Meeting the Transportation Challenges of the 21st Century: Intermodal Opportunities in the Appalachian Region

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CHAPTER 1
THE ROLE OF TRANSPORTATION IN THE DEVELOPMENT OF THE ARC REGION

Introduction

Through much of the 20th century, the businesses, communities, and people of Appalachia suffered the consequences of being isolated from economic opportunity. Much of the nation's highway building in the mid-20th century passed the region by, due to the construction and financial challenges posed by Appalachia's rugged mountain chains and deep valleys. With key interstate links diverted elsewhere, many of the Region's businesses, communities, and residents discovered that they were disconnected from the new highway network and from the national economy that it fueled. As the impact of this isolation grew in intensity, the Appalachian Regional Commission (ARC) worked to establish the 3,090 mile Appalachian Development Highway System (ADHS), with the goal of overcoming the social and economic consequences of the Region's isolation.

In an effort to prevent a reoccurrence of the harsh consequences of isolation, this study looks into the future to evaluate the powerful forces that are influencing the economy and to identify both transportation challenges and opportunities that will shape Appalachia in the 21st century. Having devoted much of the past half-century reacting to the Region's transportation deficiencies, this initiative is focused at a more proactive approach that identifies opportunities which can better position Appalachia for economic and societal success in the years to come.

Looking ahead to the future, the economic influences of the quickly emerging global economy will reshape the way Appalachia interacts with its partners and competitors, whether across the street or around the world. Economic competition and opportunity no longer transcend state or regional lines, but now extend to the farthest points on the globe. This is a complex and demanding new economy that has been born of advanced information and communication technology and an extensive and highly refined global supply chain. The effect of globalization on the transportation system is profound, as cargo volumes are rapidly expanding and broadly diversifying. This study analyzes the changing characteristics of commodity movements to, from, and through the Region, evaluates both the transportation strengths and weaknesses that

Appalachia faces in adapting to such change, and establishes a strategic and proactive vision to help the Region compete in the global economy of the 21st century.

A reoccurrence of the sustained economic distress that grew from Appalachia's isolation during the middle of the 20th century can be avoided in the future. Doing so requires the identification of trends and challenges and the acceptance that old solutions cannot sustain Appalachia in the dynamic and rapidly changing marketplace of the 21st century.

The ADHS was developed to link historically isolated sections of Appalachia to commercial activity within and outside the region and has given rise to significant economic development benefits for the Region.

Logistics and the Transportation Revolution

Within the eastern half of the United States, the Appalachian Development Highway System (ADHS) is an integral part of the overall transportation network. The ADHS was developed to link historically isolated sections of Appalachia to commercial activity within and outside the Region and has given rise to significant economic development benefits. For example, a 1998 study estimated the ADHS had stimulated 16,270 full-time equivalent jobs and approximately $426.0 million in wages and salary as of 1995.[1]

Today, freight movement is undergoing revolutionary changes. The combination of increased containerization of goods, combined with unprecedented advances in logistics technology, has made both intermodalism and multimodalism the new global standards in freight transportation. Because of this, adequate highways alone are no longer sufficient to serve the transportation needs of the new economy. A recent report of the United States Chamber of Commerce concludes, "The United States is the world's greatest trading nation. Its economic health depends on the current and future efficiency of its intermodal system." Without question, a region's competitive position will depend on access to efficient, seamless intermodal transportation that features interconnected highway, rail, air, and marine transportation capabilities. Because of its geographic position, Appalachia serves as a crucial land-bridge for both north-south and east-

[1] The executive summary the 1998 study can be found on ARC's website at: http://www.arc.gov/index.do?nodeId=1040

west commerce. Its role in bridging the nation's heartland to key international gateways positions the Region to reap economic development benefits by improving transportation efficiency, expanding capacity, and taking advantage of strategic intermodal opportunities.

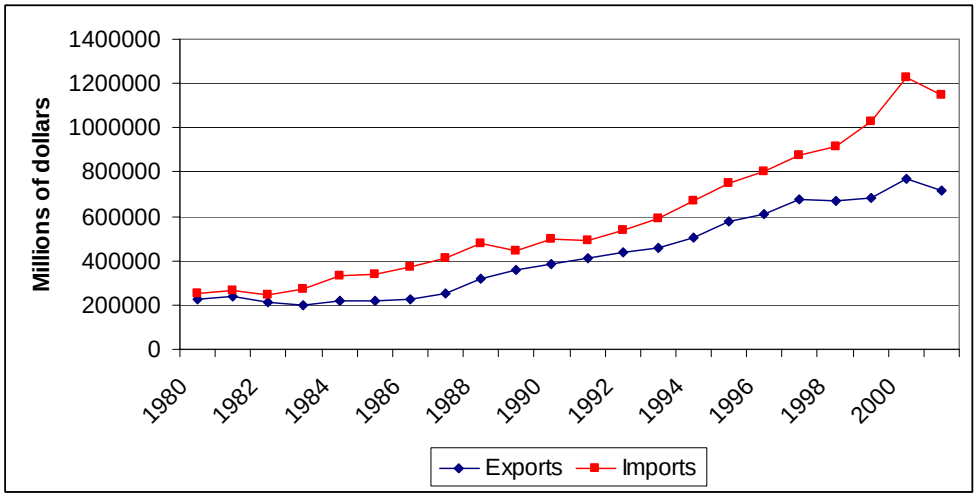
The global economy is becoming more integrated. As nations throughout the world increasingly embrace free market economics, trade polices are likely to become even more liberalized in the years ahead. Increased open trade has served as an "engine of growth" among trading partners and has been accelerated through the establishment of the World Trade Organization and associated trade agreements such as General Agreement on Tariffs and Trade (GATT), NAFTA, Free Trade Agreement of the Americas and the increasing liberalization of trade in the Pacific Rim.

In the US, imports and exports continue to increase, both in absolute value and as a percentage of GDP, as shown in Exhibits 1.1 and 1.2. Despite a slight decline in 2001, both imports and exports have been increasing at an average annual rate of 16.3 percent and 10.0 percent, respectively. The growth in imports has consistently outpaced that of exports and this trend is projected to continue for the foreseeable future.

As Exhibits 1.1 and 1.2 illustrate, the passage of NAFTA in 1992 and its implementation in 1994 helped accelerate the growth in both imports and exports. However, the acceleration in imports has been significantly faster than exports.

Exhibit 1.1

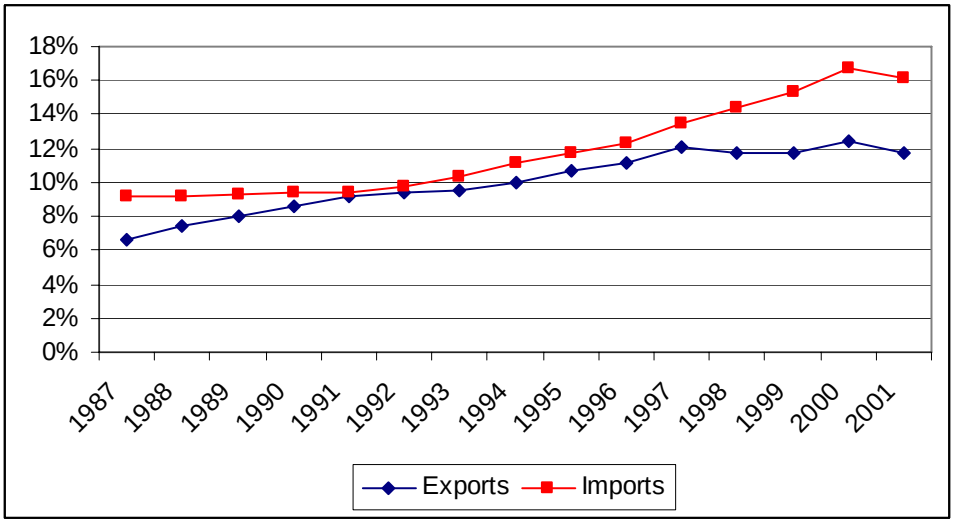
U.S. Imports and Exports, Goods (in 1996 chained dollars)



Source: U.S. Department of Commerce, Bureau of Economic Analysis

Exhibit 1.2

U.S. Imports and Exports as a Percent of GDP



Source: U.S. Department of Commerce, Bureau of Economic Analysis

The globalization of the world economy and the resulting increase in international trade have had and will continue to have significant implications for transportation networks worldwide, including those in Appalachia.

Evolution of Trade Corridors

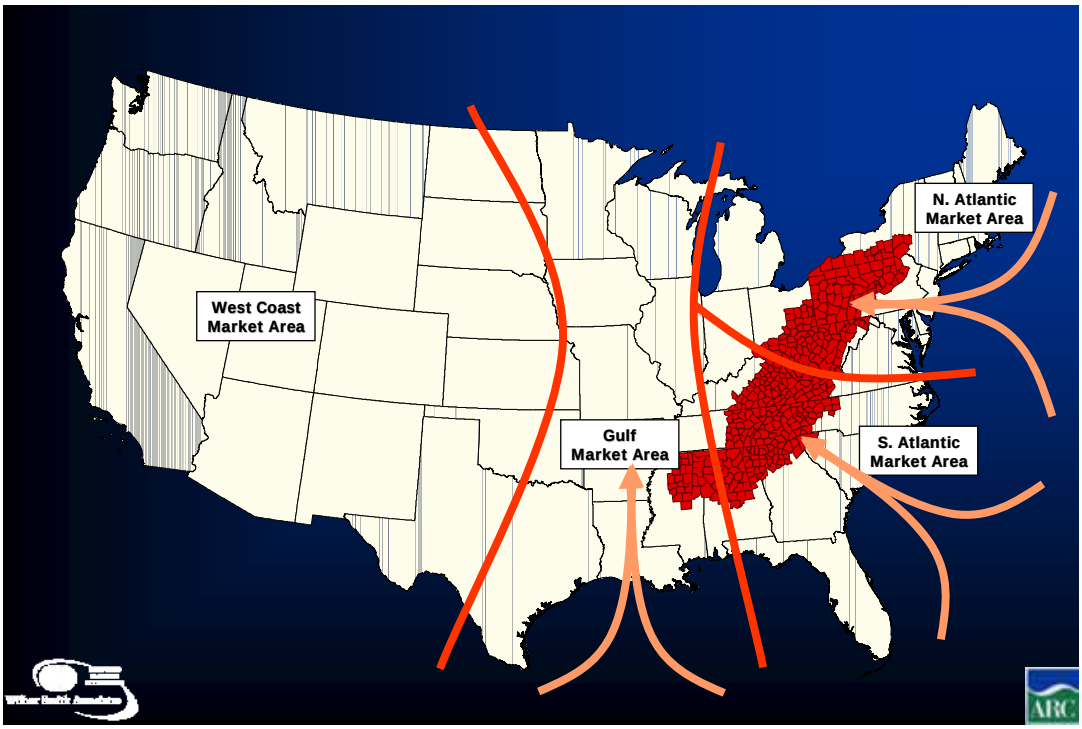
The globalization of trade has resulted in dramatic changes in domestic freight corridors that support international commerce. For example, increased trade with China and the Pacific Rim has led to the development of enhanced east-west transportation infrastructure. NAFTA is requiring similar development of north-south corridors. The expansion of trade agreements to include Latin American countries is already having significant impacts on transportation needs in the Appalachian Region. The emergence of the west coast as the primary entrance point for Pacific Rim trade put early pressures on the development of major east-west corridors such as I-80, I-40, and key transcontinental rail corridors. The surge in Latin American trade during the nineties has put a new emphasis on emerging north-south trade lanes that penetrate Appalachia. The increase in global trade coupled with other developments, including the proposed widening of the Panama Canal and the establishment of transshipment points in strategic locations such as the Bahamas, suggests that north-south lanes, as well as east coast ports, will continue to see dramatic increases in the volume of goods being handled.

The surge in Latin American trade during the nineties has put a new emphasis on emerging north-south trade lanes that penetrate the ARC region.

The densification of both east-west and north-south trade lanes provides Appalachia with an opportunity to take advantage of becoming a land bridge for trade activity by combining all-water service to key East Coast and Gulf ports with intermodal rail movements into the nation's hinterland. Exhibit 1.3 illustrates the land bridge concept for Appalachia.

