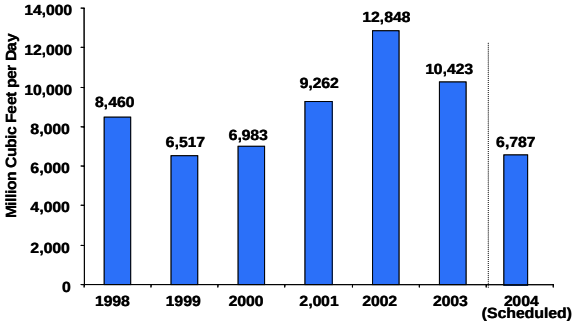
U.S. Natural Gas Pipeline and Underground Storage Expansions in 2003

This special report examines developments in the national natural gas pipeline network and the underground natural gas storage segment of the industry during 2003. In addition, it includes a discussion and a comparative analysis of the recent level of growth in each of these areas and an examination of the amount of additional development proposed for completion over the next several years. It does not address abandonments (shutdowns) of existing capacity or changes in overall pipeline or gas storage capacity. Questions or comments on the contents of this article should be directed to James Tobin at james.tobin@eia.doe.gov or (202) 586-4835.

Pipeline transportation and underground storage are vital and complementary components of the U.S. natural gas system. While mainline gas transmission lines provide the crucial link between producing area and marketplace, underground gas storage facilities help maintain the system's reliability and its capability to transport gas supplies efficiently and without interruption. Natural gas storage capacity ensures supply availability in downstream markets during periods of heavy demand by allowing a more reliable flow of production and transmission flows. In some instances, development or expansion of the pipeline network is tied inexorably with storage and vice versa.

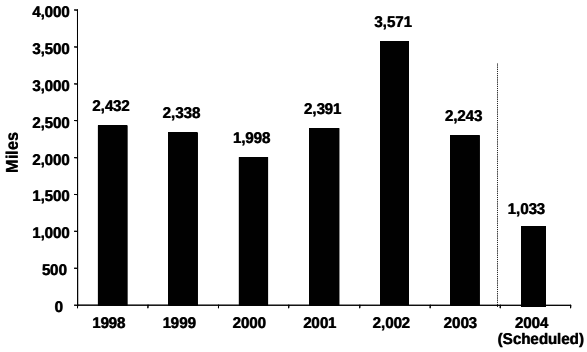
Figure 1. Natural Gas Pipeline Capacity Additions, 1998-2004



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Pipeline Capacity and Construction Databases.

Both natural gas pipeline and underground storage development decreased in 2003 compared with 2002 levels; pipeline capacity additions fell by 19 percent while additions to underground storage working gas capacity (see Box, "Underground Storage Operations and Operator Types," p. 3) fell by 27 percent.[1] Furthermore, while roughly 2,200 miles of pipeline and 10.4 billion cubic feet per day (Bcf/d) of natural gas pipeline capacity (see Box, "Pipeline Capacity Usage," p. 5) were added to the national transmission network during 2003, the current inventory of new pipeline capacity/mileage development projects indicates that pipeline capacity additions will drop once again in 2004 (Figures 1 and 2).[2]

Figure 2. Miles of Large Natural Gas Pipeline Added in the United States, 1998-2004



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Pipeline Capacity and Construction Databases.

In 2003, new and expanded underground gas storage fields added 18.6 Bcf of working gas with daily peak day withdrawal capability increasing by 2.0 Bcf/d (Table 1), compared with increases of 26 Bcf and 2.5 Bcf/d, respectively, in 2002. Reflecting the market's continuing demand for additional high-deliverability storage, more than 68 percent of new working gas capacity (19 Bcf) and 83 percent of added withdrawal capability (2.0 Bcf/d) in 2003 was new salt cavern development or its expansion.

Overall, at least 49 natural gas pipeline projects and 9 storage projects were completed during 2003 (Table 1). Of the former, 31 were expansions of existing pipeline systems or segments (Table 2). The other 18 included 3 new pipeline systems, 3 new gathering systems, and 12 new extensions or laterals[3] associated with existing

[1] In this article, additions to pipeline capacity, underground gas storage working gas capacity and daily peak day withdrawal capability (daily deliverability) levels, are based upon volumes quoted in application filings with the Federal Energy Regulatory Commission (FERC) or State agencies, or cited in company press releases or trade press sources. Because capacity and/or deliverability levels may be revised and/or adjusted as a project progresses, any volumes cited herein may not agree with final certification levels, or with volumes eventually reported on survey reports such as those filed with the Energy Information Administration (EIA).

