eastern, and Algonquin Gas Transmission systems (west to east). In addition, an interconnection with another affiliate, Trunkline Gas Company, could be upgraded to improve gas supply transshipments from the Southwest Region, if appropriate (as could the Panhandle Eastern Pipeline system). The Eastern Express project (0.7 Bcf per day) would utilize Midwestern Gas Transmission Company (an affiliate of Tennessee Gas Pipeline Company) to ship supplies southward (or though exchanges of gas) to Tennessee Gas's interconnection in northern Tennessee and then, through expanded facilities on its existing system, transport supplies from the Midwest to the east coast.[48]

③ *Southwest-Midwest*

Corridor has significant off-peak capacity

The Southwest-to-Midwest corridor extends northward out of East Texas, Louisiana, and Arkansas (Arkoma Basin production) and generally through Tennessee/Kentucky into the Midwest Region, although a part of it also travels through Missouri (Figure 12). The principal interstate pipeline systems operating along this corridor are: ANR Pipeline Company (ANR), Midwestern Gas Transmission Company (via Tennessee Gas Pipeline Company), Natural Gas Pipeline Company of America (NGPL), Texas Gas Transmission Company (TGT), Texas Eastern Transmission Company (TETCO), and Trunkline Gas Company.[49]

These systems represent approximately 7.3 Bcf per day, or 29 percent of the total pipeline capacity feeding into the Midwest Region (24.8 Bcf per day). They also account for more than 30 percent of the total pipeline capacity exiting this area of the Southwest.

Several of the major pipeline projects that were planned for development between 1991 and 1996, in large part to provide shippers on this corridor greater access to supplies from the Arkoma Basin in Arkansas/Oklahoma to the Northeast and Midwest markets, were not built. Part of the reason may have been the competing plans for Canadian import expansions and the low utilization rates on the existing lines extending to the Midwest Region.

Very little underground storage is located along the midsection of this corridor. However, shippers have access to significant amounts of storage at either end. This corridor also links together two major gas trading centers: the Henry Hub in Louisiana and the Chicago Center in northern Illinois. In addition, the corridor also includes several natural gas trading (and price discovery) locations accessible to shippers and traders via the several major commercial electronic trading systems set up in the United States and Canada. During the heating season, these markets are actively used by shippers and other market participants as a way to balance their receipts/deliveries, for arbitrage between the two markets, and to smooth market and price fluctuations through hedging.

Pipeline utilization rates on the corridor during peak periods of the heating season are generally in the 90 to 100 percent range, but during the nonheating season, usage rates range between 50 and 70 percent per average day. These figures indicate that a significant amount of capacity is available during off-peak periods, even though at the northern end of the corridor there is a large amount of underground storage capacity to refill. At the end of the 1995-96 heating season, for instance, the amount of working gas capacity to be refilled in the three States at the terminus of this corridor—Illinois, Indiana, and Kentucky—was approximately 287 billion cubic feet (Bcf),[50] or the equivalent daily refill requirements of 1.4 Bcf per day (210 days in the nonheating season). On this basis, deliveries to storage would need only about 18 percent of the daily pipeline capacity available on this route.

[48]In addition, the Eastern Express project would include expansion of Tennessee Gas's pipeline (0.2 Bcf per day) between its Niagara, New York, import point and its interconnections near Leidy, Pennsylvania, and its northern line extending directly to New England.

[49]Mississippi River Gas Transmission Pipeline Company (0.7 Bcf per day) also transports gas along this corridor but it terminates in the St Louis, Missouri, area. Its operations in Illinois are confined to the area east of St Louis.

[50]Based on an average 35 percent working gas capacity remaining at the end of March 1996 in all sites located in the three States.

In addition, during August 1996 total natural gas consumption in these three States was only 26 percent as much as that in January, the month of highest consumption. At this level, and assuming that deliveries to these three States were only from this corridor, capacity requirements would be only about 1.9 Bcf per day during this off-peak month. Even with the deliveries to storage considered, pipeline capacity needed to meet the needs of the area is less than 50 percent of what is already available. Perhaps because of this situation, no additional capacity is currently planned along this corridor.

④ *Southwest Panhandle-Midwest*

Route is a major link between Waha Hub and Chicago

This corridor extends from the West Texas and Oklahoma Panhandle areas northward through the major gas production fields (Hugoton, Panhandle, etc.) located in southwestern Kansas, and then northeastward toward the Midwest marketplace (Figure 12). Midway on its course, in Nebraska, it links with another corridor (see Rocky Mountain-Midwest section) bringing supplies in from the Rocky Mountain areas of Wyoming, Utah, and Colorado.