Exhibit 1.3

ARC Region as a Land Bridge for International Trade



Appalachia can play a strategic role of getting goods between key ocean ports, including NY/NJ, Norfolk, Charleston, Savannah, Gulfport and Mobile, and the nation's Midwest and southeastern regions. One way of strengthening the land bridge concept is through "inland ports." `Inland ports provide a short haul rail movement to shuttle containers away from crowded port facilities to less congested inland sites for processing and transfer to other rail and truck services. The Virginia Port Authority has already developed the successful Virginia Inland Port (VIP) at Front Royal, VA. In addition to the VIP, Huntsville International Airport's International Intermodal Center also demonstrates how a fully coordinated intermodal center can attract significant economic and employment success. Elsewhere, South Carolina is exploring the potential of establishing inland ports linked to the marine terminals of the Port of Charleston.

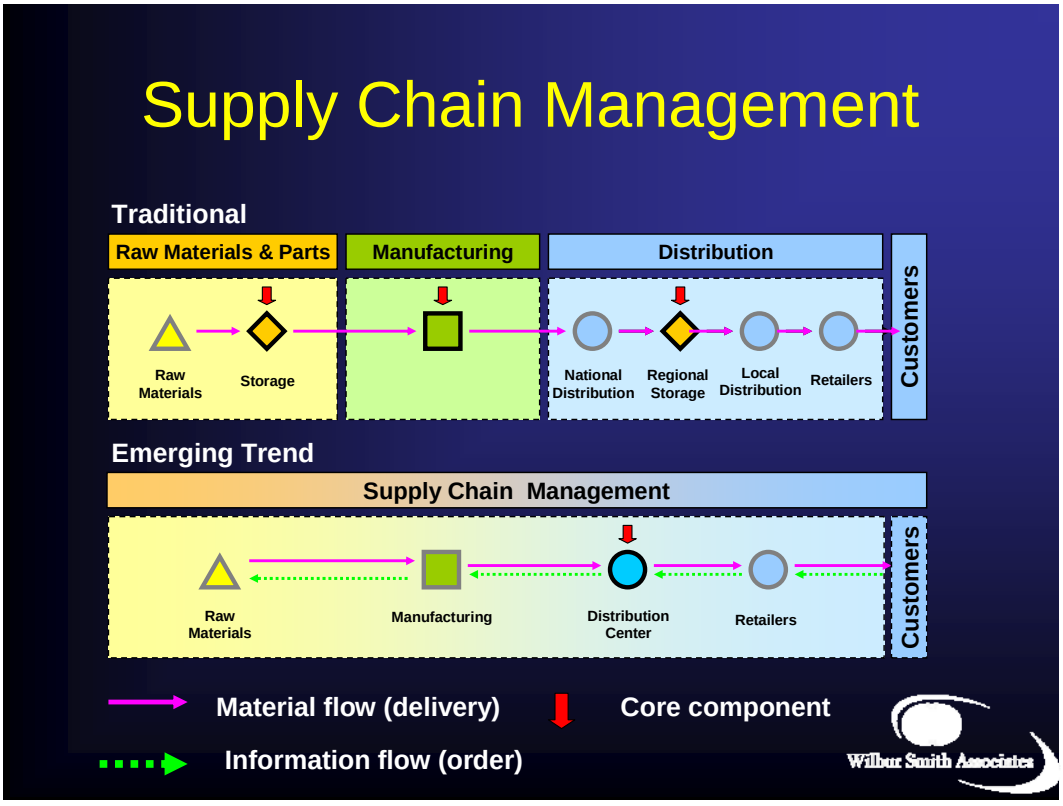
The Role of Supply Chains

The creation of a far-flung supply chain, arising from the need to access global supply networks and markets, has significantly increased the importance of transportation services. The need to link distant markets through seamless commercial networks will lead to increased demands for international transportation service providers. Thus, the supply chain is often referred to as the new economic unit of competition. The changes in supply chains and the resulting impact on transportation needs are illustrated in Exhibit 1.4.

In essence, the trucks on the roads, the containers on the ships, and the cars on the railroad are the new warehouses of the 21st century.

Exhibit 1.4

The Role of Changing Supply Chains



As can be seen, advancements in communication technologies have played a key role in supply chain management. There are now fewer warehouses and lower inventories all along the supply chain. In essence, the trucks on the roads, the containers on the ships, and the cars on the railroad are the new warehouses of the 21st century. National and regional distribution and transshipment centers are replacing the traditional storage warehouses.

The Need for Multi-modal Transportation Systems

Another phenomenon associated with global trade is the ever-increasing containerization of freight. By packing goods into standardized containers, shippers and carriers can achieve agglomeration economies in terms of specialized equipment. Containers also provide safety and security measures that are increasingly important. One of the key benefits to containerizing freight is that it becomes possible to quickly and inexpensively transfer it from ship to rail to truck, without unloading the contents of the container itself. Global trade requires an intermodal transportation network due to the containerization of its cargo. As imports and exports continue to increase in their relative importance to total GDP, the need for intermodal container distribution hubs capable of supporting trucking, rail, air cargo, and potential inland navigation service will increase. For example, goods transported using multiple modes increased by 31.2 percent in terms of value and 6.8 percent in terms of ton-miles from 1993 to 1997.[2]

Within the current context, it is important to note that globalization is not restricted to only manufactured commodities. It is also affecting the trade of raw materials, including coal. In the US, domestic users of these resources now have a much broader array of international suppliers from which to choose. Without question, a diversified regional economy cannot emerge without the support of a modally diverse and inter-connected transportation network.

Without question, a diversified economy will rely on a modally diverse and inter-connected transportation network.

[2] U.S. Department of Transportation, Bureau of Transportation Statistics and U.S. Department of Commerce, Census Bureau 1997 Economic Census, Transportation, 1997 Commodity Flow Survey.

The Impact of Foreign Direct Investment on Trade Flows

In addition to globalization of trade, the flow of foreign direct investment (FDI) has significant impacts on trade flows. Foreign direct investment has grown by more than ten fold over the last 20 years and this trend has significantly shaped the volume, direction and tempo of international trade flows. Most recently, inflows of FDI to mainline China have been especially dramatic, with FDI rising to almost $53 billion (US) in 2002, making it the largest recipient of FDI in the world and a growing production and export center. While the worldwide slump in economic growth has led to a decline in FDI flows over the 2001-2002 period, forecasts predict that FDI will rebound in 2004. Despite the recent declines in FDI, the stock of worldwide FDI is impressive, generating sales by foreign affiliates of multinational companies amounting to $18 trillion in 2002, as compared to worldwide exports of $8 trillion.[3]

Clearly, FDI has affected the structure of global specialization by countries and firms and has deepened the integration of global production networks within industries and regions. In turn, the globalization of production has contributed significantly to the growth in trade flows and has intensified the worldwide demand for intermodal transportation and logistics services. Of particular importance for regional development in the United States is the emergence of Asian and Latin American-based production centers by foreign affiliates, which have increased the volume and tempo of trade and the demand for transportation services. As a result, both imports and exports between the United States and these two regions have grown all along the value-added chain. These trends are forecast to become more pronounced over the course of the next decade, with far-reaching implications for transportation and logistics planning of trade-related corridors serving the trade gateways of the United States.[4]

In turn, the globalization of production has contributed significantly to the growth in trade flows and has intensified the worldwide demand for intermodal transportation and logistics services.

The Growth in Electronic Commerce

Another trend that has significant impacts on transportation infrastructure needs is the growth in electronic commerce. The two most significant implications for transportation infrastructure and

[3] "Global FDI Flows Continue to Fall; UNCTAD Now Forecasts 2004 Rebound" by the United Nations Conference on Trade and Development, September 8, 2003; "Trends and Recent Developments in Foreign Direct Investment" Directorate for Financial, Fiscal and Enterprise Affairs, Organization for Economic Cooperation and Development, June, 2003.

[4] *Latin American Trade and Transportation* (LATTS).

services arising from the increase in e-commerce include:

- Increased demand for better, faster and more flexible delivery service
- Rapid growth in small/high value shipments traveling longer distances

A potentially positive effect for Appalachia is that growth in transportation service sector activities and the emergence of electronic commerce produces smaller shipment sizes, which rely on express or less-than-truckload shipping – shipping patterns that already dominate motor carriage in lightly populated areas within the Appalachian Region. The increase in less-than-truckload shipping in other regions of the U.S. will lead to less disparate transportation costs, thus improving the competitive position of Appalachia.

Changing Manufacturing and Production Technologies

Many of the changes in the manufacturing sector over the last two decades have been a direct result of increased foreign competition. In an effort to regain a competitive advantage, American manufacturers began to modernize their facilities and production technology, as well as their management practices. In addition, newer, smaller manufacturers producing a greater variety of high-tech and specialized products have started to emerge. Trends that have affected American manufacturing include the continued growth of large multinational companies, the rise of knowledge-intensive and technology-based industries, and changes in the nature of production processes including:

- Just-in-time (JIT) delivery systems
- Specialization and custom-made production
- Lean of just-in-time manufacturing
- Decentralization of manufacturing

Failure to plan for the evolving transportation needs of the manufacturers of the new economy will hinder the region's ability to attract and retain these businesses and the jobs they represent

All of these changes have had significant implications for transportation demand. For example, the shift toward knowledge-based and high technology production has led to a shift away from bulky, heavy shipments of manufactured goods toward lighter, higher value shipments. The shift to JIT production has led to the need for JIT delivery services. This requires more frequent and

reliable deliveries, thus putting increased pressure on states to provide adequate transportation infrastructure to meet the needs of businesses they hope to attract and retain.

In regions such as Appalachia that have historically been heavily dependent on manufacturing, these changes in supplier-chains and transportation demand underscore the need for long-term transportation strategies. Failure to plan for the evolving transportation needs of the manufacturers of the new economy will hinder Appalachia's ability to attract and retain these businesses and the jobs they represent.

Transportation and Economic Development in Appalachia

The relationship between transportation infrastructure and economic development has been the focus of increasing analysis, discussion, and interest during the past decade. This represents a new paradigm in analyzing transportation investments. Historically, such investments have been valued based on efficiency gains, such as travel cost and time savings. Recently, however, there has been a push to promote transportation infrastructure improvements to enhance economic development in terms of jobs, income, and tax base expansion. This is especially crucial in an economically distressed region like Appalachia.

Stakeholder groups comprised of elected officials, transportation and economic development specialists, government agencies, and business leaders have specified numerous ways in which transportation impacts economic development including:[5]

- Enhancing economic development by lowering the cost of doing business, through streamlined transportation efficiencies;
- Linking key economic centers in a region to global markets, thus making the area more attractive for growth;
- Providing for more efficient flows of commerce through the Region to enhance the development potential of areas traversed by these lanes of commerce;
- Facilitating the movement of people to new jobs and public services;
- Opening up new sites for commercial and industrial development;

[5] Weiss, Martin H. and Roger Figura (2003). "A Provisional Typology of Highway Economic Development Projects." US DOT, Highway Administration: Washington DC.

- Providing improved local access to stimulate retail development;
- Enhancing the flow of goods and services within a sub-regional trade area to increase induced economic benefits;
- Facilitating the diversification of the local economy; and
- Supporting new business initiatives.

The recent surge in the recognition of transportation infrastructure as an economic development tool is not a rebirth of the "build and they will come" theory that led to many misaligned investments in the past. Instead, this shift is in response to input provided by potential developers and industry experts. The underlying concept is that a lack of transportation alternatives can retard economic development potential, as commerce tends to flow to those regions offering the broadest and most cost efficient options. For example, Appalachia stands to reap substantial economic gains from the increase in foreign trade, especially with Latin America. However, failure to invest in the transportation infrastructure necessary to maintain the Region's competitive stance and its ability to connect with the global supply chain will result in lost economic and employment opportunities.

Transportation Requirements of Commodities and Industrial Sectors in the ARC

Although each sector and even firms within those sectors will have their own unique transportation requirements, these demands can be grouped into three broad categories:[6]

- Sectors which produce raw materials or bulky, low-market-value products with less emphasis on delivery time or reliability requirements;
- Sectors which rely on JIT inventory systems and/or produce higher-market-value products with more time sensitive delivery and reliability requirements; and
- Service industries, other than retail or wholesale trade, whose primary freight transportation requirement is overnight package delivery and are more concerned with access for their service fleet and the transportation of their customers and employees.