[2] Gas pipeline development activity peaked in 2002 when more than 12 Bcf of new gas pipeline capacity and 3,571 miles of pipe were added. Energy Information Administration, *Expansion and Change on the U.S. Natural Gas Pipeline Network – 2002*, May 2003, http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2003/Pipenet03/ngpipenet03.pdf

[3] Often it may be necessary for a mainline pipeline to build an extension, or lateral, off its existing system to serve a single new customer or to penetrate a new service area. Although the "lateral" will be a smaller diameter pipeline than that of the mainline, its design capacity may or

Table 1. Recent and Proposed Regional Natural Gas Pipeline and Underground Storage Additions to Capacity

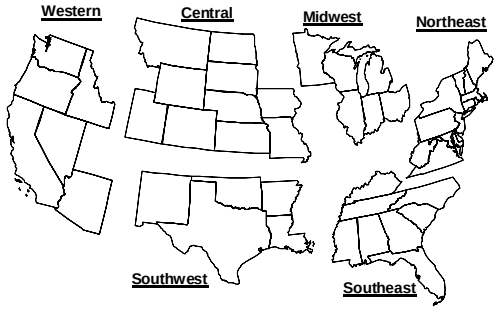
Regions (see Figure 3)	Pipeline Projects								Underground Storage Projects					
	Completed in 2003				Scheduled for 2004 (Estimated)				Completed in 2003			Scheduled for 2004 (Estimated)		
	Projects	Added Capacity (MMcf/d)	Cost ($Millions)	Miles	Projects	Added Capacity (MMcf/d)	Cost ($Millions)	Miles	Projects	Added Working Gas Capacity (MMcf)	Added Withdrawal Capability (MMcf/d)	Projects	Added Working Gas Capacity (MMcf)	Added Withdrawal Capability (MMcf/d)
Central	12	1,162	182	409	6	560	104	34	1[a]	0	0	1	3,500	68
Midwest	4	651	132	129	3	1,063	90	51	1	5,000	300	5	42,200	1,005
Northeast	8	1,318	346	82	9	862	547	122	1	1,000	200	2	500	140
Southeast	9	1,532	905	463	2	195	122	53	1	3,910	870	0	0	0
Southwest	6	2,480	266	264	11	2,999	465	667	3	7,658	600	5	17,700	439
Western	6	2,368	1,693	885	6	1,083	315	97	2	1,008	45	3	11,669	370
To Mexico /Canada	4	912	41	11	1	25	2	9	NA	NA	NA	NA	NA	NA
U.S. Total	49	10,423	3,564	2,243	38	6,787	1,645	1,033	9	18,576	2,015	16	75,569	2,022

[a] Storage project consisted of an expansion of daily injection capability only.
Note: MMcf/d = Million cubic feet per day. Excludes projects on hold as of December 2003. In the table, a project that crosses interregional boundaries is included in the region in which it terminates. Offshore projects are included in the Southwest region.
Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Pipeline Construction and Natural Gas Underground Storage Projects Databases.

pipeline systems. Expenditures for gas pipeline development amounted to more than $3.6 billion in 2003, well below the $4.4 billion spent in 2002.

Of the nine storage projects completed during 2003, only one salt cavern site was a new facility, compared with three new facilities completed in 2002. Of the remaining eight projects, six were expansions to high-deliverability salt cavern facilities, one a depleted reservoir type storage field, and the other an aquifer storage field.

Figure 3. U.S. Geographic Regions Used in Report



Source: Energy Information Administration, Office of Oil and Gas

Overview

Overall, the U.S. gas transportation network continued to grow in 2003, although at a slower pace than in 2002. For instance:

- **Following smaller increases in 2002, pipeline transportation capacity in the deepwater Gulf of Mexico increased by more than 1,825 million cubic feet per day (MMcf/d) in 2003.** In fact, capacity additions in the Gulf represented 74 percent of all new gas pipeline capacity in the Southwest region in 2003, and 18 percent of new capacity in the United States (Table 2). Continued deepwater gas and oil development in the Gulf of Mexico could also result in more than 1,700 MMcf/d of new gas pipeline capacity being installed in the Gulf in 2004 (if all currently approved 2004 offshore scheduled projects are actually completed in 2004).