There are four major interstate pipelines that run along this corridor: ANR Pipeline Company, Panhandle Eastern Pipeline Company, Northern Natural Gas Company, and Natural Gas Pipeline Company of America. These four pipelines alone constitute 67 percent of total pipeline capacity exiting this area. These pipeline routes, however, represent only about 17 percent of the total capacity into the Midwest Region. The Trailblazer Pipeline system (average flow of 0.5 Bcf per day in 1996) ties in Rocky Mountain supplies with an interconnection to Natural Gas Pipeline Company of America in Nebraska.

Several of the pipeline companies operating within this corridor have completed system expansions since 1990, although the additions were relatively small in comparison with additions in other corridors. For instance, in 1992, Natural Gas Pipeline Company of America (NGPL) added about 90 MMcf per day on the portion of its Amarillo line coming into Illinois and also improved capacity on its system coming out of the production areas of West Texas by about 245 MMcf per day. In 1996, Northern Natural Gas Company (NNG) completed an expansion of 351 MMcf per day on its west-to-east route, improving service in the area and extending north to southern Wisconsin. At its terminus, it also improved its transmission facilities and transport capabilities in the Texas and Oklahoma panhandles by 310 MMcf per day in 1991 through 1993. The ANR Pipeline system increased capacity by 16 percent in this corridor, although this represented an increase of only about 83 MMcf per day. Capacity levels on the Panhandle Eastern Pipeline system did not increase at all.

Market centers located in the Waha and Panhandle area of West Texas serve this transportation corridor at its apex. At its terminus, shippers and traders can link their Texas trading with the Chicago market center.[51] In addition, the Mid-continent market center, located in southcentral Kansas, provides shippers with the opportunity to do business with traders in the other two areas. All four pipelines operating in the corridor have direct or indirect links with each of the market centers.

Traders and transporters using this corridor can also tie their business and trading activities in with futures market trading. Both the New York Mercantile Exchange (NYMEX) and the Kansas City Board of Trade (KCBOT) have operated futures trading markets in the West Texas area for several years. These markets provide traders with the opportunity to hedge their trading activities and avoid price volatility risks.[52] Of the two markets, the KCBOT has generated the most interest since its operational debut in 1995.

Also, because of its links to West Texas and the Oklahoma Panhandle area, many (spot market) trading points have become associated with this corridor. Some of the most active natural gas trading points (on a volume basis) have developed along it.

Only a limited amount of underground storage capacity is available to transporters through markets centers located along this route. Only the Mid-Continent and Chicago market centers offer any applicable access to storage services for shippers. However, during the nonheating season a sizeable amount of capacity on these systems is used to transport supplies for injection into storage facilities in Illinois, Indiana, and Michigan. The ANR Pipeline system in particular has a number of open-access sites located at the northern end of its system in Michigan. NGPL has a number of storage sites located in Illinois.

Very little expansion along this corridor is planned over the next several years. The only significant projects slated for development are the NGPL Amarillo expansion between Iowa and Illinois (110 MMcf per day), scheduled for completion in 1998, and the Northern Natural Gas Company's East Leg 2000 expansion, which will increase service capacity in its Central and Midwest markets by as much as 450 MMcf per

[51]Energy Information Administration, *Natural Gas 1996: Issues and Trends*, DOE/EIA-0560(96) (Washington, DC, December 1996), Chapter 3.

[52]The locations of these futures markets in the Waha area of West Texas also enables their services to be available to shippers operating in East Texas moving supplies through the Texas intrastate system.

day.[53] The fact that these two projects are focused in the northern tier of this corridor while the southern section is not slated for significant expansion reflects primarily the ripple effect of proposed expansions to Canadian import capabilities.

⑤ *Southwest-Western*

Westward corridor is overbuilt

The Southwest–Western corridor is used to transport supplies from the Permian Basin area of West Texas, through New Mexico (where the northern route taps into the San Juan Basin production area), and westward primarily to California (Figure 12). Two major interstate pipelines, El Paso Natural Gas Company and Transwestern Pipeline Company, operate along this corridor (Table 8). Both of these pipelines end at the California or Nevada State borders, where they deliver supplies to Southwest Gas Company (Nevada), Southern California Gas Company, and Pacific Gas & Electric Company, the largest pipelines serving the California marketplace. In addition, Transwestern Gas Pipeline Company links with the Mojave Pipeline Company, an interstate pipeline placed in service in 1992 to transport natural gas supplies to the enhanced oil recovery (EOR) and cogeneration customers located in Kern County, California.