Industries falling into the first category include agriculture, wood products, mining, construction, and traditional manufacturing. There are exceptions, such as perishable agricultural goods and

[6] National Cooperative Highway Research Program report 421, "Economic Trends and Multimodal Transportation Requirements," Transportation Research Board, Washington D.C., 1999.

certain high priority construction and manufacturing materials. Transportation requirements for industries in this category are characterized by low cost, low speed, and low damage. Modes typically used include barge, truck, and rail, with only limited air service application.

The second category would capture industries such as high tech manufacturing, as well as wholesale and retail trade. Transportation requirements for these industries include frequent, reliable, fast and innovative services. The most commonly used modes of transportation include air, truck, and high-speed intermodal rail.

The final category is comprised primarily of service sector industries other than wholesale and retail trade. Transportation requirements for the services sector is characterized as time sensitive with direct human interaction, which demand frequent, reliable, fast and innovative services. The primary modes used by the service sectors are truck and air.

The commodity flow analysis conducted for this study demonstrated the diversity of goods flowing through Appalachia. For example, bulk goods (coal and lumber), raw materials (food and pulp products), intermediate inputs (fabricated metals and chemicals) and finished products (electrical machinery and transportation equipment) are all within the top 20 commodity flows in the Region. This is not surprising, given that traditional industry clusters in Appalachia have included manufacturing such as textiles, wood products, and furniture. However, recent years have brought some changes, as some textiles have moved overseas, coal production stagnated, and automotive manufacturers and their suppliers migrated south. With this shift in industrial base, came new demands on Appalachia's transportation system. The historic reliance on rail (driven primarily by the coal industry) has broadened to include a need for interstate quality highways to meet JIT demands of new manufacturers.

As the economy of Appalachia continues to evolve, it will be essential to attract the industries of the "new economy." The Region is already experiencing the dislocation of key furniture and automotive supplier industries. As a result, many states in the Region are turning their recruitment efforts to new industry clusters, including logistics and distribution services and high tech manufacturing. The transportation requirements of these industries go well beyond the need

for highways. The industries of the 21st century will require seamless intermodal connectivity with frequent and reliable deliveries. The attraction of these new industrial clusters will hinge on Appalachia's ability to meet their demanding and diverse transportation needs.

The industries of the 21st century will require seamless intermodal connectivity with frequent and reliable deliveries.

The remainder of the study will examine opportunities and strategies for enhancing the region's competitiveness through transportation efficiencies. Chapter 2 presents a commodity profile of the region, along with forecasts of future freight flows. The characteristics and capacity of the region's intermodal resources are reviewed in Chapter 3. Finally, Chapter 4 provides conclusions and a comprehensive vision of future directions. In addition, case studies and an analysis of potential economic impacts of specific intermodal opportunities for Appalachia are provided under separate cover.

CHAPTER 2
FREIGHT FLOWS

Introduction

In order to assess the potential intermodal opportunities in Appalachia, a commodity flow profile was needed. This exercise is key in assessing the current status of freight transportation systems, identifying the full potential of the ADHS, understanding the commodity mix transiting the Appalachian Region, and highlighting specific opportunities and challenges. To gain such an understanding, a detailed analysis of current and future freight flows by commodity and mode was undertaken by the Study Team. The following sections within this chapter will detail the findings for highway, rail, and barge movements throughout Appalachia.

The mix of commodities flowing into and out of a region has important implications for its transportation system. The ARC Region commodity flow data suggest that Appalachia relies heavily on the movement of bulk commodities, matching the industrial mix for the Region. Transportation characteristics for this commodity mix are low cost and low speed, requiring the use of truck, barge, and rail, with limited air service needs. As the following pages detail, Appalachia is very dependent on truck traffic. However, the data also tells a story about gaps in the existing transportation system. Most high value commodities, like those often used in high tech manufacturing (characterized by JIT production), rely on containerization and intermodal capabilities. The lack of these commodity types originating and terminating in Appalachia is a signal that the transportation system is inadequate to provide efficient movement of those goods; thus, hindering the Region's ability to attract these higher end manufacturing industries. Additionally, as the Region's coal industry faces unprecedented competition, creating more efficient transportation capabilities can help mitigate some of the competitive pressures from external coal sources.

The ADHS represents a hallmark achievement that continues to contribute significantly to Appalachia's development. The analysis of regional freight flows has revealed four fundamental roles for the ADHS in the 21st century. In summary:

- The ADHS, in combination with other development efforts, can contribute to the improvement of economic conditions within Appalachia;
- The ADHS provides an increasingly important set of alternative routings during periods of traffic congestion within or near the Region;
- The ADHS provides redundancy that is essential to national security; and
- The ADHS provides largely untapped opportunities to combine motor carriage with other freight modes in the creation of capacity/efficiency-building intermodal lanes.

The following sections will detail current and forecasted freight flows within and through Appalachia by commodity and mode.

Highway Freight Flows

Methodology

The primary data used in the analysis of motor carriage were derived from the *Freight Analysis Framework* (FAF) released by the US Department of Transportation's Office of Freight Management in the fall of 2002. The FAF motor carrier data combine information from the U.S. Department of Commerce's *Commodity Flow Survey* with proprietary data to produce county-to-county freight flows. These flows are then aggregated to a state-to-state level to protect the confidentiality of shippers. It should be noted that there is concern regarding the use of FAF for analysis at the project level. Due to these concerns, the Transportation Research Board convened a special committee to conduct an evaluation on the potential shortcomings of the data. The results of that committee can be found at http://trb.org/publications/reports/fafltrfeb2004.pdf .

Because the ARC Region is defined by county rather than state jurisdictional boundaries, one of the primary tasks of the current analysis was to reallocate the state-to-state flows to the county level. This was accomplished through a two-step process. First, the FAF data, provided on a two-digit Standard Transportation Commodity Code (STCC) level, were regressed on a variety of county specific explanatory variables. Next, the parameter estimates were used as weights in a proportional allocation algorithm that identified county specific freight flow profiles.

The FAF data also contain forecasted state-to-state flows for 2010 and 2020. These forecasts are based on forecasted employment in relevant industries for those years. The FAF forecasts were used as the basis for forecasting flows within the current analysis. The predicted state-to-state flows were used to generate ratios that were applied to the already allocated county-to-county data.

Current and Future Truck Flows

Commodities originating in the ARC Region are dominated by farm products, clay, concrete, glass, stone, food and kindred products in terms of total tonnage. While the growth in farm products is forecasted to be relatively stagnant (and actually decrease between 2010 and 2020), the growth in clay, concrete, glass and stone, lumber and wood products, and food and kindred products is predicted to be robust. Other significant commodities originating in the ARC Region in terms of weight (more than 100 million tons) include chemical, petroleum, and coal products. Notable is the fact that higher value goods, such as machinery and electrical equipment, are significantly less prevalent in the Region. This same pattern prevails for goods terminating in the Region. Current originating and terminating commodity flows for the Appalachian Region (based on the most recent data available) are summarized in **Tables 2.1** and **2.2**, respectively.

Again, these bulk commodities tend to be relatively low in value and be less dependent on speed and reliability in terms of transportation needs. Importantly, the Region is capable of delivering excellent bulk commodity transportation alternatives, especially given the redundancy in trade routes offered by the ADHS and its rail and inland navigation counterparts. Combined with the infrastructure necessary to handle the transshipment of containerized freight between modes, Appalachia's highway system could serve as a vital business attraction attribute to manufacturers operating in a reliability and time sensitive JIT environment. For example, Smyrna, Tennessee, located just outside the Region, is home to Nissan's largest North American manufacturing facility. One of the keys to Nissan's on-going expansion at that location is the ability to have direct access to excellent rail and highway services. At this location, Nissan is

Combined with the infrastructure necessary to handle the transshipment of containerized freight between modes, the region's highway system could serve as a vital business attraction attribute to manufacturers operating in a reliability and time sensitive JIT environment.

currently operating a JIT system that maintains a minimum of a 2-hour and a maximum of a 48-hour parts supply inventory.

Table 2.1
Originating ARC Region Truck Tons
(in millions)

Commodity	Estimated 1998 Traffic	Estimated 2010 Traffic	Estimated 2020 Traffic
Clay, Concrete, Glass, and Stone	189.6	303.8	397.1
Food & Kindred Products	131.0	190.3	291.4
Lumber and Wood Products	129.5	195.7	252.4
Petroleum or Coal Products	84.6	99.6	110.0
Coal	83.4	106.3	116.6
Chemicals	79.6	111.7	128.5
Farm Products	74.1	81.9	78.3
Primary Metal Products	74.1	102.3	114.7
Pulp Paper Products	48.6	64.6	79.7
Textile Mill Products	24.2	27.8	29.1
Fabricated Metal Products	23.2	33.9	42.2
Rubber and Plastics Products	21.5	31.5	40.0
Transportation Equipment	21.4	30.8	36.7
Furniture and Fixtures	8.7	12.8	15.5
Electrical Machinery	8.1	13.3	16.5
Machinery (Excl. Electrical)	7.2	15.4	24.7
Printed Matter	4.2	5.6	8.2
Apparel	2.7	4.1	4.9

Table 2.2
Terminating ARC Region Truck Tons
(in millions)

Commodity	Estimated 1998 Traffic	Estimated 2010 Traffic	Estimated 2020 Traffic
Clay, Concrete, Glass, Stone	195.03	309.90	403.10
Farm Products	179.81	203.59	198.38
Food & Kindred Products	165.69	238.99	364.17
Lumber & Wood Products	122.23	184.55	236.84
Petroleum or Coal Products	102.10	122.19	135.10
Chemicals	100.21	142.92	161.81
Primary Metal Products	74.64	102.12	114.67
Pulp Paper Products	68.12	90.02	108.92
Coal	51.61	65.81	72.18
Transportation Equipment	28.09	37.99	44.08
Fabricated Metal Products	26.21	37.62	46.90
Rubber or Plastic Products	20.61	30.10	38.23
Textile Mill Products	17.09	18.97	19.25
Electrical Machinery	9.54	18.81	26.23
Machinery (Excl. Electrical)	7.95	15.99	23.61
Furniture or Fixtures	6.35	9.21	11.29
Printed Matter	5.62	7.47	10.81
Apparel	3.43	5.81	7.44

Mapping commodity flows allows for the analysis of key trade lanes and the role of the ADHS. The maps reveal that a few ADHS segments already provide an important link for both north-south and east-west trade lanes. For example, segments in Pennsylvania and Tennessee augment the east-west lanes while portions of the ADHS in Virginia are vital to that state's north-south trade route. These graphical representations are not only very informative, they also allow for the identification of potential chokepoints in the system. **Figure 2.1** illustrates current highway tons originating or terminating in the ARC Region and **Figure 2.2** illustrates the forecasted highway tons for 2020.