- **Pipeline capacity constraints exiting Wyoming production fields eased considerably with completion of the Kern River Transmission Pipeline expansion (900 MMcf/d) in May 2003.** Completion of this project doubled the capability of the Kern River Transmission Pipeline to transport natural gas from Wyoming to California and Nevada. Because of a lack of sufficient take-away capacity on the interstate pipeline system serving the Wyoming area over the past 5 years, spot prices in the region had been much lower on average than, for instance, prices at the Henry Hub. Soon after the project's startup in May, spot prices in the Rocky Mountain trading area

may not impact the mainline itself. If there is sufficient unused capacity existing on the mainline system to accommodate the needed "new" capacity of the lateral, then the mainline system will be unaffected. On the other hand, if enough unused capacity is not available, all or part of the mainline system itself may need to be expanded as well.

rose significantly, to levels more comparable to those at other major gas trading points in U.S. production areas.

- **Export capacity to Canada increased by 216 MMcf/d or about 6 percent in 2003, although gas pipeline import capacity between the United States and Canada grew by only 44 MMcf/d, the smallest annual increase since 1994.** The export capacity increase occurred when the Portland Natural Gas Transportation System, which was originally designed only to import gas (into New Hampshire), was reconfigured to provide bidirectional service to its customers. The objective of the reconfiguration was to provide shippers of Canadian Sable Island gas, using the Maritimes & Northeast Pipeline, with an opportunity to redirect some of their gas to markets located in Quebec, which previously had access only to western Canadian gas supplies.

- **Export capacity to Mexico increased by 24 percent, or 696 MMcf/d, in 2003, reflecting the increasing demand for U.S gas along the border with Mexico, particularly by electric generation customers.** It is the second year in a row that natural gas pipeline export capacity increased by more than 600 MMcf/d. Since 1998, export capacity to Mexico has almost tripled. Moreover, as export capacity to Mexico has grown, the average annual load factor on exporting pipelines also has grown significantly, from an average 15 percent in 1998 to 32 percent in 2002.[4]

- **Most storage development has occurred in the Southwest/Gulf Coast area.** Over the past 6 years, the existence of a large gas pipeline infrastructure and the presence of a rich salt formation geology on the gulf coast of east Texas, southern Louisiana, Mississippi, and Alabama have supported significant development of new salt cavern storage sites, expansions to existing storage, and the installation of new, or the expansion of existing, pipelines tied to these sites. In 2003 alone, this area of the United States accounted for 26 percent of the new pipeline capacity, and 55 percent of the combined working gas storage capacity additions installed in the Southeast and Southwest regions.

- **Environmental and/or routing concerns in the New York metropolitan area have significantly delayed several major projects in the Northeast region.** For instance, the Millennium Pipeline project (714 MMcf/d), originally proposed in 1996 for completion in 2000, was delayed once again in 2003. Subsequently, in early 2004, the sponsor of the project divided the installation into two separate phases with the less environmentally sensitive portion slated for 2006 and the other with an "open-ended" completion date. Another Northeast project that is currently "on hold" is the Islander East Pipeline (250 MMcf/d), which was approved by the Federal Energy Regulatory Commission (FERC) in October 2002 for development in 2003. However, its construction has been halted by the State of Connecticut, also for environmental reasons.

Underground Storage Operations and Operator Types

Operations

An underground storage site is described by its total capacity (the total volume of gas that can be stored in the facility), its base gas or volume of gas that remains in the facility at all times, and its working gas capacity, which is the difference between the first two measures (total capacity minus base gas). Base gas is the amount of gas that supports the working gas by providing pressure to enable the working gas to be withdrawn at an acceptable rate. Working gas is the amount of gas in the site that is available for withdrawal to serve customer or system needs.

Each day gas may be injected into and/or withdrawn from an underground facility, either increasing or decreasing the working gas. In theory, the level of working gas cannot exceed the working gas capacity nor may it drop below zero. In practice however, it is possible to exceed the working gas capacity by overpressurization, and it is possible to go below zero by withdrawing base gas. The determination of base gas has some degree of flexibility, depending on what level is determined necessary to maintain a desired withdrawal rate.

Owner/Operator Types

Interstate pipeline companies: Underground storage is particularly important to interstate pipeline companies because they depend heavily on storage inventories to facilitate load balancing and system management on their long-haul transmission lines.

Local distribution companies (LDCs) and intrastate pipeline companies: LDCs generally use gas from storage to serve customer needs directly, whereas intrastate pipeline companies use underground storage for operational balancing and system supply as well as the energy needs of end-use customers.

