AEP EXHIBIT NO. 1

IN THE UNITED STATES OF AMERICA

BEFORE THE

SECURITIES AND EXCHANGE COMMISSION

In the Matter of American Electric Power Company, Inc.: File No. 3-11616

PREPARED DIRECT TESTIMONY OF DAVID HARRISON JR., Ph.D. ON BEHALF OF THE AMERICAN ELECTRIC POWER SYSTEM

December 7, 2004

I. CREDENTIALS, PURPOSE, CONCLUSIONS

Q. Please state your name, business address, and current position

A. My name is David Harrison, Jr. I am a Senior Vice President at National Economic Research Associates, Inc. ("NERA"). NERA is a firm of consulting economists with its principal offices in a number of major offices in the U.S. and abroad. My business address is 200 Clarendon Street, Boston, Massachusetts 02116.

Q. Please describe your academic background.

A. I received a Ph.D. in Economics from Harvard University, where I was a Graduate Prize Fellow. I also hold a B.A. *magna cum laude* in Economics from Harvard College, where I was a member of Phi Beta Kappa, and a M.Sc. in the Economics of Transport from the London School of Economics, where I was the Rees Jeffreys Scholar in the Economics of Transport.

Q. Please describe your work experience.

A. After receiving my Ph.D., I was an Assistant Professor of City and Regional Planning at Harvard University and later an Associate Professor at the John F. Kennedy School of Government at Harvard University, where I taught in the areas of microeconomics, environmental and energy policy, regional and urban economics, transportation policy, benefit-cost analysis, and other topics. I was a participant in the MIT-Harvard Joint Center on Urban Studies, a member of the Faculty Steering Committee of the Energy and Environmental Policy Center at Harvard University, and a member of the Advisory Board of the Interdisciplinary Program in Health at the Harvard School of Public Health.

I also served as a Senior Staff Economist on the President's Council of Economic Advisors, where my areas of responsibility included energy and environmental regulation, natural resource policy, occupational health and safety, and transportation policy. I was the senior staff member on the Regulatory Analysis Review Group and the principal White House staff member on the review of administration policy regarding the automotive industry. I

have also worked at the U.S. Department of Transportation, the U.S. Department of Housing and Urban Development, and the National Bureau of Economic Research.

At NERA, I direct projects in regional economic assessments, energy policy, environmental policy, transportation, and other areas. I have consulted for many private and public organizations on a wide range of topics. Private clients include major companies, trade associations, and law firms. Public sector clients have included the U.S. Environmental Protection Agency, the Georgia Department of Natural Resources, the Massachusetts Department of Environmental Protection, the National Acid Precipitation Assessment Program, the Organization for Economic Cooperation and Development ("OECD"), the European Commission, the Italian Ministry of the Environment, the Massachusetts Department of Environmental Management, and the South Coast Air Quality Management District.

Q. What is the purpose of your testimony?

A. The objective of my testimony is to assess whether the combined American Electric Power ("AEP") system—composed of the AEP and Central and South West ("CSW") systems—can be considered part of a "single area or region" for purposes of the Public Utility Holding Company Act of 1935 ("Act").

Q. What do you conclude from your analyses?

A. I conclude that the combined AEP system is located within a larger region based upon the totality of various information, including employment distributions, transportation infrastructure, commodity flows and prices, and general trade interactions. The transportation infrastructure includes natural gas and oil pipelines, waterways, road networks, rail networks, and other facilities that have developed considerably over the past 70 years to lower the cost of both transportation and communications and to facilitate trade within a broader functional region. Relevant commodity flows include natural gas, oil, and coal, which provide important fuels for electricity generation, as well as many other types of goods.

Q. How is your testimony organized?

A. I begin with background on the AEP combined system and the various criteria that regional economists have used to define regions. The literature emphasizes that the concept of region depends upon the context. In terms of regions composed of areas linked by trade and commercial relationships, the transportation system is important in providing opportunities for trade and interaction among various parts of the region.

I then provide information on various major transportation infrastructure facilities that exist within broad areas that encompass the areas covered by the AEP combined system, including natural gas and oil pipelines, road networks, waterways, and rail lines. This information includes maps showing the key facilities as well as data on capacities, product flows, and price connections. I include information that illustrates the large expansions that have occurred in much of this infrastructure over the roughly 70 years since the Act was passed, noting that this expanded infrastructure supports an expanded geographic trading region. I then provide information on overall trade flows among broad geographic areas of the U.S. to illustrate further how the combined AEP system fits within a broad region. The final section provides some concluding remarks.

II. BACKGROUND ON AEP COMBINED SYSTEM AND REGIONAL CONCEPTS IN ECONOMICS AND ECONOMIC GEOGRAPHY

Q. Could you provide a summary of the states in which the combined AEP system operates and provide a context for these states?

A. The combined AEP system includes operations in eleven states: Ohio, West Virginia, Virginia, Indiana, Michigan, Kentucky, Tennessee, Texas, Oklahoma, Arkansas, and Louisiana. Below I refer to the integrated AEP system in terms of two AEP zones: "AEP West" (Texas, Oklahoma, Arkansas and Louisiana) and "AEP East" (Ohio, West Virginia, Virginia, Indiana, Michigan, Kentucky, and Tennessee).

Q. How do regional economists define regions?

A. There is no one definition or criteria for what constitutes a "region;" the concept of region is heavily dependent upon the context. Hoover and Giarrantani distinguish two general bases or types of regions: (1) *homogeneous regions* demarcated on the basis of internal

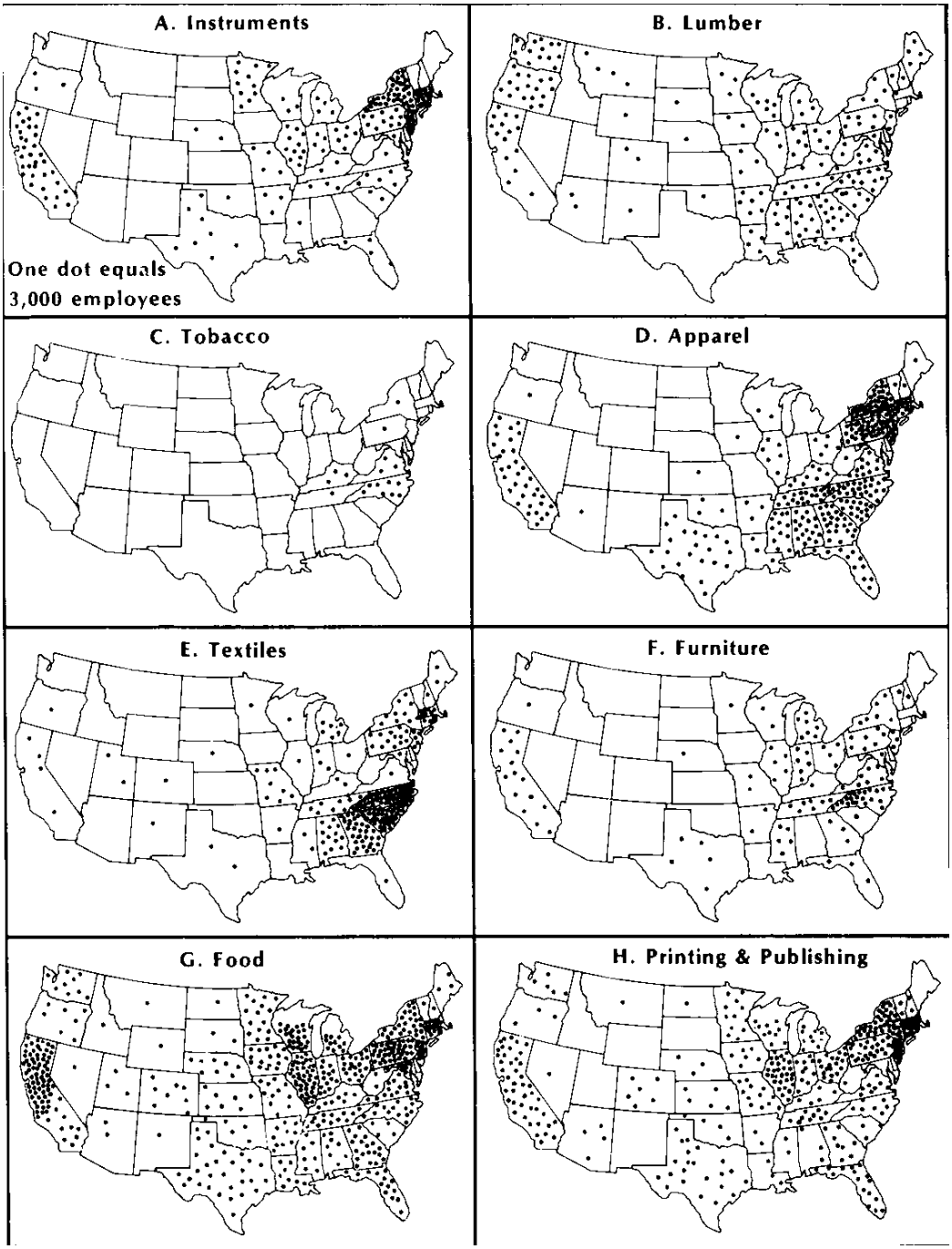
uniformity (e.g., the "winter wheat belt" in the central part of the U.S.); and (2) *functional regions* based upon areas that exhibit more interaction with one another than with outside areas based upon some criteria.[1] Functional regions are characterized by economic interdependence. This economic interdependence includes movements of goods and services and other measures of transactions within the region. Economic interdependence is also reflected in the degree to which prices are correlated.

Q. What regional groupings might be defined in terms of homogeneous areas?

A. One means of defining homogeneous regions would be in terms of the location of common types of facilities. Different types of manufacturing industries select different kinds of locations. The following figures show the spatial distributions of employment, by state, of various types of manufacturing.

[1] Hoover, E. M. and F. Giarratani. *An Introduction to Regional Economics.* Third Edition. University of Pittsburgh. URL: http://www.rri.wvu.edu/WebBook/Giarratani/main.htm

Figure 1. U.S. Manufacturing Employment Clusters



Source: Wheeler, et al, 1998. *Economic Geography.* John Wiley & Sons, New York, NY.