Figure 2.1

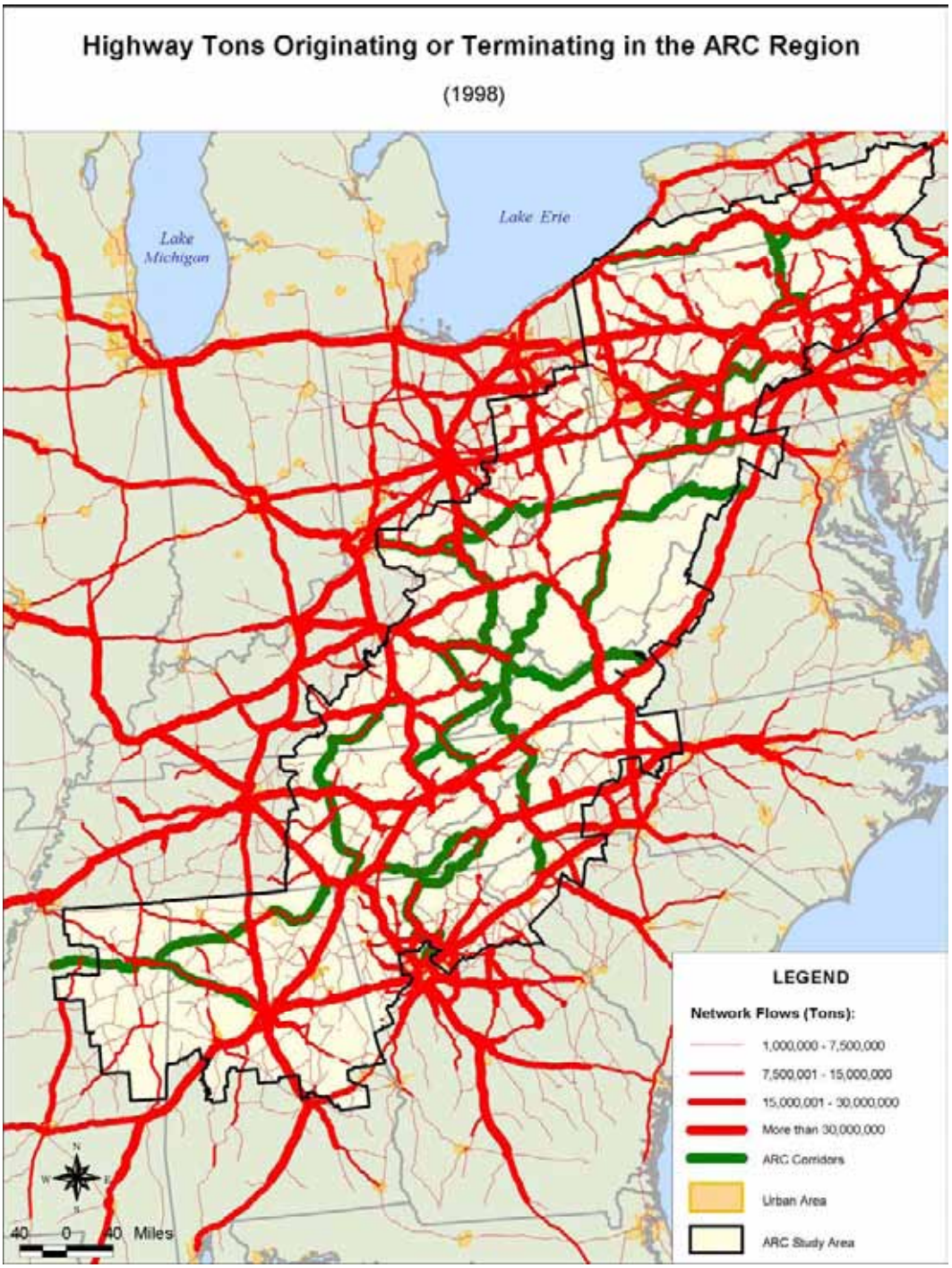
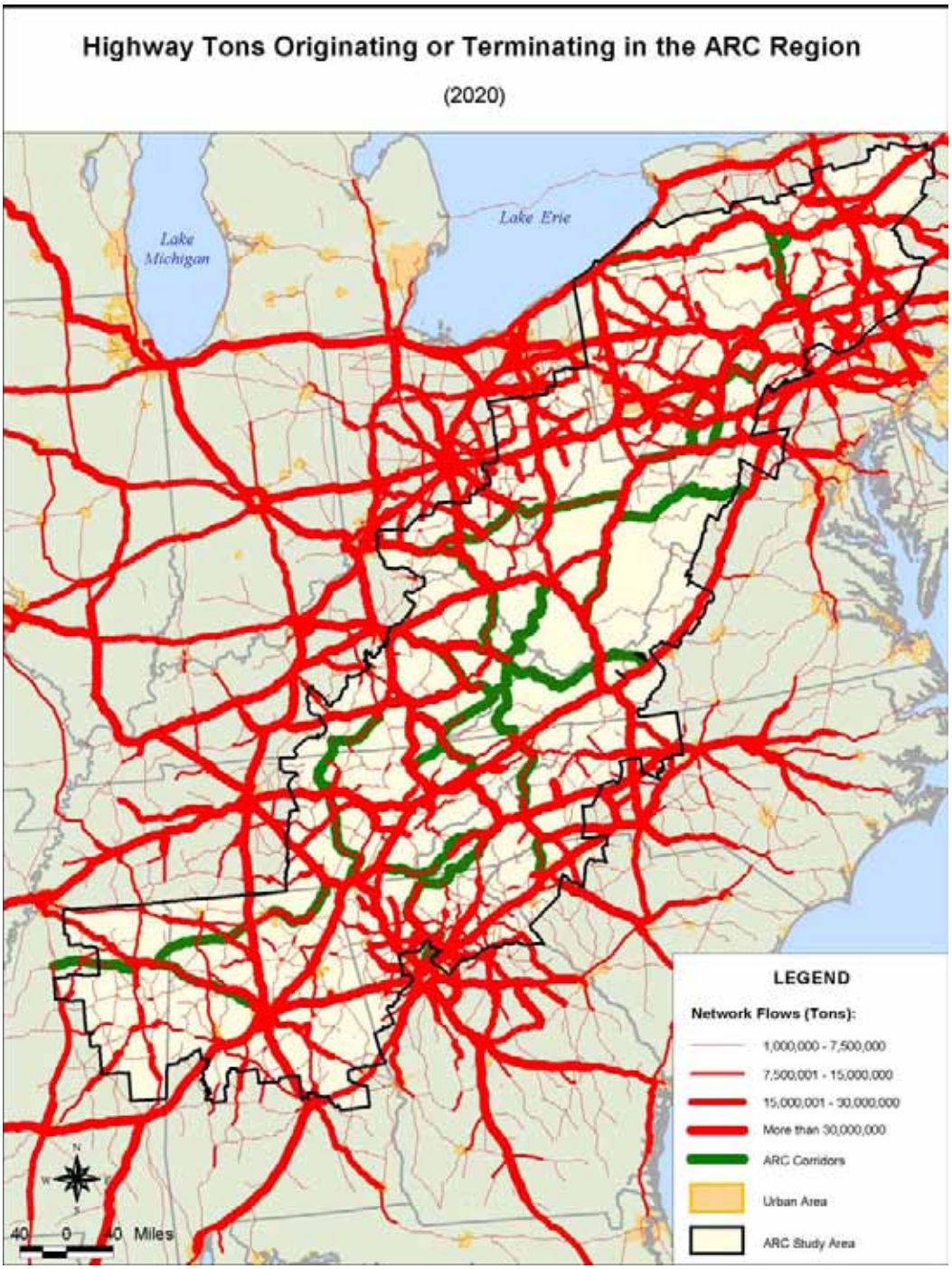

Highway Tons Originating or Terminating in the ARC Region
(1998)
Lake Michigan
Lake Erie
LEGEND
Network Flows (Tons):
1,000,000 - 7,500,000
7,500,001 - 15,000,000
15,000,001 - 30,000,000
More than 30,000,000
ARC Corridors
Urban Area
ARC Study Area
40 0 40 Miles

Figure 2.2


Highway Tons Originating or Terminating in the ARC Region
(2020)
Lake Michigan
Lake Erie
LEGEND
Network Flows (Tons):
1,000,000 - 7,500,000
7,500,001 - 15,000,000
15,000,001 - 30,000,000
More than 30,000,000
ARC Corridors
Urban Area
ARC Study Area
40 0 40 Miles

Not surprising, intra-region traffic growth is predicted to be greatest in and around urban areas. For the largest urban areas, including metro Atlanta, Birmingham, Chattanooga, metro Cincinnati, Knoxville, and Pittsburgh, local truck traffic is expected to nearly double within the 20 year forecast period.

Data shows that this projected traffic growth is largely tied to local population growth and economic activity, rather than interstate and/or interregional commerce. Two inferences from the segment specific commodity flow data support this conclusion. First, county specific origin and destination segment data show that each of the 40 largest county and commodity specific flows (in terms of annual growth through 2020) is an intrastate flow. Indeed, twenty percent of the freight flows originating in the ARC Region have terminating points within the same county. The majority of these flows are between an ARC county and a proximal intrastate urban center.

Also supporting the observation that local population growth and activity is driving Appalachian truck traffic is the identification of freight moving on the high-growth flows that are dominated by commodities that generally travel relatively short distances by truck. These are commodities such as clay and stone products, wood products, and coal.

Highway Capacity Issues

The FAF development process also yielded a readily usable source of data describing highway capacity on most major roadway segments. These data include measures of current and future volumes along with segment capacities and volume to capacity ratios. As volume-to-capacity ratios (VCR's) approach 1.0, highway congestion becomes an issue.

Data for rural and urban highway segments are summarized by state in **Table 2.3.** This summary includes 1998 (most recent data) and forecasted 2020 VCR averages and the number of miles with a VCR of greater than 0.80.

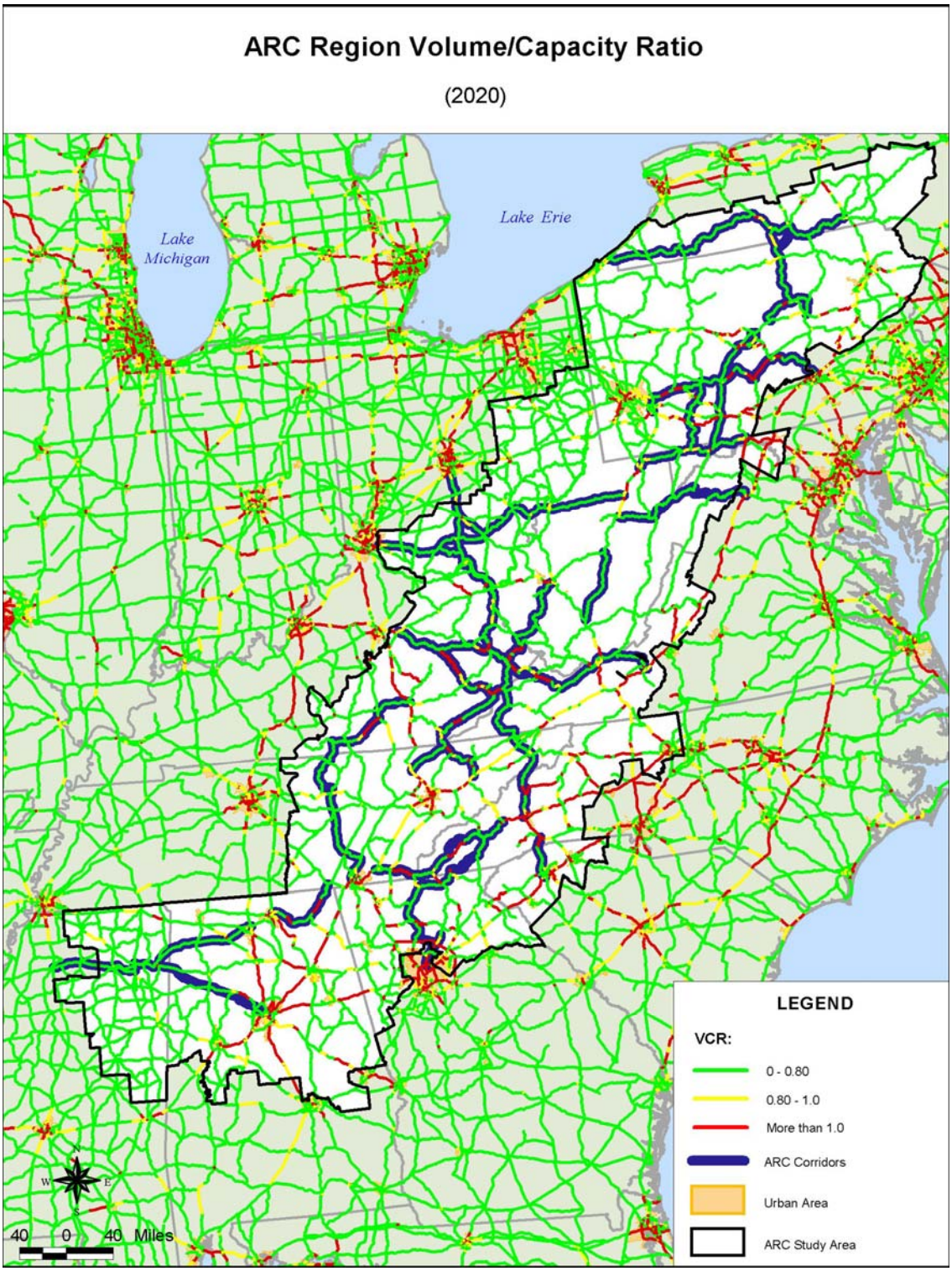
Table 2.3
Summary of Highway Segment Volume to Capacity Ratios in ARC Counties