During the first part of this decade, these two pipeline systems expanded considerably: El Paso Natural Gas Company by 19 percent and Transwestern Pipeline by 41 percent. However, these expansions added capacity into California just when it was least needed and, as a result, a competitive situation developed between lower-cost Canadian supplies and Southwestern regional production. An additional impact was that unused capacity on these systems not only brought about a significant drop in load, but in several instances customers actually turned back contracted capacity, opting instead to satisfy their needs through the capacity release market. Compared with 1990, when average daily utilization levels on the El Paso and Transwestern systems were above 90 percent, in 1995 average-day utilization levels for the two pipelines were below 60 percent. Indeed, on its system peak day in 1995, El Paso Natural Gas had only a 66-percent load factor overall. Transwestern Pipeline's load factor on its peak day was 60 percent (Appendix A, Table A5).

The lower section of the long-delayed TransColorado pipeline system was completed in 1996. The southern 25-mile section of this 266-mile proposed pipeline system is currently moving about 120 MMcf per day from the Ignacio area of the southern Colorado San Juan Basin to the Blanco hub in northern New Mexico. While this is less than half of its design capability of about 300 MMcf per day, when the northern section of the system[54] is completed (proposed late 1998), this recently completed section is expected to operate at close to its full capability.

Finally, the completion of Transwestern Pipeline Company's San Juan Basin expansion (255 MMcf per day) in 1996 expanded capacity on the New Mexico side of the San Juan Basin and partially relieved a production constraint situation that has hindered the flow of production out of the area for several years. While some of this improved capability will go to the Western marketplace, a major objective of this project has been to improve producer access to customers in the U.S. Northeast and Midwest.

The Blanco (hub) market center, operated by Transwestern Pipeline Company and located on the New Mexico portion of the San Juan Basin, has become a major pooling point for producers in the area and for shippers, especially those wanting to forward their supplies eastward to the market centers in West Texas (Waha area) and for transhipment on the Northern Natural Gas system (an affiliate of Transwestern), located to the northeast via the Texas and Oklahoma panhandles (see corridor ④).

Nevertheless, a significant amount of West Texas and New Mexico gas supplies still are transported along this corridor to Arizona, California, and Nevada. In 1996, more than half of the natural gas consumed in those States (approximately 994 billion cubic feet) was transported via this route.

There is very little underground natural gas storage capacity associated with this corridor. At the extreme eastern end of the corridor, only one site, the Washington Ranch facility operated by El Paso Natural Gas Company, is reserved primarily for system support services and is not available for customer use. At its western end, in southern California, a limited amount of storage capacity is available to shippers at five sites operated by Southern California Gas Company (SoCal). While about 60 percent of this capacity is reserved for the company's own use, shippers can access what is available, as well as such storage-related services as short-term gas loaning and parking, through the California Energy market center, which is also operated by SoCal.

Although some of the natural gas injected into these storage sites comes from producing fields in southern California, a significant amount of the working gas stored at these sites

[53]This expansion will accommodate shippers on the expanded Northern Border Pipeline system.

[54]The TransColorado Pipeline was originally slated for completion in mid-1992 but changing market conditions and other factors delayed construction until recently. The northern section will run from the Big Hole area of Rio Blanco County in northwest Colorado to the Ignacio area in southern La Plata County, Colorado.

comes out of this corridor. The combined injection rate capability of the five sites is 1.1 billion cubic feet (Bcf) per day, while their total working gas capacity is 115 Bcf. This translates into roughly 104 days needed to fill these sites from scratch. But working gas levels at these sites rarely fall below 30 percent,[55] which means that the equivalent of approximately 83 days per year of about 1 Bcf capacity service on the corridor could be said to be carried by storage service operations, or only about 4 percent on an annual basis.

Because of the excess capacity along this corridor, those projects that have been proposed are intended primarily to support expanded service to the eastern end of this corridor. Nevertheless, the end result of completing these projects will be to improve and expand service to the western end as well. For instance, Transwestern Pipeline Company has proposed further expansion of its San Juan facilities by up to 245 MMcf per day in 1998, while El Paso Natural Gas Company has submitted plans for a compression enhancement project in the same area, which would improve its capacity by 116 MMcf per day. The location of the facilities that are part of these projects, that is, the San Juan Basin triangle, is such that service benefits will affect area producers and shippers transporting to either end of the corridor.

⑥ *Canada-Midwest*

Corridor is major import route for Canadian gas

This transportation corridor lies between Western Canadian supply areas and the U.S. Midwest and links two Canadian systems, TransCanada Pipeline Ltd. and Foothills Pipeline Company, with three United States pipeline systems, Great Lakes Gas Transmission Company, Northern Border Pipeline Company[56] and Viking Gas Transmission Company (Figure 13). This tie-in represents about 4.4 Bcf per day of pipeline capacity, or about 41 percent of total U.S. natural gas import capacity in 1997. Since 1990, capacity on this route has increased by more than 40 percent.