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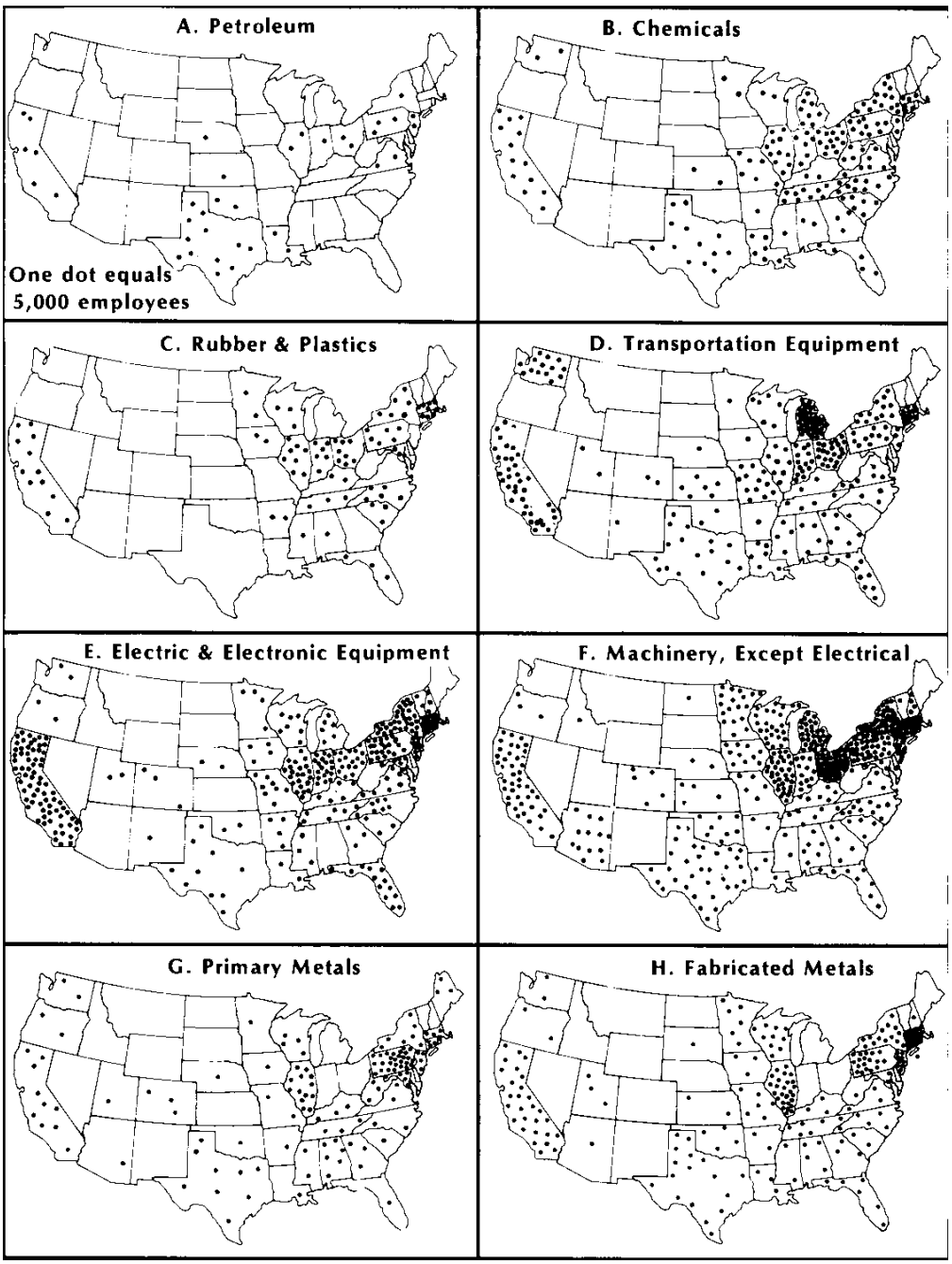
Figure 2. U.S. Manufacturing Employment Clusters



Source: Wheeler, et al, 1998. *Economic Geography.* John Wiley & Sons, New York, NY.

Q. What regions appear to emerge based upon the criteria of these various types of manufacturing industries?

A. Clearly the spatial patterns differ considerably, although many of the manufacturing types show regions that include most of the states in the Midwest, East and South. Many of the

categories show a second region concentrated on the west coast, predominately California but also often including Oregon and Washington.

Q. How do these patterns relate to the states that make up the combined AEP system?

A. The states that make up the AEP system are included within many of the broad regions defined in terms of the location of these manufacturing types.

Q. Turning to regions that might be identified in terms of functional integration, what are the criteria for determining a region?

A. The functional criteria can be varied, ranging from single types of interactions to more general trading relationships. As discussed below, for example, a functional region might be defined in terms of the flows of a particular commodity such as natural gas or oil, or the region could be defined in terms of general trade flows. Transportation infrastructure is crucial to the determination of the geographic scope of a functional region.

Q. Could you elaborate on the role of transportation infrastructure in determining the size of a functional region?

A. Investment in transportation infrastructure encourages the movement of goods by lowering transport costs and encouraging broader areas to trade with one another, and thereby encouraging these areas to become part of a larger functional region. Transportation infrastructure investments reduce costs for two reasons.[2] First, the addition of new capacity (or operational improvements on existing routes) can decrease congestion and travel times. Second, an expansion of the transportation network (e.g., highway system) increases the density of the linkages, making point-to-point trips less circuitous as well as reducing the day-to-day variability in travel times. For both reasons, the cost of transporting goods from one area to another—measured in vehicle-miles or vehicle-hours—decreases, thereby reducing costs.

[2] Federal Highway Administration. 2004. *Freight Transportation Improvements and the Economy.* U.S. Department of Transportation. URL: http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13960.html

Transportation infrastructure investments also improve the reliability of transporting goods, allowing firms to predict the amount of buffer time required in the delivery of goods. (Buffer time is defined as the amount of time built into a trip to reduce the risk of being late.) Reduced buffer time means that inventories can be reduced and storage costs are reduced (a feature of "just-in-time" delivery). This increased reliability of shipment—even over long distances—that is made possible by transportation infrastructure investments provides another inducement to trade over an expanded geographic area.

Q. You have mentioned infrastructure investment generally. What are the important types of infrastructure that influence the transport costs and thus the growth in the size of relevant functional regions?

A. The major infrastructure types typically mentioned are the railroads, the inland and coastal waterways, and the highway system. To those should be added the natural gas and oil pipelines.

III. REGIONAL TRANSPORTATION INFRASTRUCTURE

A. Natural Gas Pipelines

Q. Turning first to natural gas, could you describe the infrastructure for natural gas transportation in North America?

A. There is a highly developed network of pipelines to transport natural gas from wellheads to consumers in North America. It consists of major pipelines linking production areas to consumption areas as well as networks of smaller pipelines for local distribution. Figure 3 shows the grid of 24'' diameter and greater pipelines. The densest pattern of pipelines includes those extending from the Gulf Coast production area to the Midwest and the Northeast; the second greatest concentration of pipelines is from the West Central Texas and Oklahoma to the Midwest. Currently pipeline and storage companies operate over 290,000 miles of transmission pipeline.[3]

[3] National Petroleum Council. 2003. *Balancing Natural Gas Policy*. Volume 1. September. pg. 43.

Figure 3. North American Natural Gas Pipelines (with Diameter 24'' or Greater)

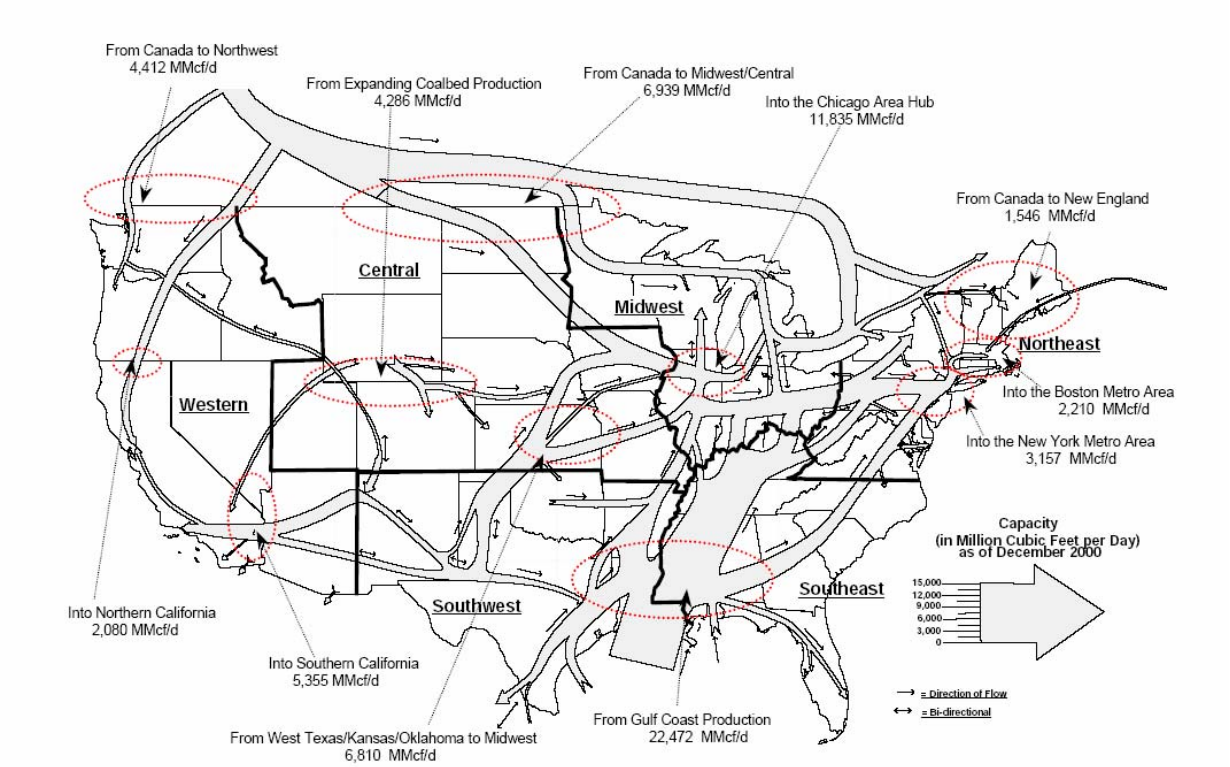
Source: National Petroleum Council. 2003. "Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy. Summary of Findings and Recommendations." Volume 1. September.

Q. What are the capacities and volumes of natural gas transported in North America?

A. Figure 4 shows the major transportation routes and capacity levels in 2000. It shows that the biggest capacity is for the pipelines that extend from the Gulf Coast production region to major markets in the Midwest and the Northeast. The capacity on this route is several times larger than the next largest route capacity. Actual transportation volume (throughput)

varies seasonally and over the years depending on supply and demand conditions. Detailed statistics for natural gas receipts are available by state by year, some of which are summarized below for the AEP states. Generally speaking, basic economics dictates that pipeline capacity be built and utilized efficiently, which means over a relatively long time period transportation volumes are approximately proportional to pipeline capacities.

Figure 4. Natural Gas Pipeline Transportation Routes and Capacity Levels



Source: U.S. Energy Information Administration. 2001. "Natural Gas Transportation – Infrastructure Issues and Operational Trends." James Tobin. Natural Gas Division. October.

Q. Do these broad flows include flows of natural gas between AEP West states and AEP East states?

A. Yes. The information on flows between AEP West states and AEP East states illustrates the broader patterns for natural gas flows shown above. Table 1 summarizes natural gas net receipts in AEP West and AEP East states in years in the last six decades. For the most part, AEP West states are net suppliers of natural gas and AEP East states are net receivers of natural gas, reflecting the gas flows described above.

Table 1. Domestic Net Natural Gas Receipts in AEP States (Mcf)

	1946	1957	1967	1980	1990	2000
Arkansas	42,491	184,318	197,790	168,555	43,553	109,180
Louisiana	-193,814	-1,247,038	-4,146,147	-4,934,848	-3,670,463	-3,671,089
Oklahoma	-134,957	-310,420	-881,580	-703,786	-1,444,386	-845,206
Texas	-395,531	-2,605,487	-3,247,981	-2,778,207	-2,229,743	-1,913,125
AEP West Total	**-681,811**	**-3,978,627**	**-8,077,918**	**-8,248,286**	**-7,301,039**	**-6,320,240**
Indiana	39,091	151,186	442,703	459,897	436,420	561,632
Kentucky	-40,902	64,481	120,974	162,724	340,002	216,996
Michigan	48,372	305,320	698475	862303	990,176	1,112,200
Ohio	126,957	578,411	925,143	707,139	532,579	668,358
Tennessee	24,297	133,887	238,323	252,803	104,733	296,292
Virginia	2,044	48,499	114,853	136,654	145,036	232,580
West Virginia	-78,225	-14,339	-34,230	32,494	-50,709	-154,652
AEP East Total	**121,634**	**1,267,445**	**2,506,241**	**2,614,014**	**2,498,237**	**2,933,406**

Sources: American Gas Association. 1947,1959. *Gas Facts*. Bureau of Statistics.
U.S. Energy Information Administration. 2001. Historical Natural Gas Annual 1930 Through 2000. December. URL: http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/historical_natural_gas_annual/hnga.html

Q. How does natural gas transportation affect prices for natural gas in different parts of the country?

A. If a commodity can be shipped from one location to another without constraints, the commodity prices at the two locations tend to move together. Natural gas prices reflect this phenomenon. When the price of gas at location A rises, it attracts gas from location B, causing the price at location B to rise as well.