State	*Rural / Urban*	*Average VCR, 1998*	*Average VCR, 2020*	*Miles Greater than 0.80*
Alabama	RURAL	0.409	0.723	142
	URBAN	0.587	0.927	154
Georgia	RURAL	0.414	0.686	96
	URBAN	0.529	0.839	61
Kentucky	RURAL	0.371	0.639	87
	URBAN	0.441	0.697	12
Maryland	RURAL	0.526	0.893	36
	URBAN	0.653	1.089	14
Mississippi	RURAL	0.212	0.359	4
	URBAN	0.256	0.411	2
New York	RURAL	0.250	0.403	0
	URBAN	0.310	0.494	0
North Carolina	RURAL	0.476	0.864	107
	URBAN	0.608	0.977	46
Ohio	RURAL	0.264	0.424	0
	URBAN	0.343	0.542	10
Pennsylvania	RURAL	0.352	0.564	163
	URBAN	0.470	0.730	62
South Carolina	RURAL	0.686	1.026	87
	URBAN	0.533	0.809	17
Tennessee	RURAL	0.376	0.613	25
	URBAN	0.502	0.793	77
Virginia	RURAL	0.431	0.739	48
	URBAN	0.437	0.691	1
West Virginia	RURAL	0.296	0.516	13
	URBAN	0.380	0.610	2

Figure 2.3


ARC Region Volume/Capacity Ratio
(1998)
Lake Michigan
Lake Erie
LEGEND
VCR:
0 - 0.80
0.80 - 1.0
More than 1.0
ARC Corridors
Urban Area
ARC Study Area
40 0 40 Miles

Figure 2.4


ARC Region Volume/Capacity Ratio
(2020)
Lake Michigan
Lake Erie
LEGEND
VCR:
0 - 0.80
0.80 - 1.0
More than 1.0
ARC Corridors
Urban Area
ARC Study Area
40 0 40 Miles

Analysis of the data suggests a situation within Appalachia that is completely consistent with what is observed nationally. Across America rural roadway segments are generally capable of handling both current and anticipated traffic volumes. The same is true of feeder systems in both rural and urban settings. Capacity constraints, where they are observed, occur most often on multi-lane expressways and more frequently in urban areas with a strong positive correlation between the proportion of truck traffic and the observed level of congestion.

This pattern of congestion was initially observed in the 1960's and has tended to accelerate as the cost and complexity of developing urban expressways has risen.[7] Within the ARC Region, the one possible exception to this general congestion pattern may be the Commonwealth of Pennsylvania, where actual or potential congestion is observed in both rural and urban areas.

Within the current context, it should be noted that few ADHS segments are threatened by severe congestion constraints, now or in the future. To the contrary, most ADHS segments have medium to low VCR's and, therefore, available capacity. Given that a number of ADHS routes parallel existing Interstate highways where congestion is either already evident or anticipated, these ADHS segments can provide relief capacity to those highway corridors facing congestion constraints. Thus, redundancy is a key role for the ADHS as trade within and through the region continues to grow.

The relative capacity afforded by the ADHS becomes even more evident when pass-through traffic is added to the analysis. Projected ADHS traffic growth is relatively modest. However, traffic growth on other highway route segments – particularly Interstate highway segments – is predicted to be significant over the forecast period. A careful analysis of the regional highway route system yields a couple of key of strategies for ensuring that the capacity offered by the ADHS is more fully utilized. These include:

[7] The rapidly increasing cost of constructing urban expressways is, to some degree linked to more stringent environmental controls. It is also the product of increasing land values and more vigorous zoning efforts. Interestingly, vehicle traffic per lane-mile has remained relatively constant on the lower density roadways that feed expressway systems.

- Ensuring that ADHS segments are constructed to fully meet traditional Interstate highway design standards. In certain cases, ADHS links do not feature controlled access (interchanges, on/off-ramps).
- Ensuring that grade and alignment of ADHS segments are as favorable to freight traffic as those found on the Interstate system.

Summary of Highway Freight Movements

The ADHS has been designed and constructed to stimulate and support economic development in historically isolated areas of Appalachia. Many of these routes would not have been built had they been judged by the traditional efficiency criteria used to justify highway construction.

There are two important ways in which the ADHS can reach its full potential in supporting the transportation and economic needs of the Region. First, as noted above, a number of ADHS routes provide critical capacity, as other nearby highways begin to reach, and sometimes exceed, design capacity levels.[8] This will result in the diversion of traffic to ADHS segments and the growth of both traffic levels and access to commerce along these ADHS segments. To maximize such benefits, it may be necessary to upgrade specific ADHS route segments to more closely resemble Interstate design characteristics. In addition to capitalizing on its capacity, the ADHS also holds the potential to more fully integrate with the Region's railway, water, and aviation modes in a way to build a stronger and more dynamic link between Appalachia and the global marketplace of the 21st century. Such intermodal opportunities are more fully assessed in the case studies.

[8] Specifically, ADHS inclusive routings could provide much needed relief to I-70, I-75, and I-81.

Railroad Freight Flows

Methodology

The primary data source for the current analysis of rail transportation to, from, and within the ARC Region is the Surface Transportation Boards Carload Waybill Sample (CWS). CWS records for ARC region movements provide state-to-state annual tonnage by commodity type. Unlike the treatment of truck traffic, these depictions reflect both originating and pass through traffic. This variance in methodology reflects the sensitivity of rail route selection to traffic levels. Any attempt to route only Appalachian traffic over the railroad networks would generate routings that are not observed in practice.[9]

Current and Future Rail Flows

CWS data illustrate that Appalachian rail traffic is dominated by the movement of coal. The Region's coal is generally moved to one of three destinations (1) barge transload facilities on the Ohio River, Big Sandy River, or Kanawha River; (2) directly to utility or commercial users; or (3) to Virginia ports for international export. Railroad shipments of coal have diminished measurably over the past three years, particularly the movement of export coal. For example, Norfolk Southern export movements reached a high of more than 25 million tons per year in the late 1990's. For 2002, the same total was less than 10 million tons. The loss of export coal is the direct result of new productive capacity in Colombia, South Africa, and Australia. The FAF values used to predict future rail movements of coal suggest strong growth in coal volumes over the coming two decades. It is possible, however, that these forecasted values were generated in advance of the new competing capacity elsewhere.

Appalachian regional rail volumes and forecasts are summarized below in **Table 2.4** and **Table 2.5**, by originating traffic and terminating traffic respectively.

[9] Rail traffic was routing through the use of RAILNET, a software product developed by Dr. David Clarke, Clemson University. Because, the software routes traffic based on a cost minimization process, it can be used to simulate the effects of infrastructure modifications.

Table 2.4
Rail Traffic Originating in ARC Counties

Commodity	*1998 Tonnage*	*2010 Tonnage*	*2020 Tonnage*	*Estimated Total Growth*
Coal	284,124,490	346,503,752	371,343,758	87,219,268
Primary Metal Prod.	12,063,237	16,690,650	18,873,073	6,809,836
Non-Metallic Minerals	10,646,781	13,119,816	13,937,011	3,290,230
Chemicals	8,642,576	11,644,988	13,103,480	4,460,904
Petroleum Prod.	8,508,121	9,656,502	10,142,437	1,634,316
Clay, Concrete, Glass, Stone	8,364,724	13,949,417	18,667,431	10,302,707
Lumber & Wood Prod.	6,070,160	8,804,107	11,092,277	5,022,117
Pulp & Paper Prod.	3,651,904	4,969,460	6,358,220	2,706,316
Scrap Materials	3,352,960	4,945,413	5,395,343	2,042,383
Metallic Ore	2,775,872	2,217,619	2,132,885	-642,987
Food & Kindred Prod.	2,771,356	4,027,069	6,141,193	3,369,837
Transportation Equipment	1,425,000	1,968,002	2,307,459	882,459
Farm Products	1,348,696	1,683,101	1,883,399	534,703
Mixed Shipments	961,360	1,395,964	1,779,341	817,981
Electronic Equipment	92,120	109,739	115,685	23,565
Mail or Express	63,800	93,872	117,478	53,678
Rubber & Plastic Prod.	60,080	83,459	105,347	45,267
Fabricated Metal Prod	52,796	62,358	70,017	17,221
Crude Petroleum	44,226	36,619	47,024	2,798
Misc. Freight Shipments	41,812	49,516	41,693	-119
Furniture or Fixtures	28,720	45,124	59,719	30,999
Misc. Manufactured Prod.	22,720	35,827	47,908	25,188
Freight Forwarder Traffic	18,680	26,720	28,086	9,406
Instruments	2,040	2,822	3,782	1,742

Table 2.5
Rail Traffic Terminating in ARC Counties

Commodity	*1998 Tonnage*	*2010 Tonnage*	*2020 Tonnage*	*Estimated Total Growth*
Coal	106,776,751	131,631,928	142,262,703	35,485,952
Metallic Ore	16,101,735	13,392,738	12,315,593	-3,786,142
Chemicals	14,734,830	20,310,423	22,839,562	8,104,732
Farm Products	10,952,813	13,591,586	14,549,263	3,596,450
Primary Metal Prod.	9,833,579	13,639,278	15,454,890	5,621,311
Scrap Materials	6,219,577	9,154,715	9,962,821	3,743,244
Clay, Concrete, Glass, Stone	5,523,426	8,852,300	11,583,608	6,060,182
Petroleum Prod.	5,476,703	6,383,725	6,894,590	1,417,887
Non-Metallic Minerals	5,376,092	6,485,156	6,615,095	1,239,003
Food & Kindred Prod.	4,910,108	7,081,410	10,571,650	5,661,542
Lumber & Wood Prod.	4,677,676	6,326,148	7,708,665	3,030,989
Pulp & Paper Prod.	3,522,540	4,447,276	5,330,913	1,808,373
Transportation Equipment	1,666,416	2,130,109	2,379,941	713,525
Mixed Shipments	734,040	1,055,093	1,343,214	609,174
Crude Petroleum	250,206	198,697	254,229	4,023
Misc. Freight Shipments	68,344	88,233	74,228	5,884
Forest Products	43,148	50,112	51,972	8,824
Mail or Express	29,480	47,989	66,011	36,531
Fabricated Metal Prod	28,504	32,840	37,431	8,927
Electronic Equipment	24,600	44,417	59,809	35,209
Misc. Manufactured Prod.	21,960	26,820	36,183	14,223
Machinery	6,760	6,973	7,150	390
Rubber & Plastic Prod.	6,400	5,454	6,588	188
Freight Forwarder Traffic	5,080	8,866	10,101	5,021
Small Package Freight	2,400	5,701	6,779	4,379
Furniture or Fixtures	2,160	3,529	4,838	2,678

The vast majority of the Region's non-coal rail traffic is originating or destined for the major urban centers of Birmingham, Chattanooga, Knoxville, and Pittsburgh. There is a modest amount of steel related rail traffic in eastern Ohio and in West Virginia's northern panhandle. Additionally, there is a moderate amount of chemical traffic in and out of the Charleston, West Virginia area. However, most rural shippers of non-coal commodities are moving very small annual volumes. **Figure 2.5** and **Figure 2.6** graphically depict total rail flows (origin and destination) within the ARC Region for 1998 and 2018, respectively.