Also, another pipeline, the Bluewater system, located at the eastern end of the corridor and placed in service in 1995, can transport up to 250 MMcf per day on a bi-directional basis between the United States (Michigan) and Canada (Ontario). It was developed primarily to support regional storage services and business at the regional Grand Lacs natural gas market center; thus it is strategically located. It lies along a route that will be expanding to accommodate increasing amounts of Western Canadian gas being transported to Northeast markets via a southern Canadian/U.S. alternative (see below).

A large number of underground storage facilities are located in proximity to several of the pipeline systems operating in this corridor, although not all of them are directly accessible to shippers. For instance, nine sites (1 Bcf per day injection, 1.8 Bcf per day withdrawal capability) are directly accessible to shippers using the Great Lakes Gas Transmission system, while the storage facilities located in Illinois and operated by Northern Illinois Gas Company (eight sites, 3.4 Bcf working gas capacity) are available only through the Chicago Market Center, which is affiliated with the company, or through the company itself.[57] Altogether, the daily injection capability at storage facilities linked to the receiving end of this corridor represents the potential use of about 5 Bcf per day of pipeline capacity during the storage refill period from April through October. If the proposed development of additional pipeline capacity along this corridor for extension to the Northeast Region is completed, shippers will have access to storage facilities and local distribution companies located in Pennsylvania and New York as well. Indeed, some proposals to expand storage availability in the Northeast to accommodate this capacity growth are already being put on the table.[58]

Expansions have occurred on two of the corridor's pipeline systems since 1990: Great Lakes Gas Transmission (GLT) and Northern Border Pipeline. Capacity on GLT increased significantly, 620 MMcf per day or 37 percent since 1990. Increasing imports, nevertheless, kept this corridor operating at or near capacity during most of the heating season and at about 90 percent on average throughout 1996 (based on annual flow). In 1995, the summer load factor averaged about 72 percent. Currently, GLT actually returns about 68 percent of the gas it imports at Noyes, Minnesota, to Canada via its St. Clair, Michigan, export point to customers in Ontario or transshipment to New York State through Ontario. GLT, with its access to its underground storage sites located in Michigan, can provide its customers with a seasonal supply backup depository and a peaking source.

The Northern Border Pipeline (NBP) system expanded by 0.4 Bcf per day, or 39 percent from 1991 through 1993. The pipeline is currently running at or above capacity throughout

[55]Energy Information Administration, Form EIA-191, "Underground Natural Gas Storage Report."

[56]Northern Border currently serves the Midwest Region with deliveries to Northern Natural Gas Company and Natural Gas Pipeline Company of America. The pipeline receives large amounts of gas from Canada at Monchy near the Saskatchewan and Montana borders. Monchy is the second largest of the nine entry points for natural gas imports from Canada.

[57]The Chicago Center is only indirectly accessible to shippers using this corridor.

[58]Energy Information Administration, "Underground Storage of Natural Gas in 1997: Existing and Proposed," *Natural Gas Monthly*, DOE/EIA-0130(97/09) (Washington, DC, September 1997).

most of the year; its lowest monthly daily average load factor in 1995 ran in the neighborhood of 96 percent. Utilization levels on the system currently are higher than they were in 1990.

The growth in natural gas demand in Midwestern markets and the competitive pricing of Canadian natural gas over the past decade spurred most of the expansion activity that has occurred on this corridor since 1990. However, some of it has also been production driven, with Western Canadian producers being the initiators. In fact, most of the expansion projects recently proposed for development over the next several years along this corridor fall into this category. The northeastern section of British Columbia and northern Alberta have developed into enormous gas-producing areas and, as a result, markets are being aggressively sought for this gas, with the United States being the obvious and major target.

A very good example of such a project is the Alliance project, which would bring gas from British Columbia to the Chicago, Illinois, area along the right-of-way of an existing oil pipeline. The project was initiated by a consortium of Western Canadian producers dissatisfied with the limited service offered by the single NOVA(Alberta)-TransCanada system route currently available to them. If completed, the proposed Alliance project alone would increase area service along the corridor by 1.3 Bcf per day.[59] Coupled with the extension of the Northern Border Pipeline (in 1998 and 2000)[60] and the Viking Voyageur project (2000), capacity on this part of the corridor could increase by more than 172 percent (3.8 Bcf per day) from 1996 levels (2.2 Bcf per day).[61]

Partly in response to producer demands for additional exit capacity from Alberta and partly because of the potential competition from proposals such as the Alliance project, TransCanada has tendered its own expansion plans (1.4 Bcf per day) to feed into the proposed Viking Voyageur project. Several U.S. pipeline companies have developed expansion plans of their own that would tie in with TransCanada's additional system expansion plans for 1998 and 1999. These projects would also increase support to shippers wanting to transport gas to Ontario, Canada, via an alternative to the northern TransCanada route and provide an integral link in support of Columbia Gas Transmission Company's Millennium project (see next section).