Q. What can we tell from gas price movements at different locations about how well these locations are integrated?

A. The closeness of price movements at different locations indicates how well the locations are integrated, because the extent to which the prices at two locations move together depends on how quickly and how much of the commodity can be shipped between them. When two locations are well integrated, it means commodities (natural gas in this case) can be shipped quickly and in large volume between them, which causes prices to move closely together.

Q. What have you found about gas price movements in different parts of the country and what do they indicate about gas market integration?

A. I selected representative major gas pricing points for the Midwest, the Northeast, Texas, California, the Rockies, and the Pacific Northwest based on shipment volume and length of price history. The correlation coefficients of these prices are presented in Table 2. (The prices are real prices deflated to 2003 dollars based upon the GDP deflator.) The correlations show close movements in prices among different parts of the country, although there are notable differences. Texas prices are very highly correlated with prices in the Midwest and Northeast, but substantially less highly correlated with other areas, particularly California.

Table 2. Correlation in Daily Natural Gas Price Spot Prices Across U.S. Areas

	Midwest	Northeast	Texas	California	Rockies	Pacific Northwest
Midwest	-					
Northeast	0.97	-				
Texas	0.99	1.00	-			
California	0.66	0.65	0.65	-		
Rockies	0.86	0.89	0.96	0.70	-	
Pacific Northwest	0.85	0.87	0.91	0.68	0.97	-

Source: NERA calculations based on *Gas Daily* spot prices from July 12, 1993 through November 2, 2004 (proprietary) for the following pricing points:

Area	**Representative Gas Daily Pricing Point**
Midwest	Midwest - Consumers Energy (MCWCONS)
Northeast	Northeast - Columbia Gas (NEATCO)
Texas	East Texas - Katy (ETXKATY)
California	California - Southern Border, PG&E (CALSPGE)
Rockies	Rocky Mountains - Kern River (RMTKR)
Pacific Northwest	Rocky Mountains - Stanfield (RMTSTAN)

Nominal prices were converted to real 2003 prices with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

Q. What are the implications of this information on natural gas infrastructure, flows and prices for regional definition?

A. The information on natural gas suggests the existence of a broad functional region linking major natural gas production and consumption areas. The region encompasses the major gulf coast production areas and the Midwest and East consumption areas. The integration of this broader region is reflected in commodity activity as well as in the correlation of natural

gas prices. The states represented in the combined AEP system are included in this broader region.

Q. How has the nature of the natural gas infrastructure changed from 1935 to the present?

A. Since 1935 the gas transportation industry has experienced substantial growth, transforming from a young rapidly growing industry into a mature steadily growing industry. Table 3 lists some statistics. From 1945 to 1969 miles of pipeline grew from 77,000 to 247,000, more than tripling. During the same period compressor horsepower and operating revenue also grew many fold, indicating a significant increase in the gas volume transported. The gas transportation industry has continued to grow since 1970 although at a slower rate. In 2003 the country had 290,000 miles of gas pipelines. We can see the same pattern of growth from the gas flows between AEP states presented earlier. This pattern of pipeline expansion is consistent with the growth of gas consumption in the U.S. The total U.S. natural gas consumption grew rapidly from 1930 to 1970 from around 2 trillion cubic feet ("Tcf") per year to around 22 Tcf per year. After dropping to around 16 Tcf in the mid 1980's, gas consumption has increased to around 22 Tcf again currently.[4]

Q. What do you infer from this historical information on the growth of the natural gas infrastructure?

[4] U.S. Energy Information Administration. 2001. Historical Natural Gas Annual 1930 Through 2000. December. URL: http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/historical_natural_gas_annual/hnga.html

Table 3. Summary of the U.S. Natural Gas Transportation Industry, 1945-1969

Year	Miles of Pipeline	Compressor Horsepower (Thousands)	Operating Revenue (Millions of 2003 Dollars)
1945	77,000	N/A	1,920
1950	109,000	3,500	3,618
1955	142,000	4,350	9,366
1960	181,000	6,359	16,069
1965	210,000	7,736	19,227
1969	247,000	9,375	21,441

Source: Federal Power Commission. 1973. *National Gas Survey.* Volume III. Report of the Executive Advisory Committee to the Federal Power Commission.
Nominal revenues were converted to real 2003 revenues with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

A. The substantial growth in natural gas capacity after the 1930s suggests that the functional region defined in terms of natural gas activity has grown over the last 70 years. Put another way, the relevant region based upon natural gas flows would have been smaller in 1935 than today.

Q. Does the natural gas infrastructure have particular relevance to this proceeding?

A. Natural gas is a significant primary fuel for electricity generation. Although it accounts for about 18 percent of total U.S. electricity production,[5] natural gas is often the fuel used for generation that is on the margin. As a result, the price of natural gas has an important influence on the price of wholesale electricity.

B. Crude Oil Pipelines

Q. Turning now to crude oil pipelines, could you describe the transportation infrastructure of crude oil and refined product in North America?

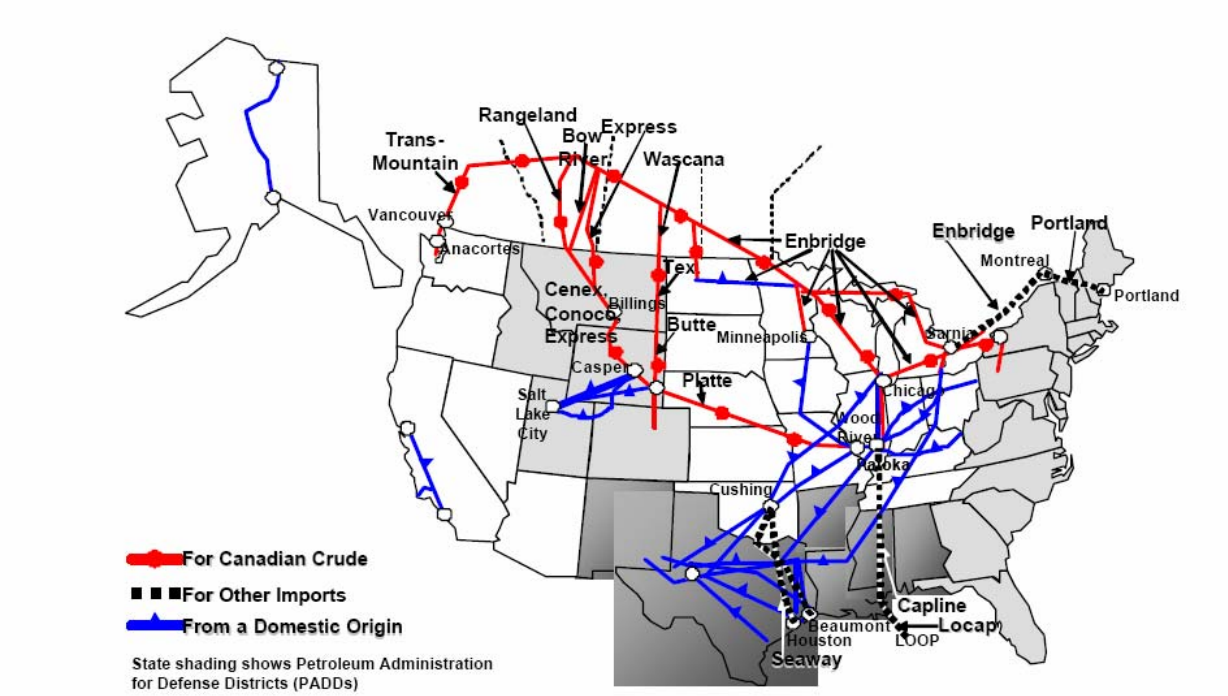
A. There are two major transportation networks for oil. One is a set of crude oil pipelines that deliver crude oil to refineries. The second is a set of pipelines for refined products that deliver various refined products—including gasoline, home heating oil, jet fuel, diesel,

[5] Energy Information Administration. 2003. "Electric Power Industry Annual Overview." December. URL: http://www.eia.doe.gov/cneaf/electricity/epa/epates.html

lubricants and the raw materials for fertilizer, chemicals and pharmaceuticals—to local distribution centers. Both networks are well developed and extensive. There are also other forms of transportation for crude oil and refined products such as trucks, rails cars, barges and tankers.

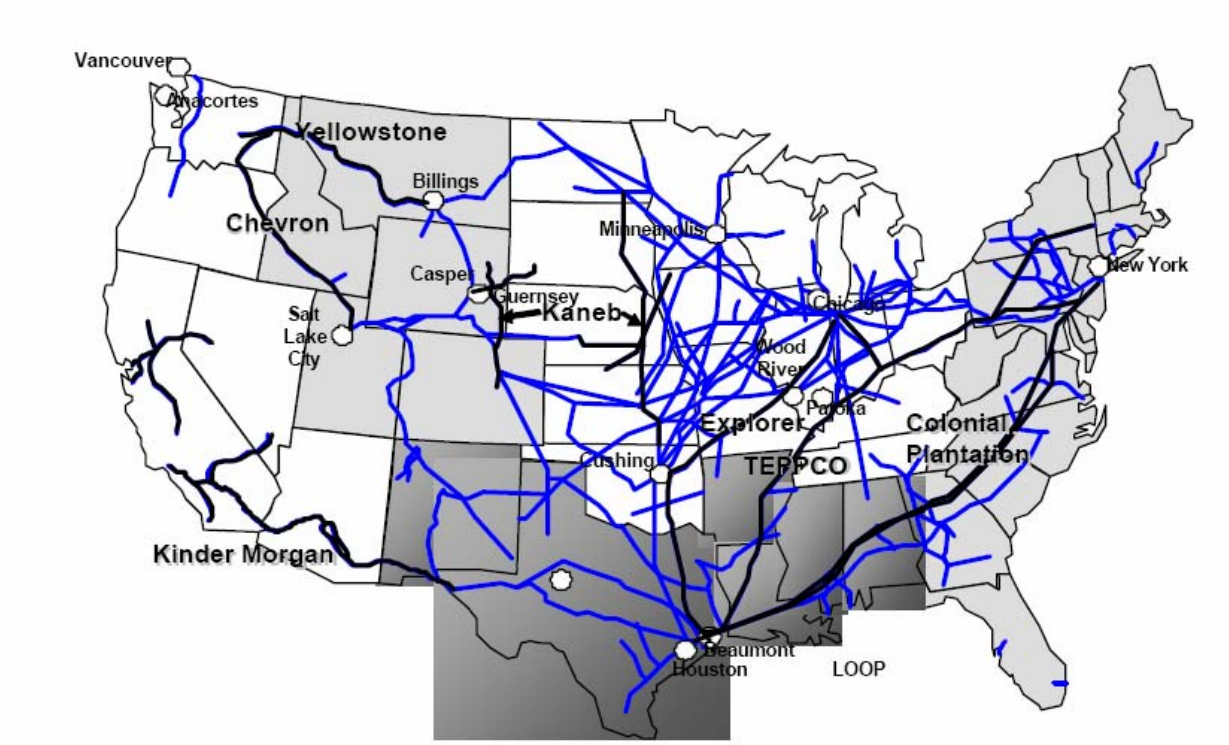
Figure 5 shows the crude oil trunk line systems, which generally serve high-volume, long haul requirements. Figure 6 shows the major refined product pipelines. Table 4 lists some summary statistics. There are over 168,000 miles of interstate crude and product (liquids) pipelines. Oil shipments constitute 17 percent of the total value of all freight in the U.S.