Figure 2.5

Originating and Terminating 1998 Rail Traffic

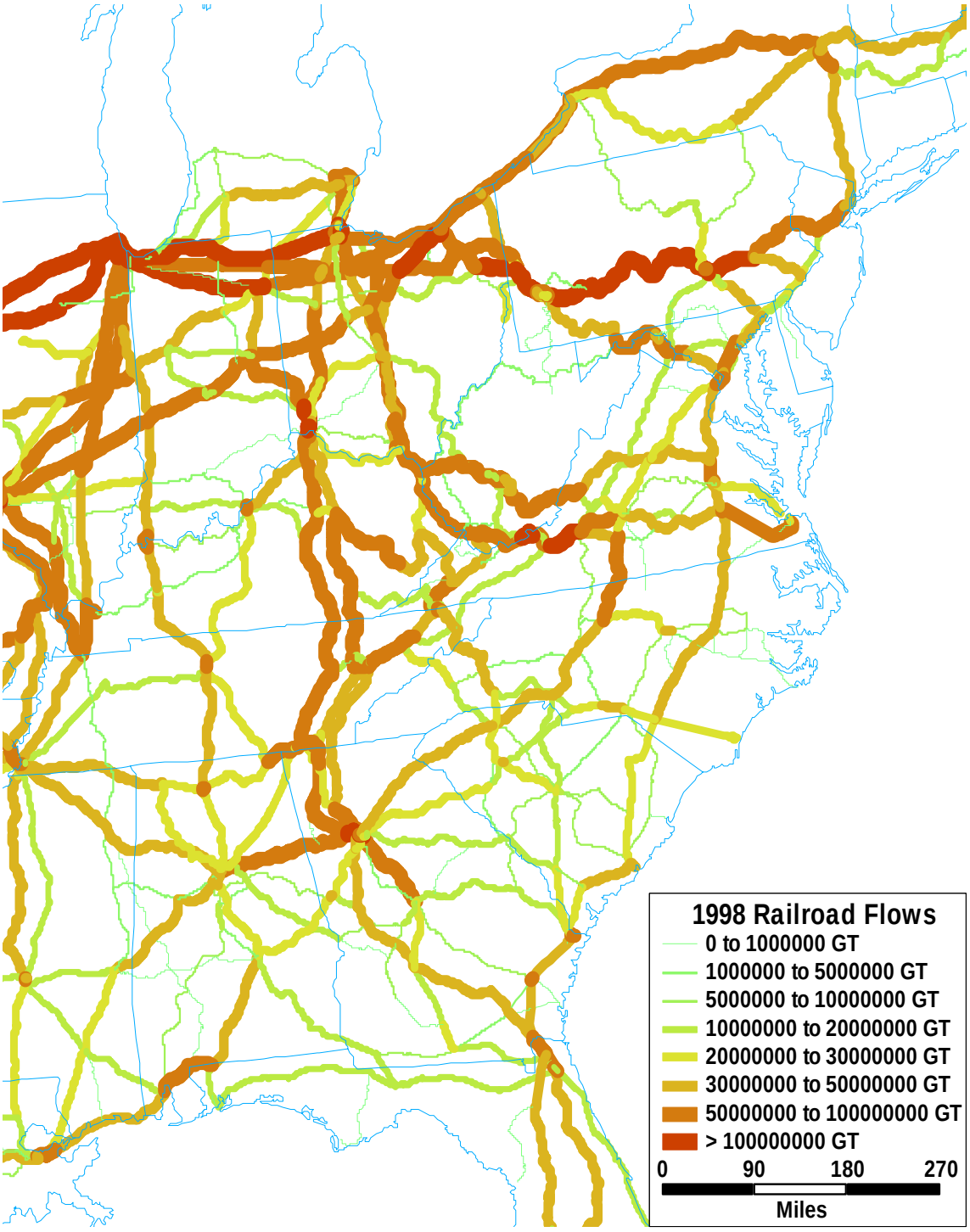
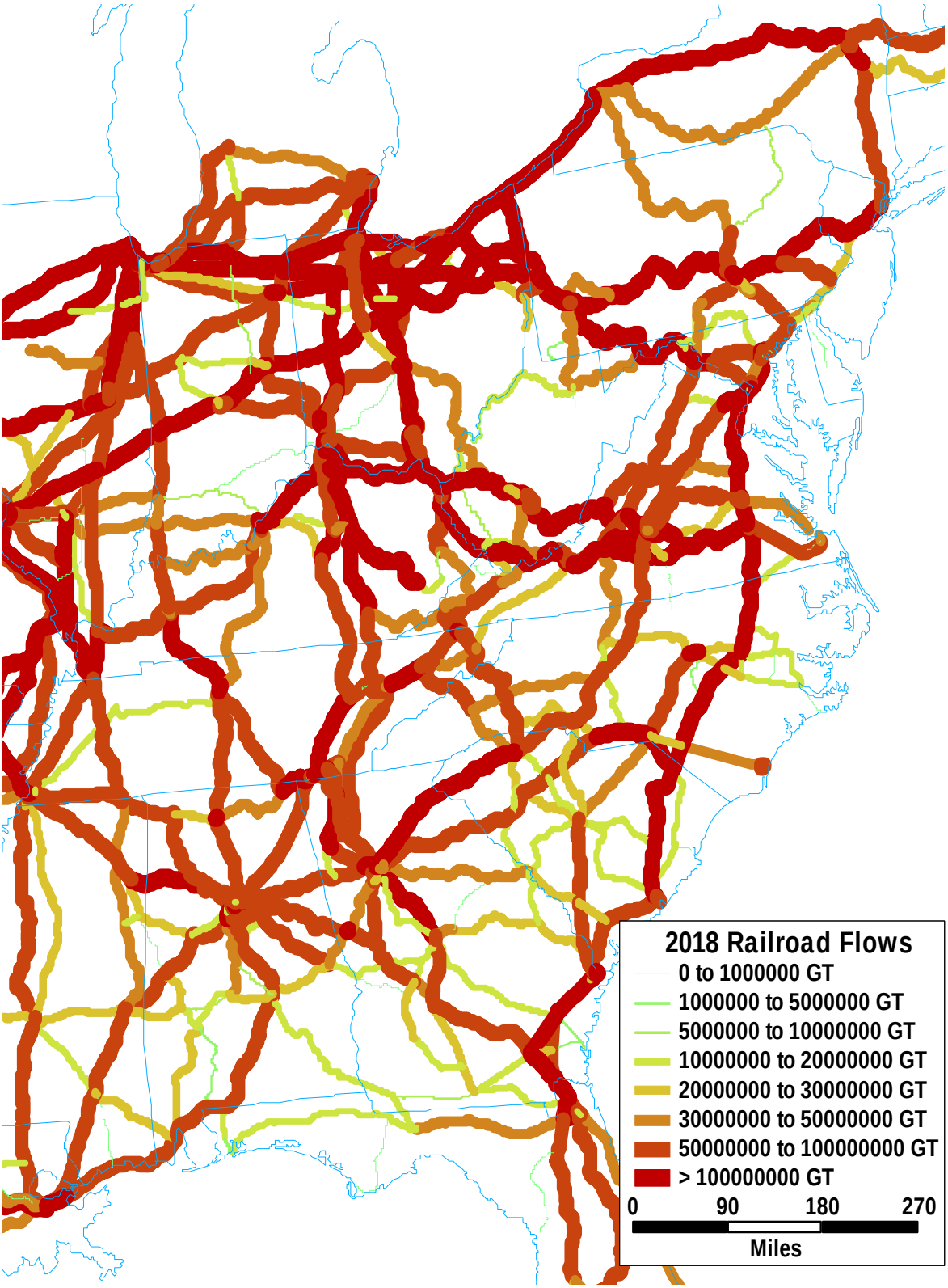


Figure 2.6

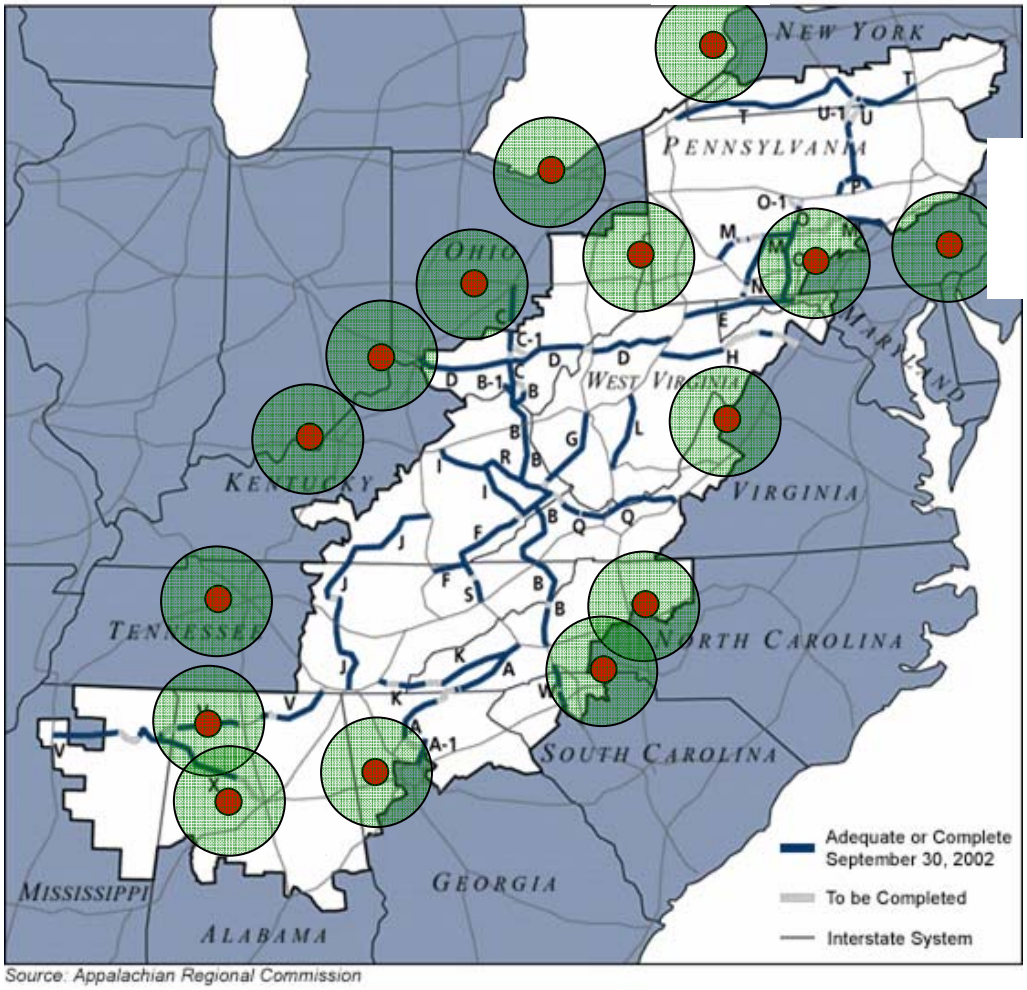
Originating and Terminating 2018 Rail Traffic



There are only three intermodal trailer/container facilities within the ARC Region. These are located in Birmingham, Huntsville, and Pittsburgh. There are also five additional facilities located very near the Region's boundaries, in Atlanta, Cincinnati, Columbus, Front Royal, and Harrisburg. A number of relevant intermodal terminals are depicted in **Figure 2.7**. With such limited intermodal access, most containers moving between the region and East Coast and Gulf Coast ports are conveyed, out of necessity, by truck.

Figure 2.7

Existing Intermodal Terminals and Service Areas and the ADHS



Source: Appalachian Regional Commission

Railroad Capacity Issues

The Appalachian Region is widely served by two Class I rail carriers, CSX Transportation (CSXT) and Norfolk Southern (NS). Two additional Class I carriers, Burlington Northern – Santa Fe and Canadian Pacific, provide service to geographically limited areas within the Region. Finally, regional rail carriers including Wheeling & Lake Erie and Kansas City Southern, and a number of short-line railroads provide key rail access to many of the region's smaller communities.

It should be emphasized that, in all but a few instances, railway capacities could be increased by adding sidings, upgrading signaling systems, or otherwise modifying the physical infrastructure. It is also worth noting, however, that the generally more severe grades and track alignments make railroad operations more expensive in Appalachia than in other non-mountainous regions.

Summary of Rail Freight Flows

Because the movement of coal dominates current regional traffic and because the competitiveness of Appalachian coal appears to be in transition, any assessment regarding the adequacy of the ARC Region's rail service is relatively speculative. Under current traffic volumes, the Region's rail facilities are adequate, but offer no real surplus capacity to accommodate growth, either in regional or bridge-traffic movements. If coal volumes decline in the future, current available rail capacity levels may expand. Under such a scenario, the Region's rail carriers might move to develop new and alternative traffic sources, as is happening elsewhere in America, or they may simply choose to abandon their newly found capacity. In certain areas there is the potential of using rail capacity to relieve highway congestion via truck to rail diversion. In addition, the excess capacity could be used to support commuter rail service in and near the Region's urban centers. Importantly, Appalachia's railway resources represent a powerful asset, as the Region searches for opportunities to retain existing commerce and attract new economic activity in the years ahead.

Commercial Navigation Freight Flows

Methodology

The primary data source for the current analysis of commercial navigation is the Army Corps of Engineers' Waterborne Commerce Statistical Center (WCSC) in New Orleans. WCSC data were then supplemented with data from the Corps' Lock Performance Monitoring System (LPMS) and with data obtained from the Tennessee Valley Authority (TVA).