Independent operators: Many of the salt formation and high-deliverability sites that are currently in use were developed by independent storage service operators.

[4]This average daily pipeline load factor is based upon an annual volume of gas moved between the U.S. and Mexico during the years 1998 through 2002. Being based on annual figures it does not reflect seasonal or daily variations in flow. See Energy Information Administration, *Natural Gas Annual 2002 (*February 2004), and previous editions.

Table 2. Natural Gas Pipeline Projects Completed in 2003

Ending Region & State	Begins in State -- Region		Pipeline/Project Name	FERC Docket Number	Greenfield (New) or Expansion Project	In Service Date	Estimated Cost ($Millions)	Miles	Additional Capacity (MMcf/d)
Central									
CO	CO	Central	CIG Valley Line II Expansion	CP03-7	Expansion	01-Dec-03	13	*	42
CO	CO	Central	CIG Valley Line III Expansion	CP03-7	Expansion	01-Dec-03	10	*	50
CO	CO	Central	NWPL Ridges Basin Dam Project	CP02-423	Expansion	15-Dec-03	17	7	0
CO	CO	Central	Questar Southern System Expansion	CP02-59	Expansion	11-Jan-03	4	*	90
IA	IA	Central	MidAmerican Des Moines Lateral	NA	Greenfield	01-Jun-03	2	13	175
MT	**AB**	**Canada**	**Regent Border Station**	**CP03-8**	**Greenfield**	**01-Sep-03**	**	**4**	**20**
MT	**AB**	**Canada**	**Sierra Border Station**	**CP01-461**	**Greenfield**	**04-Oct-03**	**	**2**	**24**
MT	WY	Central	Shoshone Pipeline	CP03-2	Greenfield	01-Oct-03	**	34	14
ND	WY	Central	WBP Grasslands Project I	CP02-37	Greenfield	01-Dec-03	58	253	80
WY	UT	Central	Questar Overthrust Tie Line 112	CP03-36	Expansion	06-Oct-03	13	17	217
WY	WY	Central	Pinedale/Jonah 2003 Expansion	NA	Expansion	01-Nov-03	65	80	300
WY	WY	Central	Questar Kern Expansion	CP02-124	Expansion	01-May-03	1	*	150
						Subtotal	**182**	**409**	**1,162**
Midwest									
MN	MN	Midwest	Hutchinson Pipeline Project	NA	Greenfield	01-Oct-03	27	89	60
MN	MN	Midwest	NNG Project MAX Expansion	CP02-436	Expansion	01-Nov-03	6	5	34
OH	OH	Midwest	NCGT Compression Addition	NA	Expansion	01-May-03	2	*	42
WI	WI	Midwest	We Ixonia Lateral	NA	Greenfield	01-Dec-03	97	35	515
						Subtotal	**132**	**129**	**651**
Northeast									
DE	PA	Northeast	Eastern Shore Natural System Expansion	CP03-80	Expansion	01-Nov-03	1	*	4
MA	MA	Northeast	Algonquin HubLine	CP01-5	Greenfield	24-Nov-03	127	29	295
MA	MA	Northeast	Maritimes & Northeast Phase III	CP01-4	Greenfield	24-Nov-03	134	25	230
NY	NY	Northeast	Niagara Mohawk Expansion	NA	Expansion	01-Nov-03	2	9	200
PA	PA	Northeast	CGT Rock Springs Expansion	CP02-142	Expansion	10-Dec-03	29	9	263
PA	PA	Northeast	DTI Ellisburg-Liedy Expansion	CP02-44	Expansion	15-Nov-02	10	*	127
PA	PA	Northeast	Tenneco Can-East/Leidy Expansion	CP02-46	Expansion	15-May-03	10	*	150
PA	NJ	Northeast	Transco Trenton-Woodbury Loop	CP02-204	Expansion	01-Nov-03	33	10	49