If all of the current proposals associated with this corridor are actually completed, capacity could increase by as much as 4.2 Bcf per day over the next several years. This level of increase is second only to that proposed for development into the Northeast Region. However, what really distinguishes the growth along this corridor is that the vast majority of new capacity would be on newly built trunklines bringing supplies in from Canada.

⑦ *Canada-Northeast*

Corridor is target of major expansion proposals

The Canada-Northeast corridor links the eastern portion of the TransCanada Pipeline system (and Western Canadian gas production) to six pipeline companies in the Northeastern United States (Figure 12). The six are: Iroquois Pipeline Company, Granite State Transmission Company, Tennessee Gas Pipeline Company, Empire Pipeline Company, Vermont Gas Company, and St. Lawrence Gas Company. Indirectly, the corridor supplies gas to the National Fuel Gas Supply Company and CNG Transmission Company. The six systems transport gas primarily into New York and the New England States at a total capacity level of 2.4 Bcf per day. While the vast majority of the Canadian capacity that comes into the U.S. Northeast is off the northern tier of the TransCanada system, about 5 percent represents capacity that traverses the U.S. Midwest (on the Great Lakes Transmission system), crosses back into Canada through Ontario, and is imported once again at Niagara, New York.

Two of the major pipeline systems along the Canada-to-Northeast corridor were constructed during the 1990s: the Iroquois (850 MMcf per day) and Empire (500 MMcf per day) (Figure 10). Both systems serve primarily customers in New York State, although the Iroquois system also serves customers in Connecticut and Massachusetts (Appendix A, Table A3). These two new lines, plus the smaller North Country Pipeline also added between 1990 and 1996, alone increased import capacity to the Northeastern United States by nearly 300 percent. In addition, Tennessee Gas Pipeline system more than doubled its import capacity at Niagara, New York, adding 476 MMcf per day, or about 129 percent to its 1990 level.

The increasing demand for Canadian gas in the Northeastern United States has been responsible for the very high utilization rates on the systems operating on this corridor. Annual average-day usage rates on these pipelines ran about 85 to 90 percent during 1996. During peak periods, the

[59]The proposed border-crossing site for the pipeline is slated to be able to move up to 1.6 Bcf per day of gas if necessary.

[60]In August 1996, the Federal Energy Regulatory Commission approved construction of the Northern Border Pipeline Company expansion project, which would add 700 MMcf per day to import capacity at the Montana border. Correspondingly, Foothill Pipe Line Ltd. of Canada, which interconnects with Northern Border Pipeline at Monchy, Montana, would expand its eastern leg by the same amount. In February 1997, Foothills Pipeline Ltd., proposed to expand its system further and conducted an open season to gauge shipper demand.

[61]Energy Information Administration, *Energy Policy Act Transportation Study: Interim Report on Natural Gas Flows and Rates*, DOE/EIA-0602 (Washington, DC, October 1995), Table 5, p. 32.

principal importing pipeline, Iroquois Gas Transmission Company, was operating about 22 percent above its certificated capacity. Even during the summer months, daily capacity utilization levels were in the 90 to 100 percent range. Iroquois often uses line packing on its system to handle heavy demands of shippers.

Several natural gas market centers are intricately tied to this corridor. At its western end, five market centers are located in Alberta, Canada. One of these, the AECO-C hub, is a key trading point on several commercial electronic trading systems and is also the point of trade for NYMEX futures contracts transacted for Western Canadian gas. In addition, several U.S. natural gas trading centers are located at the eastern end of the corridor, such as the Iroquois, CNG/Sabine, and Ellisburg-Liedy market centers. These centers provide customers with interconnections to at least 10 interstate pipeline systems and 4 intrastate systems serving shippers throughout the Northeast. The availability of such active trading centers at both ends of the corridor provides shippers with the transportation tools to transact their business efficiently.

Most of the market centers in this corridor offer customers access to underground storage services, such as gas loaning, temporary gas parking, and load balancing. In Canada, at the western end of this corridor, approximately 21 Bcf per day of daily storage deliverability is available at eight sites. In the U.S. Northeast, storage deliverability of up to 4.6 Bcf per day is available to shippers through market centers. In addition, several storage sites located in Ontario, Canada, are available to shippers transporting supplies to the area via the Great Lakes Transmission system.

This corridor is slated to undergo a major expansion over the next several years. If all the current expansion proposals were implemented, total direct Canadian import capacity into the U.S. Northeast could approach 5.0 Bcf per day by the end of the century, a 110-percent increase over 1997 levels. An already-approved TransCanada Pipeline Ltd. expansion project, slated for 1998 with further additions being considered for 1999 and 2000, would result in expansions at several import points into the U.S. Northeast and development of at least one new import point for Columbia Gas Transmission's Millennium project.