The WCSC data describe individual barge movements. These are typically aggregated by commodity and origin-destination dock pair for purposes of analysis. However, even at the most disaggregated level, the WCSC data do not contain information describing any associated landside movement. Any information regarding rail or truck movements to or from the river must be developed separately. In the case of rail, this is not difficult. However, identifying barge-related truck movements is challenging.

Current and Future Barge Flows

As with rail movements in Appalachia, coal dominates waterborne commerce. Still, there are significant volumes of petroleum products and steel-related commodities (both raw and finished) moving by barge within the Region. Annual tons for 2001 ARC Region waterborne commodities are summarized in **Table 2.6** and **Table 2.7** by origination and termination respectively.

Commodity	*2001 Tonnage*
Coal	109,509,281
Petroleum Products	9,156,161
Metallic Ores	7,366,178
All Other Commodities	6,447,293
Primary Metal Products	2,789,672
Chemicals	1,449,431
Non-Metallic Minerals	471,789
Farm Products	459,847
TOTAL	137,649,652

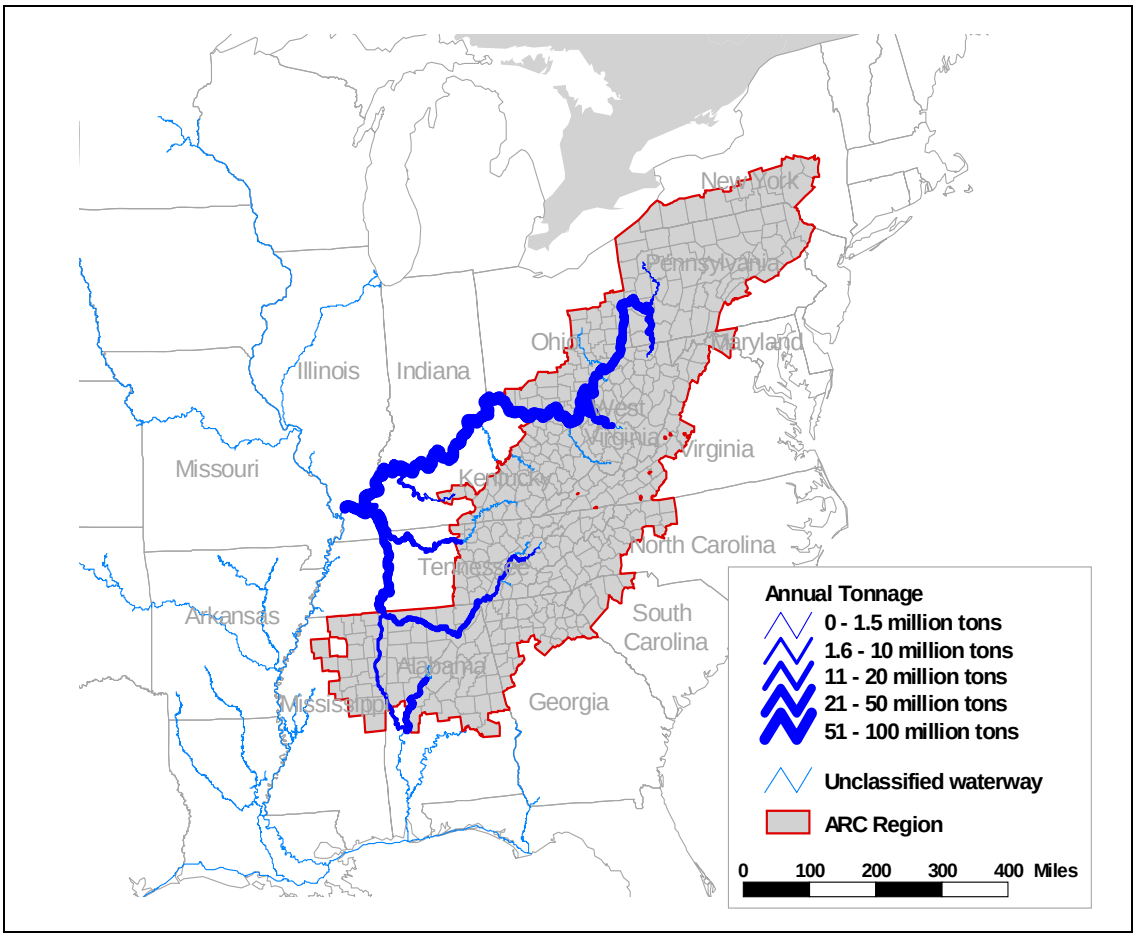
Figure 2.6
Barge Traffic Originating in ARC Counties

Table 2.7
Barge Traffic Terminating in ARC Counties

Commodity	*2001 Tonnage*
Coal	80,191,486
Metallic Ores	13,637,986
Primary Metal Products	9,899,697
All Other Commodities	9,493,062
Petroleum Products	5,064,488
Chemicals	4,873,543
Non-Metallic Minerals	4,650,968
Farm Products	2,549,904
TOTAL	130,361,134

Unlike truck and rail, barge movements tend to both originate and terminate wholly within the ARC Region. In fact, many of the largest Origin and Destination-commodity triplets (i.e. shipments paired by origin and destination by commodity type) represent intrastate movements of coal or petroleum products. This outcome is consistent with more generalized Ohio River basin traffic where average shipment distances are approximately 250 miles. Waterborne freight flows are depicted graphically in **Figure 2.8**.

Figure 2.8
Commercial Navigation Traffic



The Study Team did not forecast future changes in in-region barge traffic. Traffic growth within the Ohio basin is relatively stagnant. Traffic on the Ohio main stem grew at only 0.8% between 1990 and 2000, while traffic on the overall Ohio System (including the Tennessee River) grew at only 0.9% over the same period.[10] However, innovative uses of barge movements, such as container-on-barge (COB), could enhance this outlook. For example, the Port of Baton Rouge has experienced significant success with COB operations and has partnered with the Port of Houston and the Port of New Orleans to expand its current operations. Similar COB opportunities may lie in the ARC Region, as well.

[10] See *Great Lakes and Ohio River Navigation Systems Commerce Report,* 2002, US Army Corps of Engineers, Great Lakes and Ohio River Division.

Waterborne Capacity Issues

The majority of the locks on the Ohio River have 1,200 foot main chambers that allow a 15-barge tow and boat to be processed in a single lockage. This is not, however, true of the upper three locks near Pittsburgh or on most tributaries. Accordingly, for shipments bound to or from the upper Ohio or system tributaries, tows must be fleeted to smaller sizes or broken apart for lockage. Currently, the Corps of Engineers is undertaking a number of projects to expand main-stem Ohio River capacity and improve system reliability. However, given predicted traffic levels, infrastructure improvements on tributaries are unlikely.[11]

Summary of Barge Freight Flows

Inland navigation is an important transportation asset to the ARC region. Today, the extent of this importance is closely related to Appalachia's strong association with coal. Thus, as fuel markets continue to evolve, the role of inland navigation is likely to change as well. The viability and prosperity of Appalachia's barge industry, like most businesses, will hinge on its ability to take advantage of the changing commodity mix flowing within and throughout the Region and the logistic trends that dictate how those commodities flow. In consideration of the predicted growth of both truck and rail transportation, combined with the often prohibitive cost of expanding modal capacities, the Region's extensive inland navigation network presents opportunities to expand capacity and provide more diversified and cost effective services to Appalachia in the years ahead.

[11] The two exceptions to this prediction are both on the Tennessee River. Strong consideration is being given to the expansion of Kentucky lock near the confluence of the Tennessee and Ohio Rivers. Also, Chicamauga Lock may be replaced in order to provide continued navigation on the upper Tennessee River. In the case of Kentucky Lock, projected traffic growth is largely tied to TVA's projected increase in its use of Powder River coal. The lock replacement at Chicamauga is related to the structural integrity of the existing structure.

CHAPTER 3
INTERMODAL TRANSPORTATION AND OPPORTUNITIES

Current Status

Technically, "intermodal" transportation refers to any service where two or more modes are combined to facilitate a single movement of either freight or passengers. Accordingly, one might view the massive regional truck/barge and rail/barge movements of coal as intermodal in nature. Under such an interpretation, Appalachia could be viewed as a national leader in intermodal transportation coordination. For the purposes of this study, "intermodal" will refer to the coordinated, multi-modal movement of truck trailers or shipping containers over the region's highway, rail, and waterway systems. From the foregoing point of view, the ARC Region suffers from very limited intermodal capabilities, resulting in increased transportation costs and a loss of competitive edge for the Region's business interests.

In 1999, Wilbur Smith Associates, under the direction of ARC, conducted an analysis of the intermodal transportation system in Appalachia. While the ADHS and the Region's interstate system have been well documented, little was known about the Region's other transportation infrastructure. Several key findings resulted from that effort including:

Highways

- The combined interstate/ADHS highway network provides freight and passenger access, intermodal linkage, and mobility for Appalachia.
- Highways play an important role in moving Appalachian natural resources, crops and finished goods to intermodal terminals.
- Highways, especially the ADHS, have offered a strong contribution to economic success in Appalachia.

Railroads

- Railroads are critical to moving important Appalachian products in both domestic and international trade.
- Rail access to deepwater ocean ports is critical to provide the ability for Appalachia to compete and succeed in the global marketplace.

- Short line railroads play an important role in the economic vitality of rural Appalachia, but have serious physical/financial needs.
- There are few intermodal rail yards in and near Appalachia, restricting business access to containerized cargo.

Airports

- Commercial air service within Appalachia is thin; however, areas with the highest population densities are well-served by several major commercial airports located just outside the boundary of the region.
- The ADHS and Interstate highways offer good airport access.
- Smaller communities continue to press for commercial service; however, national trends show such airports often suffer from extremely high airfares. In addition, many smaller airports face an uncertain future, in terms of continued commercial air service availability.
- Businesses depend on private aircraft to transport executives and important cargoes to small communities. Such general aviation airport access enables plants to operate 24-hours a day, thereby facilitating expansion of existing business and the attraction of new investment into small communities.

Marine Terminals

- Ocean ports carry high volumes of Appalachian goods and products.
- Highway and rail linkages to ocean ports have improved, yet containerized intermodal highway/rail links remain weak.
- Inland water ports are major intermodal facilities that move large volumes of the region's products to and from other inland destinations, as well as international destinations through partnerships with major ocean marine terminals.

Identifying Potential Intermodal Opportunities

Intermodal Rail

There are two principal reasons for the relative paucity of truck/railway intermodal combinations within the region. First, overall traffic volumes outside of urban areas have been modest, which has served to retard the development of intermodal trans-load facilities. Second, many of the region's urban centers, such as Pittsburgh, Knoxville, Chattanooga, and Birmingham, have historically relied on trucking to move containers to and from major Atlantic and Gulf ports due to cost and reliability advantages. However, as highways become increasingly congested and as operational issues such as driver shortages, insurance, and fuel costs, combine to drive up trucking costs, the economic attractiveness of the region's rail services is expected to grow, as Appalachian businesses strive to sharpen their competitive edge.

As observed in Chapter 2, while limited, there are in-region intermodal truck/rail trans-load facilities in Birmingham, Huntsville, and Pittsburgh, as well as nearby facilities in Atlanta, Cincinnati, Columbus, Front Royal, and Harrisburg. With the exception of the inland ports located in Front Royal and Huntsville, these facilities are owned by the Class I railroads that serve them (CSXT, NS, and BNSF). Within the region, the economics of intermodal drayage often vary, depending on highway configurations, patterns of highway congestion, and the availability of back-haul cargo. Generally, however, only shippers within approximately 50 highway miles of a trans-load facility can receive the economic benefits of "local" drayage service. Shippers at greater distances face transportation charges that are, to varying degrees, higher, making it more difficult for such businesses to compete. Figure 2.9 depicts the estimated local drayage areas for existing intermodal truck/rail facilities relative to the ADHS. Within the ARC Region, the I-20 and I-70 corridors have limited access to local drayage service. Throughout the remainder of the Region, such access is virtually nonexistent. The volumes of truck traffic and the volume-to-capacity ratios displayed in Figures 2.1 – 2.3 indicate that the proposed Trans-Tennessee Railroad could enhance transportation efficiencies along the crucial east-west I-40 trade lane. Likewise, the double-stack initiative between the Norfolk, Virginia and Columbus, Ohio offers the potential to establish important new intermodal access in the very heart of central Appalachia.