						Subtotal	**346**	**82**	**1,318**
Southeast									
AL	AL	Southeast	SONAT North System Expansion	CP01-161	Expansion	01-Nov-03	25	5	33
FL	AL	Southeast	FGT Phase VI Expansion	CP02-27	Expansion	01-Dec-03	105	33	121
FL	MS	Southeast	FGT Phase V Stage 4 Expansion	CP00-40	Expansion	01-May-03	132	136	130
GA	MS	Southeast	SONAT South Sys Expansion I Phase 2	CP00-233	Expansion	01-Jun-03	86	41	196
GA	**LA**	**Southwest**	**SONAT South System Expansion II Phase 1***	**CP02-1**	**Expansion**	**01-Oct-03**	**70**	**68**	**192**
MS	**AL**	**Southwest**	**SONAT South System Expansion II Phase 1A***	**CP02-1**	**Expansion**	**05-Nov-03**	**62**	**24**	**98**
NC	**VA**	**Northeast**	**ETenn Patriot Extension I**	**CP01-415**	**Expansion**	**19-Nov-03**	**225**	**95**	**315**
NC	**LA**	**Southwest**	**Transco Momentum Phase I**	**CP01-388**	**Expansion**	**01-May-03**	**164**	**42**	**262**
SC	GA	Southeast	SCANA Elba Island Connection	CP02-57	Greenfield	01-Oct-03	36	18	185
						Subtotal	**905**	**463**	**1,532**
Southwest									
GM	GM	Offshore	Okeanos Deepwater PL Phase I	NA	Greenfield	30-Nov-03	100	74	1,200
GM	GM	Offshore	Triton Pipeline System	NA	Greenfield	01-Oct-03	40	41	275
GM	GM	Offshore	WFS Canyon Chief Pipeline	NA	Greenfield	01-Jun-03	94	126	350
OK	OK	Southwest	CEGT Line ACT-9	CP03-6	Expansion	01-Sep-03	2	1	240
TX	TX	Southwest	CrossTex Denton Pipeline	NA	Greenfield	01-Nov-03	**	14	40
TX	TX	Southwest	KM (MidCon) Texas Pipeline Expansion	CP96-140	Expansion	20-Mar-03	32	9	375
						Subtotal	**268**	**264**	**2,480**
Western									
CA	**WY**	**Central**	**KRT Mainline 2003 System Expansion**	**CP01-422**	**Expansion**	**01-May-03**	**1,260**	**716**	**900**
CA	CA	Western	Wild Goose Storage Lateral	NA	Greenfield	20-Nov-03	20	25	700
NV	NV	Western	Paiute Carson Lateral Upgrade	CP03-31	Expansion	01-Nov-03	11	15	6
OR	**WY**	**Central**	**NWPL Rockies Expansion**	**CP01-438**	**Expansion**	**01-Nov-03**	**139**	**91**	**175**
OR	OR	Western	Northwest Natural Mist Storage Lateral	NA	Greenfield	12-Dec-03	19	12	320
WA	WA	Western	NWPL Evergreen Expansion	CP02-4	Expansion	09-Oct-03	241	26	268
						Subtotal	**1,693**	**885**	**2,368**
Canada									
QB	**NH**	**Northeast**	**Portland Natural Gas Transmission Export**	**CP96-248-011**	**Expansion**	**1-Nov-03**	**	*	**216**
						Subtotal	**0**	**0**	**216**
Mexico									
MX	**TX**	**Southwest**	**KM (MidCon) Texas Roma Export Station**	**CP96-583**	**Greenfield**	**20-Mar-03**	**1**	*	**375**
MX	**TX**	**Southwest**	**Tenneco South Texas Export**	**CP02-116**	**Greenfield**	**01-Jul-03**	**40**	**9**	**312**
MX	**TX**	**Southwest**	**West Texas Gas Export Expansion**	**CP02-382**	**Expansion**	**14-Feb-03**	**1**	**1**	**9**
						Subtotal	**41**	**11**	**696**
						Total	**3,564**	**2,243**	**10,423**