Figure 5. North American Crude Oil Trunkline Systems



Source: Allegro Energy Group. 2001. "How Pipelines Make the Oil Market Work – Their Networks, Operation, and Regulation." Prepared for the Association of Oil Pipelines and the American Petroleum Institute. December.

Figure 6. Major U.S. Refined Product Pipelines



Source: Allegro Energy Group. 2001. "How Pipelines Make the Oil Market Work – Their Networks, Operation, and Regulation." Prepared for the Association of Oil Pipelines and the American Petroleum Institute. December.

Table 4. Characteristics of U.S. Oil and Petroleum Transportation

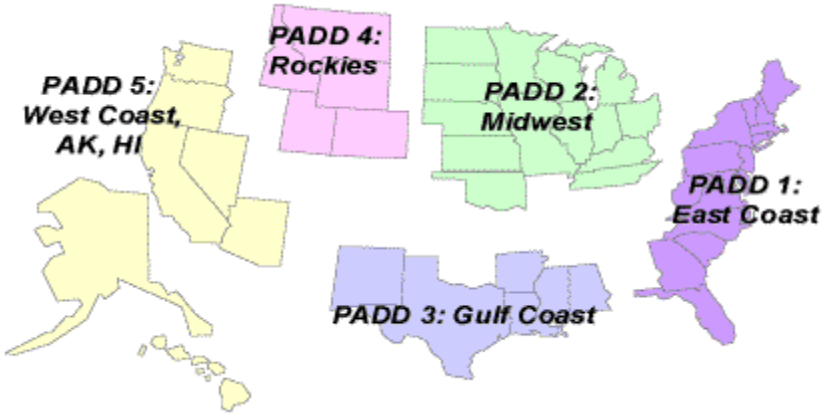
Crude oil trunk lines	55,000 miles
Crude gathering	30 to 40,000 miles
Petroleum products	95,000 miles
Number of interstate pipelines	195 for 168,417 miles
Oil shipments	40+ million barrels per day
Oil shipments as fraction of total freigh	17%

Source: Rabinow, R. A. 2004. "The Liquid Pipeline Industry in the United States: Where It's Been, Where It's Going." Prepared for the Association of Oil Pipelines. April.

Q. What is the pattern of transportation for petroleum products within the U.S.?

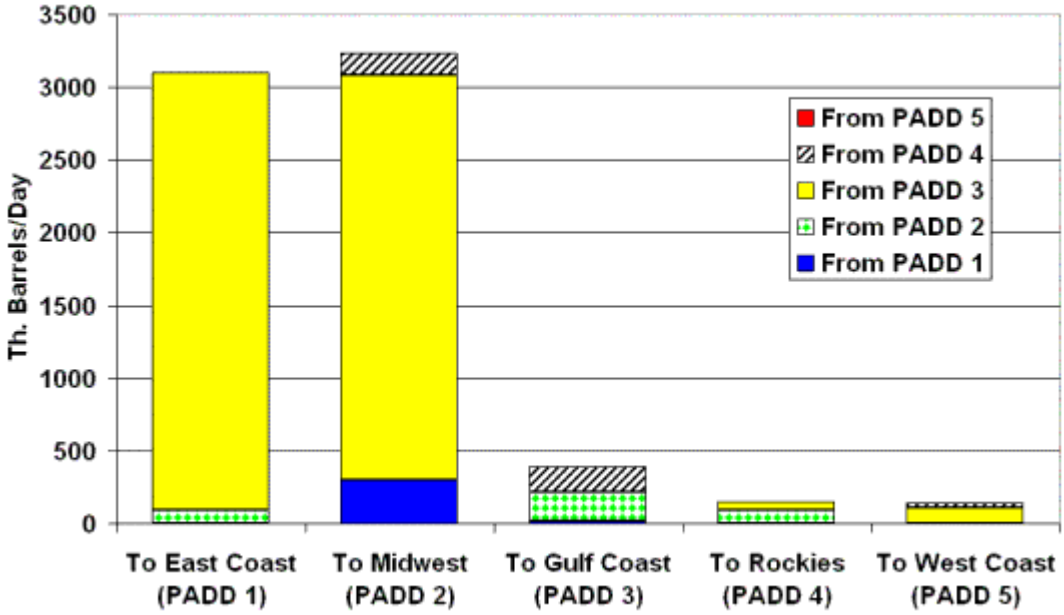
A. Oil shipment statistics are recorded according to movements among Petroleum Administration for Defense Districts ("PADDs"), which were delineated during World War II to facilitate oil allocation. The five PADDs—East Coast, Midwest, Gulf Coast, Rockies, and West Coast—are shown in Figure 7. The volume of movement in 2002 is shown in Figure 8. The two major flow volumes are from the Gulf Coast (PADD 3) to the East Coast (PADD 1) and to the Midwest (PADD 2); these flows total about six million barrels a day, or more than three quarters of the total flows. Volumes in all other directions are a small fraction of these two. This north-bound flow pattern from the Gulf Coast is similar to that in the natural gas industry but is even more pronounced.

Figure 7. Petroleum Administration for Defense Districts



Source: U.S. Energy Information Administration. 2004. *Oil Market Basics*. URL: http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/default.htm

Figure 8. Inter-PADD Oil Movements 2002



Source: U.S. Energy Information Administration. 2004. *Oil Market Basics*. URL: http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/default.htm

Q. How does petroleum products transportation affect prices in different parts of the country?

A. As with natural gas, the transportation of crude oil and petroleum products causes their prices in different parts of the country to move together. Of course, domestic transportation networks are only one part of the market integration. Because the U.S. imports about two thirds of its crude oil consumption from overseas, different parts of the country, even if separated domestically, can truly be in the same market.[6]

Gasoline and other refined product prices reflect not only crude oil prices but also refinery costs. Thus, in contrast to crude oil, prices for these refined products are likely to differ more across different parts of the country. Nevertheless, the refined product prices tend to move together. Table 5 compares the daily spot prices for gasoline in New York, the Gulf Coast, and Los Angeles from June 2, 1986 to November 9, 2004, and Figure 9 presents the

[6] In 2003, U.S. domestic crude oil production was 5,737 thousand barrels per day, compared with imports of 12,254 thousand barrels per day (U.S. Energy Information Administration. 2004. *Annual Energy Review 2003*. September. URL: http://www.eia.doe.gov/emeu/aer/contents.html).

raw price data. The prices in New York and Gulf Coast are similar, with the highest, lowest and average prices in the two areas all within one to two cents of one another. The Los Angeles price is higher, in part because California has higher refinery costs because of its more stringent environmental standards. New York and Gulf Coast prices have a 0.99 correlation coefficient, but even New York and Los Angeles have a 0.89 correlation coefficient.

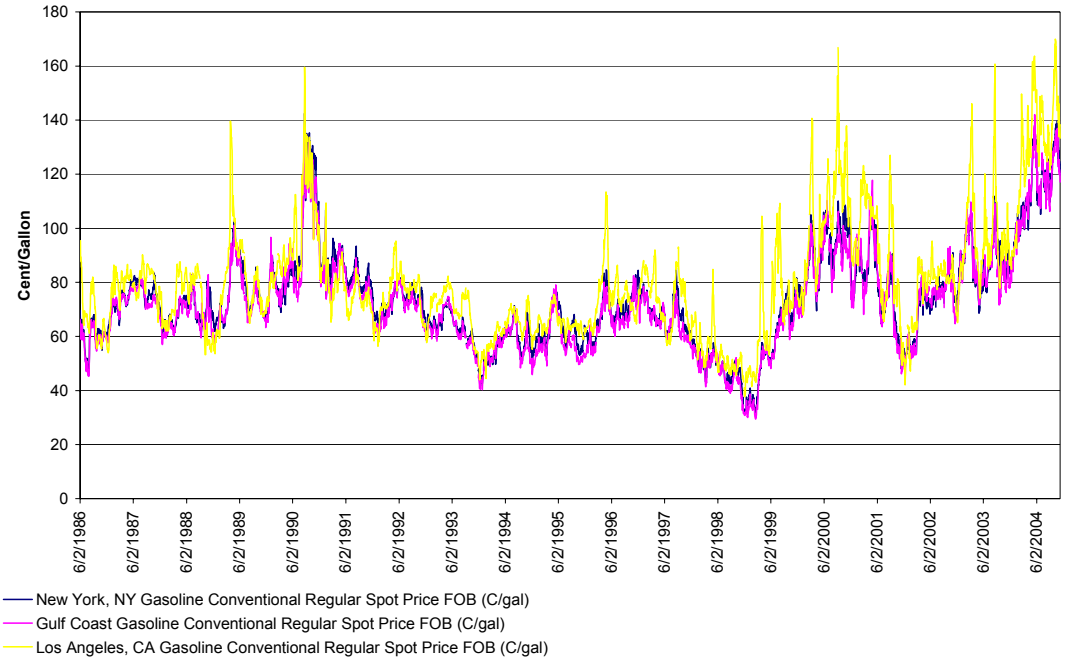
Table 5. Correlation of Daily Gasoline Spot Prices Across the U.S., 1986-2004

	Price Level (2003 Cents/Gallon)		
	Highest	Lowest	Average
New York	142.50	31.64	73.81
Gulf Coast	142.02	29.42	72.03
Los Angeles	169.97	37.69	80.13

	Price Correlation		
	New York	Gulf Coast	Los Angeles
New York	-		
Gulf Coast	0.99	-	
Los Angeles	0.89	0.90	-

Note: Price correlations are for wholesale conventional gasoline.
Source: NERA calculations based on: U.S. Energy Information Administration. 2004. Historical Gasoline Price Data. URL: http://www.eia.doe.gov/oil_gas/petroleum/info_glance/gasoline.html
Nominal prices were converted to real 2003 prices with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

Figure 9. Gasoline Prices Across the U.S., 1986-2004 (2003 Cents/Gallon)



Source: U.S. Energy Information Administration. 2004. Historical Gasoline Price Data. URL: http://www.eia.doe.gov/oil_gas/petroleum/info_glance/gasoline.html
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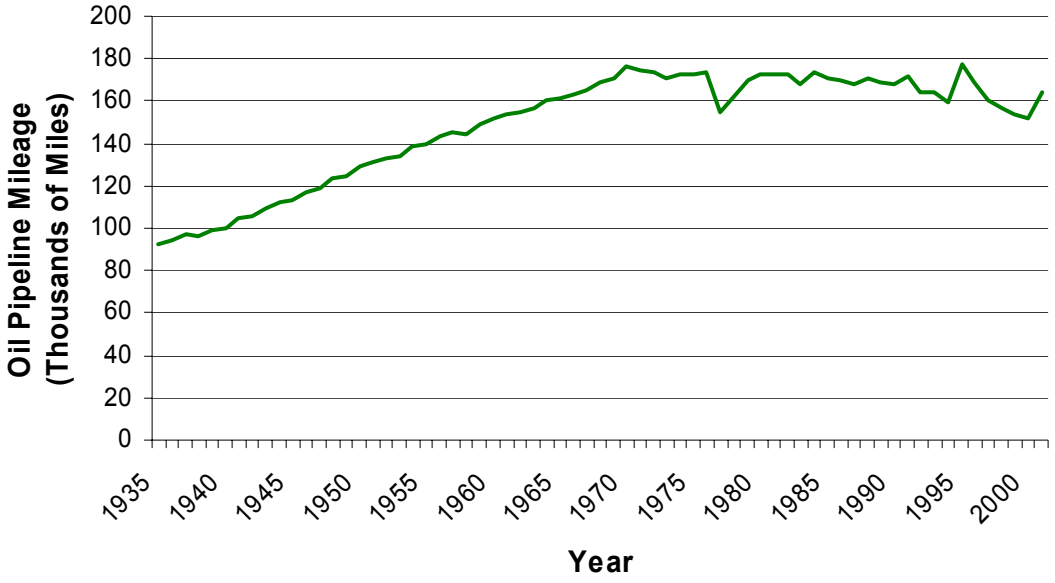
Q. What are the implications of this information on oil transportation volume and price data for regional definition?