Inland Ports and Potential New Facilities

The use of containers in international traffic has generated a tremendous growth in container movement through U.S. ports. Indeed, the Association of American Railroads estimates that total railroad container traffic has grown at an average rate of 8.6% per year between 1988 and 2000, with most of this growth attributable to international traffic. Reflecting this transition, intermodal has now surpassed coal as the largest single revenue source for America's railroad industry, demonstrating how rail is becoming an increasingly important link within the global supply chain.

The growth of container traffic has badly stressed many U.S. ocean ports and has lead to increased delays and costs associated with port processing times. As one solution to port congestion, many advocate the development of "inland" ports. Under the inland port scenario, containers are transferred directly (with only minimal delay) between ocean port facilities and satellite inland locations, where the containers are then processed and prepared for trans-shipment to and from other locations. Currently, there is a successful inland port facility at Front Royal, Virginia that was developed by the Virginia Port Authority as a satellite to its traditional marine terminals in the Norfolk/Newport News area. To the north, the Port Authority of New York/New Jersey has recently launched a Hudson River barge-served inland port in Albany, New York and is working to establish a broader, regional network of inland satellite ports elsewhere throughout their region.

As the inland port at Front Royal demonstrates, it is not necessary that such facilities be located in urban areas with large local populations. In fact, rural locations may offer important advantages. First, the lack of local roadway congestion reduces overall transportation times and costs. In addition, affordable land is often available, making initial construction and future expansion highly attractive. While these inland ports improve transportation efficiencies, they also serve as economic magnets, drawing commerce to the surrounding region. In consideration of the success of those "inland" facilities already established and of those now being planned for development, these intermodal facilities should be viewed as opportunities to link with the ADHS network in a way to create important new transportation and economic benefits for

Appalachia.[12] Interestingly, the growing reverse land bridge concept in container transportation also promotes the development of inland ports. The South Carolina Inland Port concept has recently been studied by the state and presents Appalachia with an opportunity to take greater economic advantage of the Port of Charleston, which is a growing gateway for global commerce. In addition, the current study indicates that the proposed Prichard, West Virginia Inland Port offers the potential to introduce new intermodal access to the very heart of Appalachia. Finally, another approach to inland port development demonstrates how global air cargo can be integrated into the intermodal mix. One of the nation's best examples of this concept is located at Huntsville International Airport in Huntsville, Alabama. This mixed-use complex is comprised of the Huntsville International Airport (HSV), the International Intermodal Center (IIC), and the Jetplex Industrial Park. Huntsville International Airport, in conjunction with the IIC, provides the Port of Huntsville with comprehensive aviation, rail, highway, and maritime connections, including key ocean port links to and from Gulf, Atlantic, and Pacific coasts. The Port of Huntsville offers an excellent example of how Appalachia can diversify and strengthen its economic base through improved links with the global supply chain of the 21st century.

Container on Barge (COB)

Should container on barge service emerge along the Region's inland waterway system, the ADHS and the Region's railways can serve as important new links to and from inland water terminals.[13] Efforts to launch these new intermodal services are already underway in Pittsburgh, Pennsylvania and at several other locations within the ARC Region.

Strategic Intermodal Opportunities in the ARC Region

The geographic location of Appalachia, combined with the continued densification of both north-south and east-west trade lanes, positions the Region to become a land bridge by providing

[12] For example, the proposed intermodal facility at Prichard, West Virginia would likely rely measurably using Corridor B. See, *Central Corridor Double-Stack Initiative*: Final Report, Rahall Transportation Institute, Marshall University, March 2003.

[13] Two important factors may contribute to the future commercial viability of limited container-on-barge operations. First, as noted, increased globalization is taxing the nation's ability to handle container traffic over existing ports. This may result in the use of barges for shuttle movements to inland ports – much as is being done between the Port of New York – New Jersey and the satellite port at Albany, New York. Second, increased globalization is leading to the use of container shipping for lowered valued commodities that are not as time sensitive has more highly valued goods. Thus, it may be possible to use barge transport in more extensive line-haul movements of containers containing less valuable commodities.

intermodal freight movements into the nation's hinterlands. The commodity flow analysis and forecasts, combined with an inventory of the Region's existing intermodal facilities revealed numerous intermodal opportunities. The study team identified seven of these opportunities to profile in more detail using case studies. The opportunities include projects that are in various stages of development – ranging from full implementation to early conceptual stages, yet all are designed to create important new transportation and economic development benefits. Various types of opportunities, including intermodal rail, container-on-barge, and inland ports were included in the case studies. It is important to note that the chosen case studies do not represent all of the intermodal opportunities in the region, but are meant to serve as a sampling of how transportation-related investment can help to ensure Appalachia's economic health in the 21st century. The strategic opportunities selected for additional examination include the:

- **Trans-Tennessee Railroad**: The Trans-Tennessee Railroad calls for the completion of a freight rail corridor connecting Knoxville to Memphis via Nashville. The plan would create a seamless rail corridor between the three cities, paralleling I-40 through the center of the state.
- **Central Corridor Doublestack Initiative (Heartland Corridor):** Creating doublestack container capability along the Norfolk Southern (NS) rail corridor through the heart of the Appalachian Region (connecting the Region to Columbus, Ohio and Norfolk, Virginia) will require a substantial investment to the railroad's infrastructure. Such an investment will strengthen the Region's transportation infrastructure and better connect area businesses to the global marketplace.
- **Virginia Inland Port**: The objective of an inland port is twofold; alleviate container and associated traffic congestion around a given seaport and move transportation and distribution infrastructure closer to inland commerce. This concept has been successfully achieved at the Virginia Inland Port (VIP). The 161-acre VIP, located 70 miles west of Washington DC in Front Royal, Virginia, effectively brings the Atlantic marine terminals of Norfolk and Newport News 220 miles inland, to the very doorstep of Appalachia.
- **South Carolina Inland Port**: The primary objective of a South Carolina Inland Port (SCIP) would be to alleviate congestion at the Port of Charleston and to assist in accommodating future (container throughput) growth. As the Port of Charleston has

developed, several issues regarding traffic congestion and safety, port expansion, compatible land-use, and environmental impact have clouded the Port's growth potential.

- **Port of Huntsville**: The Port of Huntsville is an inland port comprised of Huntsville International Airport (HSV), the International Intermodal Center (IIC) and the Jetplex Industrial Park. Huntsville International Airport, in conjunction with the IIC, provides Appalachia with exceptional air, rail, roadway and maritime connections to the world.
- **Port of Pittsburgh, Container-on-Barge**: The Port of Pittsburgh container-on-barge (COB) waterway network embraces the concept of containerized transport of commodities via flat deck barge. Currently, commodities transported by barge tend to be low value, bulk goods. However, the use of container barges (flat deck), capable of carrying large numbers of containers and being loaded and unloaded quickly at port, has the potential to change the dynamics of barge transport and bring new competitive advantages to area businesses.
- **Erie Cross-Lake Ferry**: The Erie to Nanticoke Freight Ferry will provide scheduled, containerized waterborne freight service between the Port of Erie in northern Pennsylvania and Nanticoke in southern Ontario, Canada. The concept is designed to take advantage of increasing trade and associated commodity flow between Canada and the United States and establish Erie as a new gateway for international trade.

More detailed descriptions and assessments of these opportunities are provided under separate cover in the Case Studies section of the report.

CHAPTER 4
FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

As has occurred throughout the history of Appalachia, powerful forces are continually reshaping and restructuring the Region's economic profile and vitality. Globalization is also producing changes in the types and volume of goods moving to, from, and across the region, which has been confirmed through the commodity flow analysis conducted within this research undertaking. Through identifying and understanding these trends, Appalachia is better able to anticipate change and position itself to become more competitive and more economically successful as it moves into the 21st century.

The commodity flow analysis demonstrated the diversity of goods flowing through the Region. For example, bulk goods (coal and lumber), raw materials (food and pulp products), intermediate inputs (fabricated metals and chemicals) and finished products (electrical machinery and transportation equipment) are all within the top 20 commodity flows in the ARC Region. This diversity of products, each feeding a different stage of production, requires an equally diverse transportation system, ranging from air cargo to rail to truck to barge. Ensuring efficient and seamless connections between these modes is essential to maintaining a competitive advantage for the region.

In communities such as Huntsville, Alabama and Front Royal, Virginia, we have witnessed how carefully planned, proactive investments in transportation infrastructure can enhance the capacity, efficiency, and responsiveness of the transportation network, while at the same time help retain existing businesses and attract new enterprise.

Finally, the analysis confirms the value of the region's full spectrum of transportation resources and capabilities, including a comprehensive 30,000-mile network of ADHS and interstate highways, railways, and inland navigation services and its 272 public use airports. Importantly, the analysis highlights opportunities to far more effectively coordinate and interconnect these important resources in a way to better capture their full economic development and employment potential for the region.

Findings

Through carefully researching economic, commodity flow, and transportation trends affecting Appalachia, important findings have been identified. These include:

- The emergence of global trade is expanding and diversifying commodity flows within and across the Appalachian Region.
- Major East-West (Asia and Europe) and North-South (Canada and Latin America) trade lanes now criss-cross the Region.
- Commodity flow patterns and trade lanes are regional in nature, extending between multi-jurisdictional boundaries.
- Foreign Direct Investment (FDI) has grown ten fold in the past 20 years and is contributing to increased commodity flows to, from, and across Appalachia.
- Diversity within the economy requires diverse transportation capabilities.
- Global and domestic commodities increasingly rely on containerization.
- The containerized supply chain is built around seamless, intermodal transportation, featuring high speed, high efficiency, and highly responsive customer service.
- The growth of commodity volumes is beginning to strain transport capacity levels, particularly at trade gateways on the Atlantic seaboard.
- Congestion increases costs, decreases efficiency and reliability, and constrains the competitive advantage of business.
- Appalachia enjoys a strong and diverse network of transportation resources, including highways, railways, inland navigation, and airports, which can play a vital role in relieving congestion at trade gateways and creating new economic opportunity in the Region.
- Appalachia transportation assets are poorly coordinated and interconnected. Limited intermodal access to and from major seaports constrains foreign trade potential for Appalachian businesses.
- National and regional transportation capacity, efficiency, and responsiveness can be enhanced through expanding intermodal links between the ADHS and the Region's rail, inland navigation, and aviation modes.
- Such links offer innovative opportunities for public/private partnerships.

- The transportation capacity, efficiency, and responsiveness offered by the ADHS and its intermodal linkages can attract new commerce and jobs into the region, as congestion increasingly chokes off alternative routings in other areas.
- As commodity flows increase in volume and diversity, proactive transportation investments are demonstrating their potential to attract commerce and employment.
- A comprehensive, region-wide transportation system is essential to economic success and offers important security, safety, environmental, and quality of life benefits.

Emerging from these findings is a set of conclusions and recommendations that can help Appalachia position itself for success in the 21st century. Rather than looking to the past, these approaches are proactive in nature and are focused at both retaining existing businesses and at stimulating new commercial opportunities in the region. The recommendations and conclusions are intermodal by design and call for establishing a closer and more integrated relationship between the Region's transportation and economic development interests.

Conclusions and Recommendations

- Search out and identify institutional mechanisms to more effectively develop regional transport initiatives that extend across traditional jurisdictional boundaries.
- Intensify the interaction and cooperation between economic development and transportation interests.
- Facilitate expanded public/private partnerships and focus on opportunities to better achieve the full economic potential of transportation investments.
- Optimize the capacity, efficiency, and responsiveness of the Region's transportation resources and actively apply these assets to attract new commercial and employment opportunities into Appalachia.
- Continually track economic and commodity flow trends to anticipate and position for change.
- Establish a Region-wide process to identify and develop improved intermodal links between the ADHS and Appalachia's rail, water, and aviation modes.

- Seek out opportunities to better utilize advanced information, communication, and security technology to enhance the Region's transportation efficiency and expand its potential to attract new commercial and employment opportunities.
- Develop a collaborative approach to more actively advocate for the region's individual and collective transportation resources, so as to assure that Appalachia will enjoy full access to opportunity in the 21st century.

Appalachia is a region that in the 20th century experienced the stark economic and human consequences of isolation. As the region moves into a new century, the freedom of access that its transportation system will be called upon to provide will be critical to the businesses, communities, and people of Appalachia. In the 21st century, the globalization of trade and desire to broaden and diversify the region's economic base will demand fast, diverse, and efficient access to opportunity.