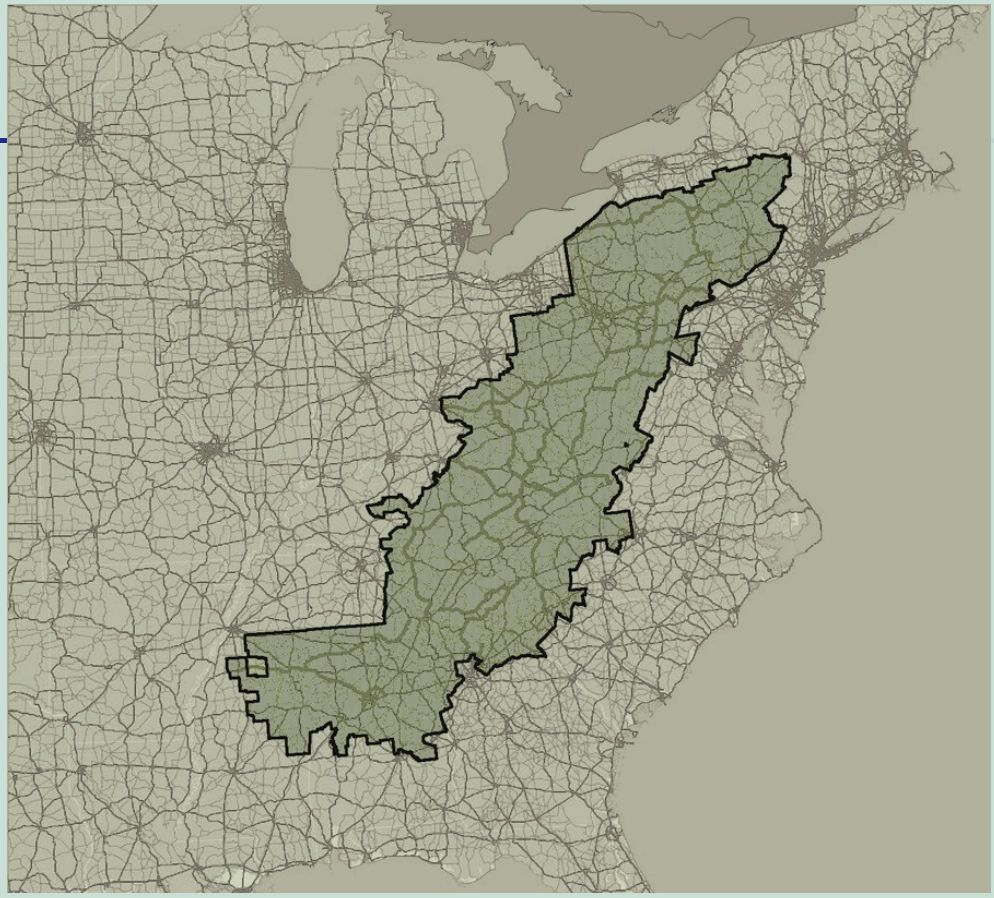
CAMBRIDGE SYSTEMATICS

# Economic Impact Study of Completing the Appalachian Development Highway System

## Final Report

June, 2008



*prepared for*

**Appalachian Regional Commission**

*prepared by*

**Cambridge Systematics, Inc.,**
**Economic Development Research Group, and**
**HDR Decision Economics**

*Final report*

# Economic Impact Study of Completing the Appalachian Development Highway System

You can view and download this report by visiting www.arc.gov.

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The authors wish to thank the Appalachian Regional Commission for providing the funding for the report.

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The Appalachian Regional Commission's mission is to be an advocate for and partner with the people of Appalachia to create opportunities for self-sustaining economic development and improved quality of life.

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# Acknowledgments

This report was funded and prepared for the Appalachian Regional Commission (ARC). It was commissioned by the ARC to study the economic impacts, benefits, and costs of completing the Appalachian Development Highway System (ADHS).

The report was prepared by a team of Cambridge Systematics, Inc., Economic Development Research Group, and HDR Decision Economics. Daniel Hodge (now with HDR) was the project manager. Major sections of the report were written by Daniel Hodge, Daniel Beagan of Cambridge Systematics, and Tyler Comings and Glen Weisbrod of Economic Development Research Group. Also contributing to this study were Alexander Heil, Siddarth Pandit, Branner Stewart, and Edward Bromage of Cambridge Systematics, and Brian Baird Alstadt of Economic Development Research Group.

The research, analysis, and report development were guided by Dr. Gregory Bischak, Senior Economist with the ARC. Ken Wester, ARC ADHS Manager, provided detailed cost analysis of the ADHS system and guidance in identifying the remaining corridors to be completed. Keith Witt, ARC GIS Advisor, provided mapping and data analysis. Jason Wang, ARC Senior Transportation Advisor, provided assistance in characterizing the remaining corridors to be completed. Sang H. Yoo, Research Associate at the Rahall Appalachian Transportation Institute at Marshall University, provided detailed GIS data on the ADHS corridors. Mark L. Burton, Director of Transportation Economics at the University of Tennessee at Knoxville, provided region-wide county-level commodity flow data derived from the first iteration of the Federal Highway Administration's Freight Analysis Framework.

The research team would also like to acknowledge and thank the many individuals and organizations in Corridors H (West Virginia), T (New York), and V (Mississippi) who agreed to be interviewed and provided critical input regarding the current and future impacts of ADHS corridor completion.