The Millennium project is projected to start deliveries in the fall of 1999 to customers in the U.S. Northeast. The proposed Vector Pipeline, which is a partner with Columbia and TransCanada in the Millennium project, will tranship supplies through Canada via TransCanada from its St. Clair, Michigan, export point to the Millennium pipeline at Niagara, New York.

Combined with the Millennium import level of 700 MMcf per day and several import expansions related to other projects, such as the Portland Natural Gas Pipeline system,[62] TransCanada's export capacity to the U.S. Northeast could increase by 0.9 Bcf per day by the end of 1999, a 53-percent increase over 1996 levels. In conjunction with TransCanada's multi-year expansion plans, Iroquois Pipeline Company has proposed an expansion of its import capabilities by 160 MMcf per day.

In addition, several new pipelines have been proposed to move gas supplies being developed off the Canadian Atlantic coast near Sable Island to markets in Canada and the United States. The Maritimes & Northeast pipeline project is slated to transport gas from the Sable Island Offshore project. Its route will take it directly into the State of Maine and through New Hampshire to interconnections with the Tennessee Gas Pipeline system in Massachusetts.

While this northern tier corridor has been the principal route used by shippers to import Canadian supplies into the Northeastern United States, the large number of projects recently proposed to bring Canadian supplies into the Midwestern marketplace (see earlier section) has spurred several major pipeline companies to plan large-scale projects that would extend some of this new capacity further eastward to Northeastern markets. If fully implemented, these projects would greatly expand the southern tier corridor, which in the past has seen only limited use as a route for imported supplies.

⑧ *Canada-Western*

Demand for Canadian gas has increased in Western markets

The Canada–Western route brings natural gas from Alberta and British Columbia, Canada, through the States of Washington, Idaho and Oregon, with terminating points in Nevada and California (Figure 12). While much of the gas moving on this corridor reaches California at its northern border, some of the supplies also reach California by way of Arizona, being moved south and west via the States of Utah, Wyoming, and Colorado.

In Canada, Westcoast Gas Transmission Ltd. and Alberta Natural Gas Ltd. (in association with Foothills Pipeline Ltd.) receive gas from the NOVA Gas Transmission Ltd. (the

[62]The Portland Natural Gas Pipeline system (PNGT) (178 MMcf per day) will replace and expand upon the Granite State Pipeline Company's 31-MMcf-per-day import pipeline that brings Canadian natural gas to Maine via Vermont and New Hampshire. The PNGT system may also be supplemented by LNG facilities that would be built in Maine.

principal pipeline system in the region linked into the major production areas in Alberta and British Columbia) and transport that gas to the U.S. border (Table 8). There the supplies are received by Northwest Pipeline Company (from Westcoast Gas Transmission) and PG&E Transmission –Northwest (PG&E-NW), formerly Pacific Gas Transmission (PGT) (from Alberta Natural Gas). The two pipelines have a combined capacity of 3.5 Bcf per day, 99 percent of import capacity in the area. This route represents one-third of the total capacity reaching the United States from Canada.

While PG&E-NW transports most of its gas (about 82 percent in 1996) directly southward to California, the Northwest Pipeline system extends south and eastward from its border receipt point, operating on a bidirectional basis along much of the eastern section. At the northern Nevada State line, Northwest Pipeline Company links with the Paiute Pipeline Company, which until recently was the only gas supplier to the Reno, Nevada, area. Only one new pipeline has been added to the corridor since 1990, the Tuscarora Pipeline Company (113 MMcf per day) in 1995. This pipeline interconnects with the PG&E–NW system at the northern California border and transports gas to the Reno, Nevada, area.

Between 1991 and 1996, capacity within this corridor grew by more than 48 percent (1.2 Bcf per day at the Canadian border) as capabilities were increased to meet expected growth in the regional natural gas market (Table 7). While the downturn in the regional economy during the period led to some excess capacity, usage levels for 1996 indicate the trend has turned around slightly, with average utilization levels along some portions of the corridor actually higher than they were in 1990 (Appendix A, Table A6).

Shippers using this corridor have access to the services of several market centers, although the types of available services are somewhat limited. For instance, within the California marketplace, the Golden Gate market center, which is affiliated with the Pacific Gas and Electric Company, limits its offerings mainly to parking and loaning services and interconnections with six of the principal pipeline system located at the southern end of this corridor. The Sumas market center, which operates in the Washington State/Canadian border area, provides shippers, primarily marketers and producers, with a pooling and aggregation point for export trading. At the apex of the corridor are the AECO-C, Alberta, Intra-Alberta and Crossfield hubs. These centers are tied closely to the NOVA pipeline system, which is the exclusive gas transporter in Alberta. The Intra-Alberta hub, which is primarily an electronic trading operation, is linked closely with trading and business conducted at the Sumas market center. This arrangement allows Alberta producers, shippers, and/or traders to coordinate trading with the pooling and aggregation services offered at Sumas.