A. There are extensive domestic transportation networks, pipelines and others, linking different parts of the country together. Although there is some indication of differences in conditions among various areas of the country—particularly in terms of refined products such as gasoline—the overall U.S. seems to be reasonably well integrated in terms of oil flows and prices. Indeed, because of the significance of U.S. imports of crude oil and the presence of a well-developed world oil market, the relevant functional region from the standpoint of crude oil could be considered the entire world.

Q. How has the state of this market integration changed from 1935 to the present?

A. Oil activities in the U.S have become much more integrated since 1935, as reflected in the large growth in the pipeline infrastructure. There are two distinct periods in the growth from 1935 to the present. The first period is from 1935 to 1970, when the domestic transportation network grew substantially, and the second period is after 1970 during which it has been more or less constant. Figure 10 shows that miles of petroleum pipelines grew from 92,000 in 1935 to 176,000 in 1970, almost doubling. Figure 11 shows a much more dramatic growth in oil freight traffic—measured in ton-miles—reflecting the growth in the volume of product transported as well as the growth in the distances covered.

Figure 10. U.S. Oil Pipeline Mileage, 1935-2001



Source: U.S. Census Bureau 1970, 1971, 1975, 1976, 1979, 1984, 1989, 1994, 1996, 2001, and 2003. *Statistical Abstract of the United States*. Washington, DC.

U.S. Census Bureau. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Bicentennial Edition, Part 2. Washington, D.C.

Figure 11. U.S. Oil Pipeline Freight Traffic, 1939-2001

Source: U.S. Census Bureau 1976, 1985, 1988, 1989, 1991, 1994, 1996, and 2003. *Statistical Abstract of the United States.* Washington, DC.

U.S. Census Bureau. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Bicentennial Edition, Part 2. Washington, D.C.

Q. What are the implications of the changes since 1935 in the U.S. domestic oil transportation system for the definition of an appropriate region?

A. The historical information suggests that the geographic scope of the relevant region grew after 1935.

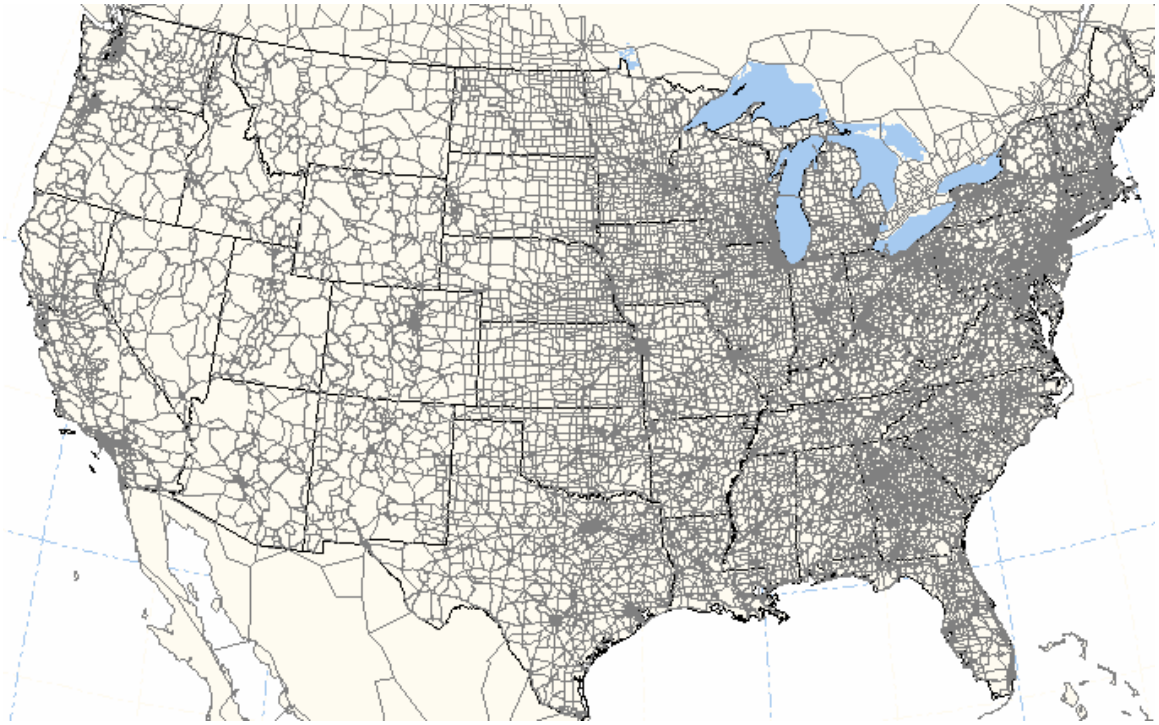
C. Roadways

Q. Turning to the road network, could you please describe the current roadway infrastructure in the United States?

A. With over 8.3 million lane-miles, the nation's roadways are the backbone of the domestic transportation infrastructure. The system includes over 45,000 miles of federal Interstate highway, which provides for transportation across broad regions of the country, and over

160,000 miles of the National Highway System.[7] Figure 12 provides a map of the nation's interstate and national highway system.

Figure 12. U.S. Highway Network, 1998



Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

Roadways allow both goods and people to travel throughout the country. The most common measure of roadway travel is vehicle miles traveled ("VMT"). In 2003, vehicles traveled 2.9 trillion miles on the nation's roadways,[8] collectively the equivalent of traversing the country almost one billion times—or almost 3.5 times per individual.

[7] Federal Highway Administration. 2003. *Highway Statistics 2003*. U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/policy/ohim/hs03/index.htm

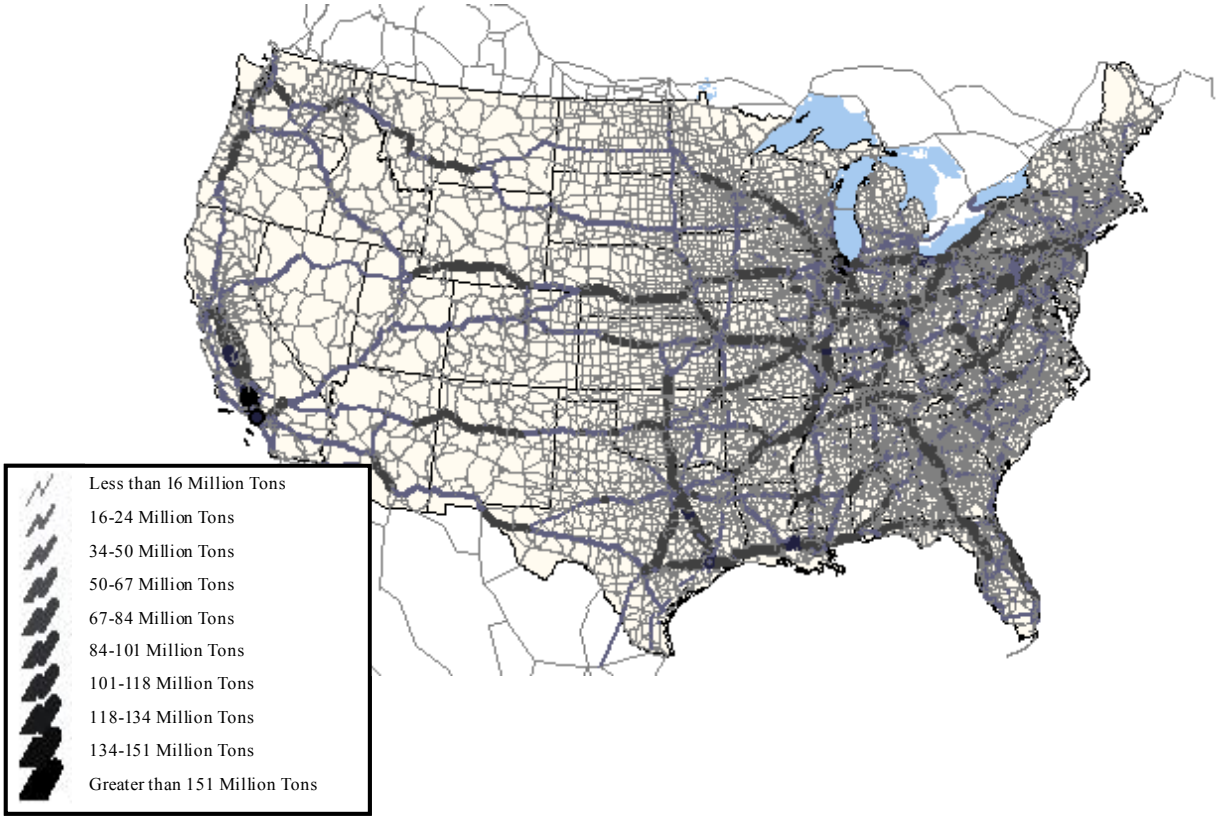
[8] Federal Highway Administration. 2003. *Highway Statistics 2003*. U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/policy/ohim/hs03/index.htm

Truck transport accounted for 1.3 trillion ton-miles of domestic goods shipments. In addition, trucks carried over $6 trillion worth of domestic commodity shipments, or almost three-quarters of the value of all goods transported domestically.[9]

Q. What are the regional patterns for freight flows using the road network?

A. Figure 13 illustrates the magnitude of the flows of freight traffic on the major highways. The figure indicates the importance of the highway infrastructure in providing economic linkages among states in the middle and eastern part of the United States.

Figure 13. U.S. Road Network Showing Intensity of Commodity Flows, 1998



Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

[9] U.S. Bureau of Transportation Statistics ("BTS"). 2003. "United States (Preliminary): 2002 Economic Census, Transportation, 2002 Commodity Flows Survey." United States Department of Transportation: Bureau of Transportation Statistics and United States Department of Commerce: U.S. Census Bureau. December. URL: http://www.bts.gov/publications/commodity_flow_survey/2002/united_states_preliminary/pdf/entire.pdf.

Q. What do these results indicate about connections between the AEP East and AEP West areas? What information is available about commodity flows by truck throughout the region?

A. The above figure illustrates that several major arteries clearly connect the AEP East and AEP West states. These major highways facilitate key economic linkages, connecting Dallas, Houston, and New Orleans with Chicago, Cincinnati, and Indianapolis. Indeed, Tables 6 and 7 demonstrate that there is a substantial amount of commodity flow between AEP East and AEP West states that moves by truck. For example, Ohio ships almost $11 billion worth of goods by truck to Texas and almost $15 billion worth of goods by truck to all four AEP West states. In total, AEP East states ship almost $60 billion of goods to AEP West states by truck, while AEP West states ship over $35 billion worth of goods to AEP East states.