CEGT=CenterPoint Energy Gas Transmission Co, CIG = Colorado Interstate Pipeline Co, CGT = Columbia Gas Transmission Co, DTI = Dominion Transmission Co, ETenn = East Tennessee Natural Gas Co, FGT = Florida Gas Transmission Co, KM= Kinder Morgan Energy Corp, KRT = Kern River Gas Transmission Co, NCGT = North Coast Gas Transmission Co, NNG = Northern Natural Gas Co, NWPL = Northwest Pipeline Co, SONAT = Southern Natural Gas Co, Tenneco=Tennessee Gas Pipeline Co, Transco = Transcontinental Gas Pipeline Co, We = We Energy Co, WBP = Williston Basin Interstate Pipeline Co, WFS = Williams Field Services Co.

* Less than one mile of pipeline/looping or compression expansion only.

** Less than $1 million.

Note: MMcf/d = Million cubic feet per day. NA = Not applicable. Interregional projects are in **bold print**. Excludes projects on hold as of December 2003. In the table, a project that crosses interregional boundaries is included in the region in which it terminates. Offshore projects are included in the Southwest region.

Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Pipeline Construction Database.

Nationally

At the close of 2003, the U.S. natural gas transportation network included more than 226 gas pipeline systems, more than 306,000 miles of pipeline, and more than 178 Bcf/d of gas transportation capacity.[5] During 2003, total U.S. gas pipeline system mileage increased by about 1 percent while overall system capacity increased by slightly more than 5 percent. There are currently approximately 400 underground gas storage sites located in the United States, operated by 127 companies (see Box, "Underground Storage Operations and Operator Types," p. 3).

After record additions in 2002, the installation of new natural gas pipeline capacity fell by 19 percent in 2003, while added mileage fell by 37 percent (Figures 1 and 2). Similarly, pipeline construction expenditures fell, although by a lesser rate of 18 percent.[6] In part, this decline reflected the fewer number of larger-scale pipeline projects (200 MMcf/d or greater) completed during 2003 (Table 2) compared with those completed in 2002 (21 versus 26), and fewer new laterals (7 versus 17) serving new power generation plants. At least 10 proposed new laterals or expansions to existing systems originally scheduled for 2003 were canceled or downsized because a planned gas-fired power plant was not completed on schedule or was canceled.

The basic profile of pipeline projects completed in 2003 also differed significantly from that in 2002. For instance, the average gas pipeline project completed in 2003 averaged 46 miles, compared with 66 miles per project in 2002, while the average capacity addition per project was 21 MMcf/d (6 percent) less in 2003 than in 2002 (213 versus 227 MMcf/d).

Interregional Developments

Of the 49 natural gas pipeline projects completed in 2003, 12 crossed regional boundaries. A major portion of the regional increase, 43 percent, occurred on interstate pipeline systems transporting gas from the Southwest region to the Southeast region (552 MMcf/d) and to Mexico (696 MMcf/d). Additions to interregional capacity in 2003 totaled 2,898 MMcf/d overall, an increase of 75 percent over the 2002 level, which was the smallest annual interregional increase in a decade. The largest amount of interregional transport capacity still remains with the 13 interstate pipeline systems transporting gas between the Southwest and the Southeast regions, 23,264 MMcf/d.

Pipeline Capacity Usage

A natural gas pipeline measures its capability to transport gas by its design capacity, that is, the peak volume of gas that it can deliver at several different levels over a specific period of time, usually a day. For instance, a systemwide design day deliverability volume, or how much gas a pipeline system can deliver to all its customers on its peak day, is its measure of overall service capacity. At the operational level, pipelines often will also include measures of peak (design) day volumes that can be transported through, or at, a specific point on its system, such as at a compressor station, along a specific pipeline segment, or received or delivered at a specific point on its system.

In this report the emphasis is upon new capacity added through pipeline construction, which is examined singularly by project (Table 2) and in the aggregate (Table 1). Pipeline project capacity additions can apply to (1) a completely new pipeline, in which case the added capacity will be equal to the systemwide capacity, (2) the expansion or addition of only a pipeline segment, or (3) upgrades to or addition of one or more compressor stations within a system.

Interregional capacity, shown on Figures 5, and 7 through 11, represents an EIA estimate of the design throughput capability of pipelines at regional border crossings. These estimates are based partially on "System Flow Diagrams" data (FERC Form 567) filed with the Federal Energy Regulatory Commission (FERC) by interstate pipeline companies, and partially on capacity additions from completion of construction projects. It provides an aggregate measure of the potential pipeline flow capability between regions and a view of how and where the interstate pipeline system has directed its growth.

Because the design and capacity of a specific pipeline or expansion project might not alter the overall capacity of the full pipeline system or cross regional boundaries, e.g., added capacity on a localized segment of a pipeline system, their respective additions would not necessarily affect the systemwide or interregional measures. Rather, their additional capacity is more specific and has impact on local production or the pipeline's ability to deliver gas for shippers.

[5]Includes the large-diameter mainline portion of 97 interstate systems, 89 intrastate systems, and 40 gas gathering systems (about half offshore in the Gulf of Mexico). Source: Energy Information Administration, Office of Oil and Gas, U.S. Natural Gas Pipeline Profile Database.

[6]Energy Information Administration, *Expansion and Change on the U.S. Natural Gas Pipeline Network – 2002*, May 2003, Table 1, http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2003/Pipenet03/ngpipenet03.pdf.