Access to underground storage for shippers along this corridor is limited. Much of the storage capacity on the southern portion is owned and operated by local distribution companies and is used exclusively to support their own seasonal storage needs. Nevertheless, shippers can acquire access to storage services on an as-available basis through some of the market center operations. The Pacific Gas and Electric Company, through its Golden Gate market center, provides limited access to its three storage sites in northern California (the center also utilizes PG&E system line packing to support its storage parking and loaning services). At the Canadian end of the corridor, much of the available storage is intricately linked with market center operations, providing parking and loaning services primarily to producers shipping gas to the United States. These Canadian sites are capable of handling up to 6 Bcf per day deliverability and have a working gas capacity level of about 412 Bcf.

⑨ *Rocky Mountains-Western*

A new westward corridor was built in 1992

This corridor did not exist until 1992, which was the year the Kern River Pipeline system was completed. This system extends from the Opal, Wyoming, area southwestward through Nevada, just north of Las Vegas, to Kern County, California (Figure 12).[63] Its capacity is approximately 750 million cubic feet per day.

The Kern River Pipeline system was developed primarily to carry gas to the enhanced oil recovery market in southern California, which has been a substantive natural gas market. In 1996 its average day utilization rate was 95 percent, while on its system peak day it operated at 102 percent. In 1997 its service was extended to the Las Vegas electric power generation market with the opening of an expanded metering facility with Southwest Gas Company, the major natural gas distributor in the Las Vegas area.

Underground storage facilities, although available at the apex of this corridor in Wyoming and Utah, do not play a major role in the operations of the Kern River Pipeline system. Although six sites are in the vicinity, with a combined daily deliverability of 0.6 Bcf per day and 66 Bcf of working gas capacity, only one, Questar Pipeline Company's Clay Basin

[63]In California, the Kern River Pipeline system physically merges with the Mojave Pipeline system (400 MMcf per day) to form one line serving customers primarily in Kern County, California. Mojave receives its supplies from Transwestern Gas Pipeline Company and El Paso Natural Gas Company at the Arizona-California border.

facility (0.4 Bcf per day, 51 Bcf), is accessible to shippers. The Western market center, located at the upper end of the system, provides customers with access to the Kern River Pipeline system and to the Clay Basin site. At the southern end of the corridor shippers have access to the services of two more natural gas market centers, the California Market Center (operated by Southern California Gas Company/Enerchange Inc.) and the Golden Gate Market Center (Pacific Gas & Electric Company).

Only one expansion along this corridor has been proposed; the Colorado Intrastate Pipeline is assessing the feasibility of expanding its system to serve customers in Nevada along a new 360-mile route (250 million cubic feet per day). This line would open a new market for new production out of the Powder River Basin in Wyoming.

During the early part of the decade, when the proposed Altamont Pipeline system was under serious consideration as a supplier of Canadian gas to California, the Kern River Pipeline Company had a proposal on the table to expand its system correspondingly. However, as a surplus of interstate natural gas pipeline capacity developed in the Western Region and the proponents of the Altamont system directed their target market eastward, those plans were set aside.

⑩ *Rocky Mountains-Midwest*

Corridor is expected to become more important as transportation capacity expands

This corridor links Rocky Mountain natural gas supplies from Utah, Wyoming, and Colorado with markets in the Midwestern United States and with several sizable metropolitan markets in eastern Kansas and Missouri (Figure 13). While the corridor itself does not extend into the Midwest, the several pipelines operating along this route interconnect with major trunklines bringing supplies from the Southwest to Midwestern markets (see ③).

The Trailblazer System, which is a contiguous linkup of the Overthrust, Wyoming Interstate, and Trailblazer pipelines, operates from western Wyoming to eastern Nebraska, where it offloads to the Natural Gas Pipeline Company of America pipeline. The Williams Natural Gas Company and the KN Interstate Pipeline Company also operate along this corridor, but these two pipelines serve primarily local regional markets (Table 8).

In late 1997, the KN Interstate Pipeline Company completed its Pony Express Pipeline (255 million cubic feet per day). This line is the first new long-distance line completed in this corridor since the Trailblazer Pipeline was installed during the early 1980's. The line runs from central Wyoming to south of Kansas City, Missouri. Currently the new line does not provide any interconnections with the two major interstate pipelines connecting this corridor to Midwestern markets; rather, its full capacity is committed to customers located in the Kansas City area.