Table 6. Highway Trade Between AEP East and AEP West States, 1997 (Millions of 2003 Dollars)

	To										
	AEP East							AEP West			
From	Ohio	West Virginia	Virginia	Indiana	Michigan	Kentucky	Tennessee	Texas	Oklahoma	Arkansas	Louisiana
AEP East											
Ohio	-	4,045	3,593	16,171	31,996	11,635	6,911	10,796	1,221	1,728	995
West Virginia	3,576	-	1,160	598	1,501	875	387	1,342	26	70	101
Virginia	3,403	1,541	-	979	1,988	2,840	2,452	2,515	1,112	382	514
Indiana	15,590	349	1,918	-	20,390	7,347	4,815	5,941	603	1,356	1,204
Michigan	21,376	803	2,116	9,232	-	3,695	3,110	6,492	1,209	647	669
Kentucky	6,995	887	2,312	5,785	6,274	-	6,168	3,447	396	899	931
Tennessee	0	670	3,832	3,005	5,178	6,541	-	7,527	991	3,034	1,322
AEP West											
Texas	5,631	664	2,273	2,706	6,514	2,227	3,351	-	10,231	6,347	10,496
Oklahoma	0	51	229	343	525	174	565	7,929	-	1,674	658
Arkansas	1,628	66	555	1,115	985	895	2,930	5,294	1,870	-	2,484
Louisiana	770	63	398	426	754	540	1,197	7,346	670	1,279	-

Source: U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." URL:
http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf
1997 dollars were converted to 2003 dollars with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL:
http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

Table 7. Total Highway Trade in AEP East and AEP West, 1997 (Millions of 2003 Dollars)

	To	
From	AEP East	AEP West
AEP East	234,036	57,471
AEP West	37,577	56,277

Source: U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." URL: http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf
1997 dollars were converted to 2003 dollars with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

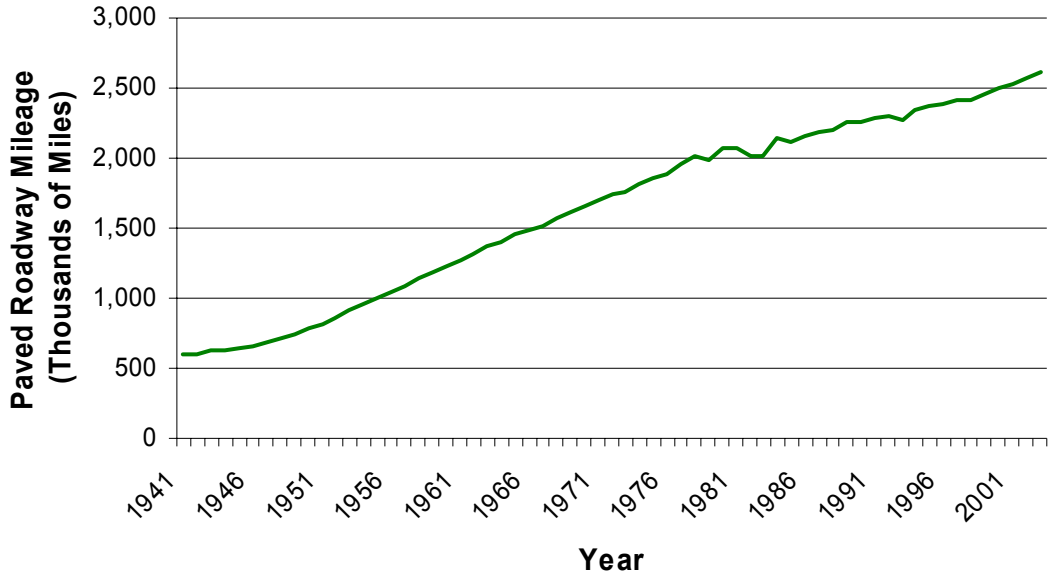
Q. What does this information on the highway system suggest about the definition of an appropriate region?

A. The national highway system provides critical infrastructure and economic linkages for the domestic transportation of goods and people. The information on the density of highway traffic suggests that there is a broad region extending over most of the Midwest, South and Northeast. States represented by the combined AEP system would be included in this broad region.

Q. How has the highway system changed since the 1935 Act?

A. In 1935, there was no federal system of highways and no federal funding for an interstate system. As a result, there were fewer than 500,000 miles of paved roadways nationwide. Today, there are over 2.5 million miles of paved roadways, as Figure 14 shows.

Figure 14. U.S. Paved Roadway Mileage, 1941-2003



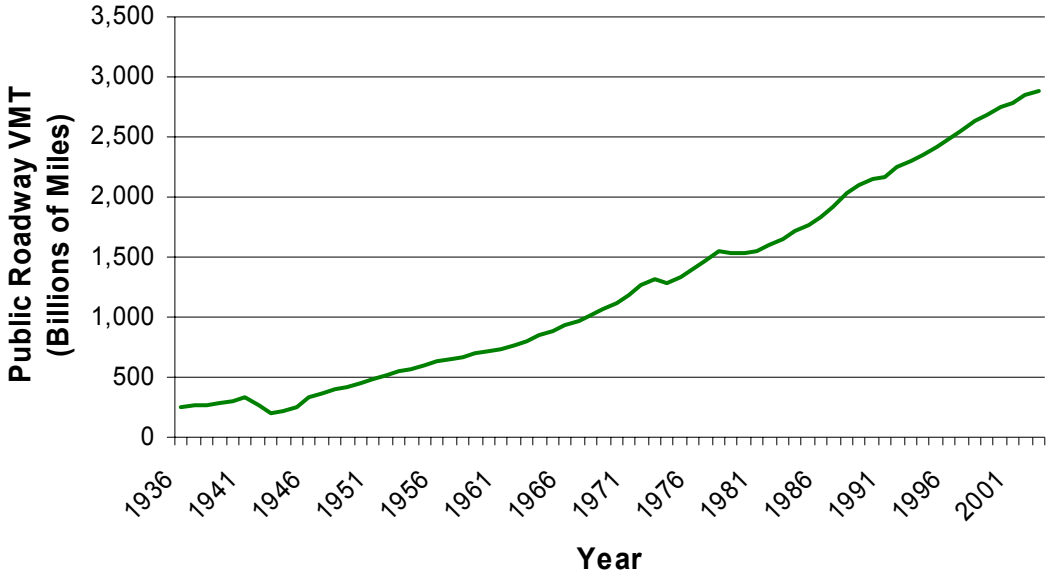
Source: Federal Highway Administration. 1995. *Highway Statistics Summary to 1995.* U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/ohim/summary95/index.html

Federal Highway Administration. 1996 through 2003. *Highway Statistics.* U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm

The Federal Highway Act of 1956 provided the first significant financial funding for a federal system of highways, although the Interstate System was originally approved in 1944. Since that time, both the quality and quantity of highways has increased. As a result, travel has skyrocketed, providing increasingly strong economic linkages between previously separate regions of the nation. Figure 15 illustrates that travel on public roadways has grown more than 10 times from 1935, to almost three trillion annual vehicle miles by 2003. This growth reflects substantial increases in the average distance that goods are shipped. Indeed, between 1960 and 1999, the average distance of good shipments by truck grew from 272 miles to 458 miles.[10]

[10] U.S. Bureau of Transportation Statistics ("BTS"). 2002. "National Transportation Statistics 2002." United States Department of Transportation: Bureau of Transportation Statistics. December. URL: http://www.bts.gov/publications/national_transportation_statistics/2002/

Figure 15. Vehicle Miles Traveled on U.S. Roadways, 1936-2003



Source: Federal Highway Administration. 1995. *Highway Statistics Summary to 1995.* U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/ohim/summary95/index.html
Federal Highway Administration. 1996 through 2003. *Highway Statistics.* U.S. Department of Transportation. URL: http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm

Q. What are the implications of this historical growth in the nation's highway system for regional definition?

A. The growth in the highway infrastructure—and the reduction in the cost of travel for people and goods—means that interactions among areas of the U.S. have become much more substantial since 1935. These expanded interactions would be reflected in an expanded geographic definition of what constitutes a functional region.

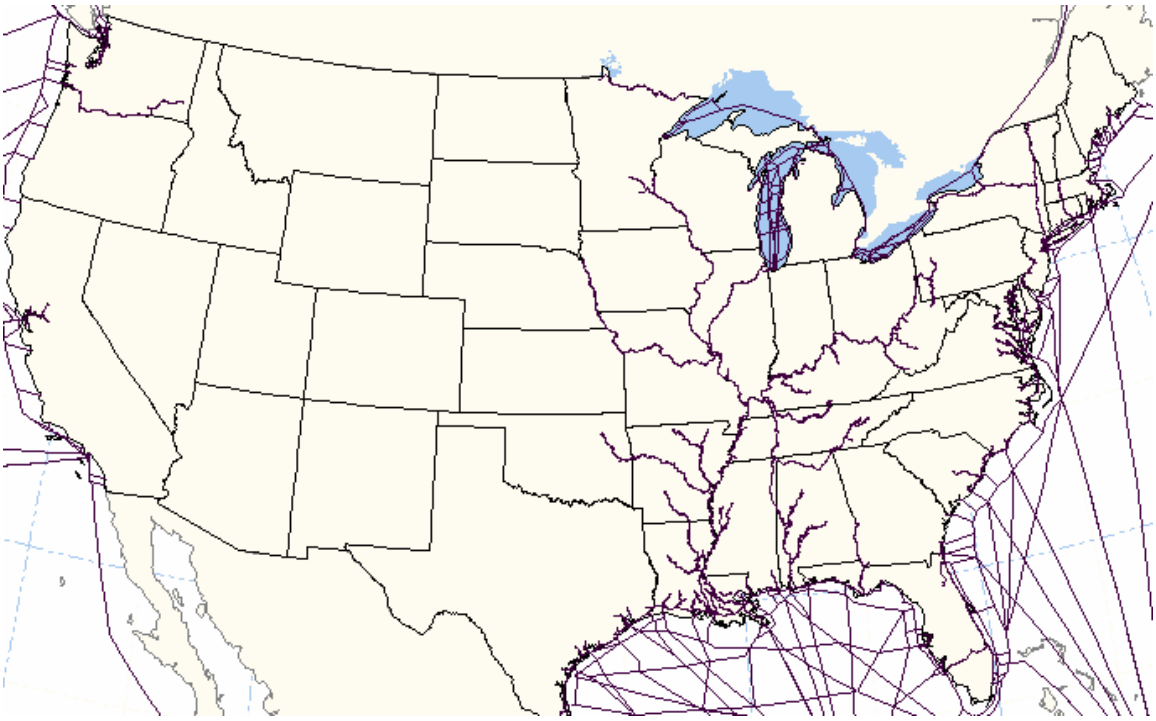
D. Waterways

Q. Turning now to water transportation, could you please describe the current system of waterways in the U.S.?

A. The Mississippi and Ohio Rivers form the main arteries of the inland waterways network in the United States, with they and their tributaries connecting Ohio, Indiana, Illinois, and the Great Lakes with Arkansas, Louisiana, Mississippi, and the Gulf Coast. The waterways system primarily transports major bulk commodities such as grain, coal, and petroleum.

The inland waterways system carries 630 million tons of cargo annually, or about 17 percent of the national volume. Cargo carried on inland waterways is valued at roughly $75 billion annually.[11] Figure 16 provides a map of the national system of waterways.

Figure 16. U.S. Waterways



Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

Q. What is the pattern of commodity flows using the waterway network in the U.S.?

[11] U.S. Army Corps of Engineers ("USACE"). 2004. "Inland Waterway Navigation Value to the Nation." United States Army Corps of Engineers. URL: http://www.iwr.usace.army.mil/iwr/pdf/navigate.pdf

A. Figure 17 illustrates the movement of goods by internal waterways. The figure reflects the overwhelming importance of the Mississippi River and its tributaries.

Figure 17. U.S. Waterways Showing Intensity of Commodity Flows, 1998

Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

Q. Will you please describe the significance of the inland waterways system to the AEP East and AEP West states?

A. With the exception of Michigan, all of the AEP East and AEP West states are located within the Gulf of Mexico watershed area. As a result, the river systems in these states flow into the Mississippi River and, ultimately, the Gulf of Mexico. In particular, AEP East and AEP West states are linked by the Mississippi River, the Ohio River, and the Gulf Intracoastal Waterway ("GIWW"), which are the primary water infrastructure for freight travel within the U.S. Indeed, as the U.S. Army Corps of Engineers (2004) notes, "States on the Gulf Coast and throughout the Midwest and Ohio Valley especially depend on the inland and intracoastal waterways." The Mississippi River, its tributaries and the GIWW

connect ports in AEP West states, such as New Orleans, Baton Rouge, Houston, and Corpus Christi, with major inland ports in AEP East states, including Memphis and Cincinnati.[12]

Q. Do you have any information on the operations of AEP with respect to inland waterways?

A. AEP River Operations transports coal and other barge freight between the Gulf Coast and locations on the Ohio, Kanawha, Mississippi, Illinois, and Missouri Rivers. AEP River Operations runs about 2,150 barges along these waterways. Coal and petroleum coke transportation accounts for most of AEP River Operations business.[13]

Q. Based on the information you have collected, what do you conclude about the waterway linkages between the AEP East and AEP West states?

A. The Mississippi and Ohio Rivers are the two busiest inland waterways in the country and they flow directly through the AEP combined region. These inland waterways, combined with the GIWW, provide direct economic linkages between the AEP East and AEP West states, facilitating the movement of commodities such as petroleum products and grain.

Q. What are implications of this information on inland waterways for the appropriate definition of a functional region?

A. The commodity flows made possible by the major inland waterways indicate a broad region through the middle of the United States running from the Great Lakes in the north to the outfall of the Mississippi River and the GIWW in the South. The states included in the combined AEP system would be included in this broader area.

Q. How has the infrastructure of U.S. waterways evolved since the 1935 Act?

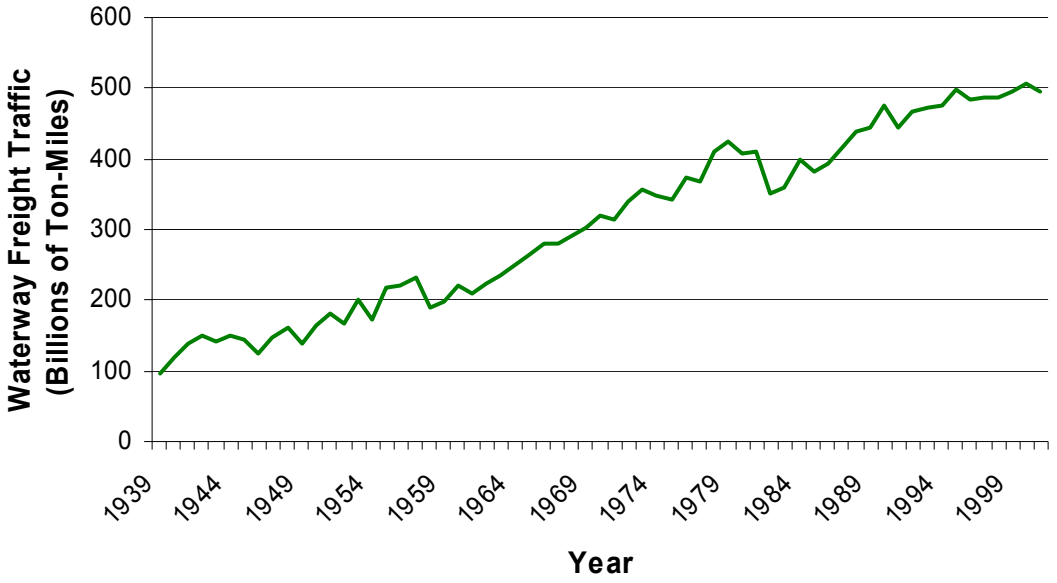
A. Since the majority of U.S. waterways are naturally occurring, there has of course been little change in the length or number of waterways. However, the capacity of U.S. waterways has grown significantly over time as vessel quality has improved and the U.S. Army Corps of

[12] U.S. Army Corps of Engineers ("USACE"). 2004. "Inland Waterway Navigation Value to the Nation." United States Army Corps of Engineers. URL: http://www.iwr.usace.army.mil/iwr/pdf/navigate.pdf

[13] American Electric Power River Operations. 2004. "What We Do." Provided by AEP via email.

Engineers has built additional locks and dredged waterways to provide for additional transport on existing waterways. As a result, waterway freight traffic has increased dramatically since the 1930s, growing more than five times to roughly half a trillion ton-miles of transport in 2001, as illustrated in Figure 18. This reflects, at least partially, an increase in the distance across which goods are transported regularly. Since just 1960, the average shipment distance over internal U.S. waterways has grown from 282 miles to 481 miles (in 2000).[14]

Figure 18. U.S. Great Lakes and Inland Waterways Freight Traffic, 1939-2001



Source: U.S. Census Bureau 1976, 1985, 1988, 1989, 1991, 1994, 1996, and 2003. *Statistical Abstract of the United States.* Washington, DC.

U.S. Census Bureau. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Bicentennial Edition, Part 2. Washington, D.C.

Q. What are the implications of these changes for the definition of an appropriate region based upon inland waterway traffic?

[14] U.S. Bureau of Transportation Statistics ("BTS"). 2002. "National Transportation Statistics 2002." United States Department of Transportation: Bureau of Transportation Statistics. December. URL: http://www.bts.gov/publications/national_transportation_statistics/2002/

A. The growth in capacity and traffic since 1935 has tended to increase the geographic size of a functional region as defined by the use of inland waterways. The increase in the average shipping distance provides an indication of the increased geographic scope of such a region.

E. Railways

Q. Turning now to railroads, could you please describe the current rail infrastructure in the United States?

A. The national rail network, consisting of almost 142,000 miles of railways,[15] spans the country. Although rail infrastructure does not provide the primary mode of commodity transportation as they once did, the railway system continues to play an important role in the transportation of certain commodities. The domestic railway system transported over $320 billion worth of goods in 2002.[16] Figure 19 shows a map of the domestic network of railways.

[15] Federal Railroad Administration ("FRA"). 2004. "Freight Railroading." United States Department of Transportation: Federal Railroad Administration. URL: http://www.fra.dot.gov/us/content/4

[16] U.S. Bureau of Transportation Statistics ("BTS"). 2003. "United States (Preliminary): 2002 Economic Census, Transportation, 2002 Commodity Flows Survey." United States Department of Transportation: Bureau of Transportation Statistics and United States Department of Commerce: U.S. Census Bureau. December. URL: http://www.bts.gov/publications/commodity_flow_survey/2002/united_states_preliminary/pdf/entire.pdf

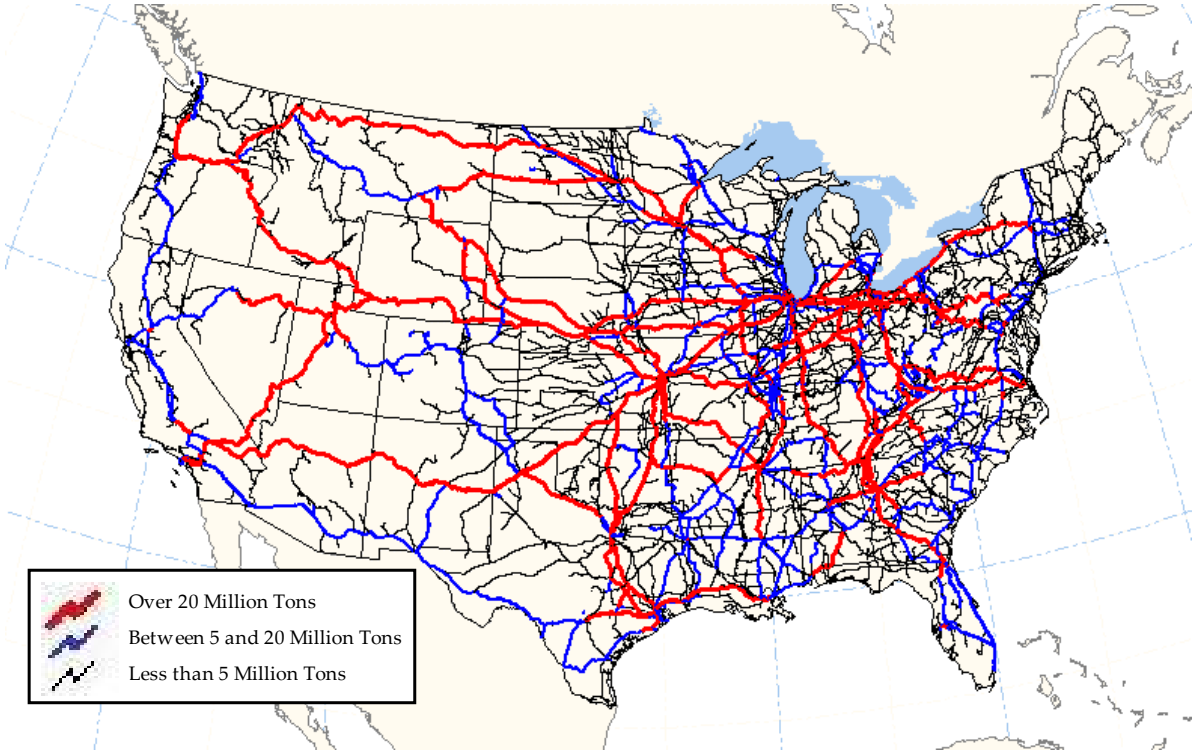
Figure 19. U.S. Rail Network, 1998

Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

Q. Will you please describe the pattern of railway flows?

A. Figure 20 illustrates the flows of railway commodities. The map shows substantial commodity flows among the Northeast, Midwest and South. Rail lines provide for hundreds of tons of commodity flow among these states. The rail lines also provide some connections with the West, although only a few major rail arteries cross the Rocky Mountains.

Figure 20. U.S. Rail Network Showing Intensity of Commodity Flows, 1998



Source: U.S. Bureau of Transportation Statistics ("BTS"), 2003. *GeoFreight Application*. United States Department of Transportation: Bureau of Transportation Statistics.

Q. What do these rail linkages indicate about the connectedness of the AEP East and AEP West states?

A. Rail lines provide yet another infrastructure connection between the AEP East and AEP West states. At least three major rail lines connect cities in Texas (notably, Dallas and Houston) with Kansas City and ultimately the Midwest. Major rail lines also run down the Mississippi Valley, linking Louisiana, Arkansas, Tennessee, Kentucky, Indiana, and Ohio.

Q. Do you have any information on the operations of AEP with respect to the railway system?

A. AEP operates approximately 7,600 railcars—roughly 5,800 of which are located primarily in the AEP West states. In 2003, AEP railcars moved 47 million tons of coal, transporting approximately 28 million tons to AEP West states and 19 million tons to the AEP East states.