Several market centers are available to shippers using this corridor. Located at the western end is the Western market center and at the eastern end the Chicago market center. The Mid-Continent market center, located in southcentral Kansas and with access to the Natural Gas Pipeline Company of America's system, has become a key natural gas trading center for customers along this corridor. The market center in Wyoming currently has limited business with shippers using the corridor, primarily because available capacity is fully booked on a long-term basis and shippers have little need for transportation, title transfers/tracking, buyer/seller matching, and trade administration services. It remains to be seen if planned expansions along this corridor will increase market center activity, as what capacity is coming in service is already fully subscribed.

Customers using this corridor have a limited number of underground storage facilities available for their use. At the terminus of the corridor in Wyoming and Colorado are 18 sites that customers may access. Much of the storage located at this end, however, is used to support local producers and distribution companies. In the Chicago area corridor, shippers have access to storage facilities associated with the Chicago market center.

Compared with most of the other corridors, this particular one is relatively small. Its importance, however, lies in its future. Currently the Trailblazer system is fully utilized throughout most of the year as the demand for lower priced Rocky Mountain supplies grows among Midwestern shippers. In the past, Wyoming and Utah supplies generally moved to a strong southern California gas market, but that market has developed an excess of pipeline capacity during the past several years and is currently considered a soft market for natural gas. With the emphasis on the Western market, development of eastward bound pipeline capacity has been limited in the past.

Summary

During the past 50 years, the natural gas pipeline network in the United States and Canada has developed into an expansive and highly integrated transmission and distribution system. The 10 major natural gas transportation corridors examined in this chapter reflect only that portion of the network which involves long-haul operations. At the regional level, many other smaller interstate, intrastate, and local distribution systems have the responsibility of delivering gas to the

ultimate consumer (see Chapter 4). In addition, there are numerous natural gas gathering systems that carry out the task of feeding supplies to the long-haul segment of the network (see Chapter 2).

Between 1990 and the end of 1997, capacity additions on these long-haul corridors totaled more than 12.4 billion cubic feet (Bcf) per day, an increase of about 17 percent. Most of this construction entailed expansions to existing mainline systems, although some new, small-to-intermediate-size pipelines were also built. The largest combined increase in new or expansion capacity, 27 percent of the total, occurred along those corridors transporting supplies from Canada (1.2 Bcf per day), the Rocky Mountains (0.8 Bcf per day) and the Southwest (1.0 Bcf per day) to the Western Region of the United States. On a singular basis, the largest increase in capacity occurred on the corridor leading from Canada to the Northeastern United States, which grew by 1.9 Bcf per day, or over 400 percent.

No matter how it is viewed, the corridors with the largest growth in deliverability since 1990 have been those coming into the United States from Canada. These corridors have also maintained the largest sustained utilization rates, with most of the pipelines in these corridors operating above 90 percent throughout most of the year. The comparatively lower cost of Canadian supplies over the past several years has been a key factor in maintaining these high utilization levels.

Based on current expansion proposals, the most extensive development of new capacity over the next several years will occur along these same corridors, except for the one directed toward the Western States. At least four new pipelines and several expansions are planned that will expand deliverability not only to the U.S. Midwest and Northeast markets but also to Canadian domestic markets. These projects will improve access to natural gas supplies in Western Canada and also create a new corridor that will bring production from the developing fields off the coast of Eastern Canada (Sable Island) to Canadian and U.S. markets. These expansions could add as much as 5.0 Bcf per day to U.S. import capacity from Canada along these corridors, a 45-percent increase over 1997 levels.[64] This anticipated growth reflects the continuing U.S. demand for Canadian natural gas, especially in the Midwest and Northeast regions, and the desire on the part of Western Canadian producers to expand further into these markets.

While the northern corridors predominate in respect to future expansions, it must be kept in mind that a great deal of natural gas productive capacity is also currently being developed in the Gulf of Mexico. The logical markets for this natural gas are in the Midwest and Northeast United States, the same markets slated for the Canadian expansions (as well as the expanding Rocky Mountain corridor). Yet, no major expansions along the corridors linking the Gulf of Mexico to these marketplaces have been announced. During the summer months, even with market storage refill supplies using significant levels of available capacity, a number of the pipelines along these corridors still have significant amounts of unused capacity available. This available capacity could absorb much of the Gulf's new-found production during off-peak periods, but during the heating season when many of these same pipelines are fully utilized, future capacity constraints could develop. If deep-water development continues over the next decade, most likely some complementary onshore expansions would occur along these corridors.

Although there are a few natural gas transportation corridors that are capacity constrained and/or are operating at close to full utilization throughout the year, the current capabilities of the pipeline network in North America are sufficient to meet the current level of demand. And, project proposals are on the table which will alleviate those few exceptions where limitations exist. In fact, on the surface it appears that an excess in pipeline capacity could develop along several corridors, especially if anticipated demand does not live up to expectations.

[64]The volume increase would be 37 percent more than the total Canadian import capacity added from 1991 through 1996, 4.3 Bcf per day.