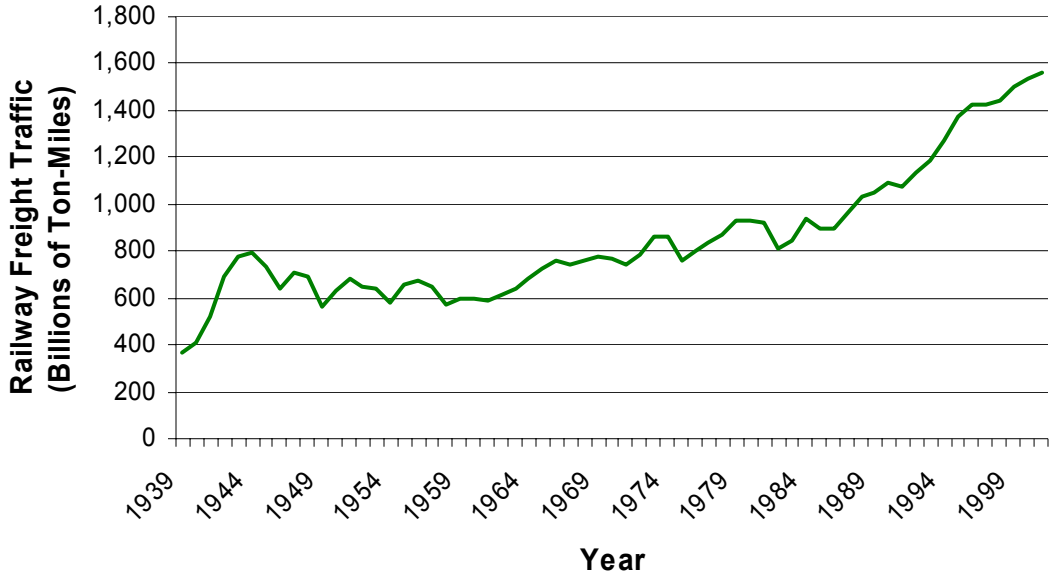
Q. What does this information on the rail network suggest about the definition of an appropriate region?

A. Although highways tend to provide for the most substantial economic linkages, railways provide another series of critical connections that allow for the movement of goods throughout a broad region of the country.

Q. How has the railway infrastructure changed since the 1935 Act?

A. In 1939, goods were transported less than 400 billion ton-miles by railroad nationwide. By 2001, this number had quadrupled to almost 1.6 trillion ton-miles, as Figure 21 shows. This reflects an increase in both the volume of goods transported and the distance of travel. Rail infrastructure has increasingly supported shipments across greater distances, with average shipment distance almost doubling between 1960 and 2000, from 461 miles to 843 miles.[17]

Figure 21. U.S. Rail Freight Traffic, 1939-2001



Source: U.S. Census Bureau 1976, 1985, 1988, 1989, 1991, 1994, 1996, and 2003. *Statistical Abstract of the United States.* Washington, DC. And U.S. Census Bureau. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Bicentennial Edition, Part 2. Washington, D.C.

[17] U.S. Bureau of Transportation Statistics ("BTS"), 2002. "National Transportation Statistics 2002." United States Department of Transportation: Bureau of Transportation Statistics. December. URL: http://www.bts.gov/publications/national_transportation_statistics/2002/

Q. What are the implications of these changes over time for the characterization a relevant region in terms of train freight traffic?

A. The growth in domestic rail traffic over the last 70 years provides another reason for an expanded geographic scope of the relevant region.

IV. TRADE FLOWS WITHIN THE REGION

Q. Turning to overall trade flows, have you developed information on the trade flows between AEP East and AEP West states.

A. Yes. The substantial infrastructure that connects the AEP East and AEP West states facilitates a substantial amount of trade between them. In 1997, AEP West states exported over $65 billion worth of goods to AEP East states and AEP East states exported almost $95 billion worth of goods to AEP West states. The flows among the AEP states are shown in Tables 8 and 9.

Table 8. Trade from All Modes Between AEP East and AEP West States, 1997 (Millions of 2003 Dollars)

	To										
	AEP East							AEP West			
From	Ohio	West Virginia	Virginia	Indiana	Michigan	Kentucky	Tennessee	Texas	Oklahoma	Arkansas	Louisiana
AEP East											
Ohio	-	4,844	4,895	18,732	37,595	14,884	8,501	15,942	1,949	2,185	2,682
West Virginia	4,728	-	2,125	725	1,790	1,243	677	2,263	36	83	268
Virginia	3,995	1,718	-	1,235	2,425	3,053	3,004	3,508	1,322	462	940
Indiana	17,992	564	2,525	-	22,277	8,658	5,750	11,264	1,049	2,089	2,554
Michigan	28,741	1,037	4,017	11,871	-	5,035	4,830	15,341	2,505	957	1,763
Kentucky	8,022	2,034	2,805	6,630	8,698	-	6,792	4,989	694	1,152	2,005
Tennessee	0	742	5,182	3,521	5,770	7,306	-	8,872	1,250	3,570	2,437
AEP West											
Texas	9,420	1,695	4,792	4,534	11,444	5,157	6,141	-	12,665	7,775	16,216
Oklahoma	0	62	452	443	832	271	810	10,088	-	1,944	1,240
Arkansas	1,915	92	831	1,237	1,334	1,282	3,370	6,257	2,150	-	3,208
Louisiana	2,139	503	988	1,170	1,821	2,025	2,910	16,239	844	2,213	-

Source: U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." URL:
http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf.
1997 dollars were converted to 2003 dollars with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL:
http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

Table 9. Total Trade from All Modes in AEP East and AEP West, 1997 (Millions of 2003 Dollars)

	To	
From	AEP East	AEP West
AEP East	286,970	94,132
AEP West	67,670	80,838

Source: U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." United States Department of Transportation: Bureau of Transportation Statistics and United States Department of Commerce: U.S. Census Bureau. December. URL: http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf.
1997 dollars were converted to 2003 dollars with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

Q. What do these trade flows suggest about the connectedness of the AEP East and AEP West states?

A. The substantial infrastructure connecting the AEP East and AEP West states provides for a substantial trade flow. This infrastructure and trade flow suggests the areas are part of a broader region. Volume of trade is a reflection of both interconnectedness and the region's size. For example, although the United States and China have a very high volume of trade, this is a reflection of the respective size of their economies rather than the degree of connection.

Regional economists have developed a methodology for standardizing measures of trade volumes to account for the volume of trade.[18] This methodology develops a linkage coefficient between regions *m* and *n* based upon the following equation:

$$L_{mn} = L_{nm} = 2(S_{mn} + S_{nm}) / (E_m + E_n + I_m + I_n),$$

where L_{mn} and L_{nm} represent the linkage coefficient and are equivalent; S_{mn} and S_{nm} represent the trade flows from region *m* to *n* and from region *n* to *m*, respectively; and E_m, E_n, I_m, and I_n represent total exports and imports from regions *m* and *n*, respectively. Essentially, this measures the fraction of two areas' total trade accounted for by trade between the two areas.

Thus, one way of assessing the information on trade volumes among AEP states as a reflection of participation within a broader region is to develop linkage coefficients for potential regions. I considered linkages among the four U.S. Census regions, using information on domestic trade flows from the Bureau of Transportation Statistics.[19] Figure 22 provides a map of the four U.S. Census regions—the Northeast, the Midwest, the South, and the West. Three of the AEP states (Ohio, Indiana, and Michigan) are located in the Midwest region and the remaining eight are located in the South region.

(...continued)

[18] Hoover, E. M. and F. Giarratani. *An Introduction to Regional Economics*. Third Edition. University of Pittsburgh. URL: http://www.rri.wvu.edu/WebBook/Giarratani/main.htm

[19] U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." URL: http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf

Figure 22. U.S. Census Regions

Source: U.S. Census Bureau. 2004. "Census Regions and Divisions of the United States." URL: http://www.census.gov/geo/www/us_regdiv.pdf

Table 10 presents the linkage coefficients for these four broad Census regions. These results indicate that the Midwest and South regions (which consist of three and eight AEP states, respectively) are the most closely connected of the four Census regions. This suggests that these two Census regions are in a broad economic region, encompassing much of the center of the country. While the boundaries of the region are somewhat ambiguous, these results provide further support for the conclusion that the AEP East and AEP West states are part of a broad economic region.

Table 10. Linkages Among U.S. Census Regions

	Midwest	Northeast	South	West
Midwest	-			
Northeast	0.30	-		
South	**0.51**	0.36	-	
West	0.26	0.20	0.30	-

Source: NERA calculations based on: U.S. Bureau of Transportation Statistics ("BTS"). 1999. "United States: 1997 Economic Census, Transportation, 1997 Commodity Flows Survey." URL: http://www.bts.gov/publications/commodity_flow_survey/1997/economic_census/united_states/entire.pdf
1997 dollars were converted to 2003 dollars with the GDP price index from U.S. Bureau of Economic Analysis. 2004. *Selected National Income and Product Accounts Tables.* Table 1.1.4. November. URL: http://www.bea.gov/bea/dn/nipaweb/TableView.asp?SelectedTable=4&FirstYear=2002&LastYear=2004&Freq=Qtr

V. CONCLUDING REMARKS

Q. Do you have any concluding remarks based upon the various types of information you have provided?

A. Yes, I would like to provide some brief final comments in three areas: (1) the various factors that are relevant for determining an appropriate region; (2) conclusions about whether AEP West and AEP East are in a single region based upon the totality of the information; and (3) the implications of the changes since 1935 when the Act was passed for the appropriate regional definition.

Q. Could you summarize your thoughts on the appropriate factors to consider in determining the relevant region?

A. My testimony has emphasized that the appropriate region depends upon the context—there is no one criteria for selecting "the region." Regional economists have suggested the usefulness of distinguishing between two general types of criteria: (1) homogeneity within the geographic area; and (2) functionality in terms of various economic interactions. I have mainly considered the implications of definition (2). In this context, the determination of whether AEP East and AEP West are within the same region requires considering a wide variety of possible criteria to provide an overall assessment based upon the totality of the circumstances in which the combined AEP system is located.

Q. What are your conclusions regarding the general pattern that emerges from the totality of information you have provided?

A. The totality of the evidence indicates to me that the AEP combined system is located within a broader region. This broader area includes key infrastructure—including pipelines, waterway, railroads and highways—that functionally tie the parts of the region together. Trade flows and product price relations provide additional indications of the usefulness of identifying this broad area for purposes of the Act.

Q. Can you identify by name the region in which the combined AEP system operates?

A. As a general matter, regions are not separated by clear boundaries. Exceptions may exist where large bodies of water or significant mountain ranges lead to sharp boundaries. One could consider the analogy to a neighborhood. Many people tend to think in terms of "their neighborhood," but the geographic definition can be fuzzy unless there is some clear boundary such as a major highway or water body.

Q. Must a region be homogeneous?

A. No. The examples I have presented indicate that functional regions tend to be based in part on diversity. One example is the differences between natural gas producing and consuming areas, linked together by natural gas infrastructure. Indeed, one would expect to find considerable diversity along various dimensions within a broad region. This diversity is evident even within a single state or urban area. Consider the case of Virginia. Comparing Old Town Alexandria with a rural community in the Shenandoah Valley will yield sharp demographic and cultural differences. Yet, I doubt that anyone would argue that Alexandria and Virginia's Shenandoah Valley are in different regions of the United States.

Q. What are the implications of changes over the past 70 years—since the 1935 Act was passed—for an appropriate regional definition?

A. It is quite clear that the definition of a region in 1935 was substantially more circumscribed than what is appropriate today. I have presented information showing enormous growth in important infrastructure and the volume of good movements; pipelines, road networks and even waterway and rail capacities all have growth considerably in the past 70 years. These capacity improvements lower the cost of travel for goods and people and thus increase the ease of interconnections across broader geographic areas. These increased interconnections

mean that entities such as electric utility systems are now in a much better position than they may have been in 1935 to provide efficient, interconnected service over a broad geographic area.

Q. Does this conclude your testimony?

A. Yes.