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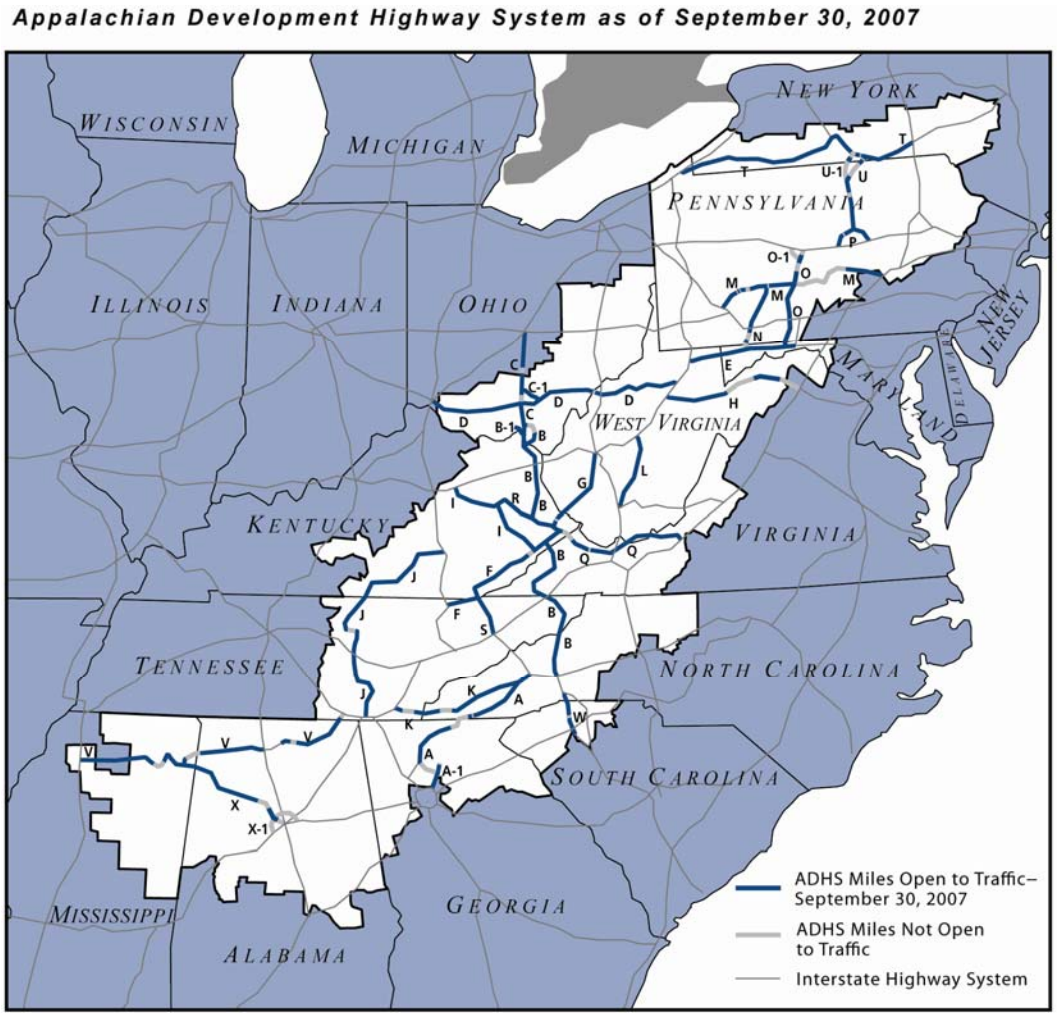
# Executive Summary

The Appalachian Regional Commission (ARC) has commissioned this economic impact study to estimate the economic impacts, benefits, and costs of completing the Appalachian Development Highway System (ADHS). The ADHS is the first highway system authorized by Congress for the purpose of stimulating economic development. The ADHS is a 3,571-mile near-interstate grade highway system composed of 31 corridors located in 13 Appalachian states with 3,090 eligible for improvement (see Figure ES.1). The system is approximately 85 percent finished and the completion will link the whole system into an integrated network connecting to national markets and trade flows.

Figure ES.1 ADHS Completed and Uncompleted Corridors




Source: Appalachian Regional Commission

The purpose of this study is to assess the travel performance, trade, and economic development impacts directly related to completing the ADHS. In addition, the study assesses connectivity, accessibility, and network effects – in other words, how do the corridor improvements connect Appalachian people and businesses to other highway facilities, multimodal transportation, and economic markets (labor force, buyers/suppliers, tourists). The study has produced estimates of near- and long-term travel and economic benefits, including benefit/cost analysis to evaluate the expected economic return on investment of completing the ADHS to both the ARC region and the U.S. Furthermore, three regional case studies have been completed in the north, central and south sections of the ARC Region to provide detailed information for calibrating the modeling assumptions based on structured interviews with key transportation users and economic development experts.

Prior to this current study, the most recent extensive economic impact analysis of the ADHS was a July 1998 report that found positive economic and travel efficiency returns to ADHS investments.[1] There are a number of key differences between that study and this new effort such that it is difficult to compare findings. Those differences include: 1) the 1998 study examined benefits from 12 already completed highway segments rather than estimating benefits of the future completion of the ADHS; 2) that study was based on an analysis of individual highway segments, while this study emphasizes network benefits of a complete highway system; 3) this study makes use of national freight flow data not previously available, which allows for a more complete analysis of national freight system benefits; and 4) this new study estimates an additional benefit not examined in the earlier study, which is the potential for economic development benefits due to improved market access to labor force, buyers, suppliers and multimodal facilities.

Results of this study include a full range of transportation performance and economic development indicators organized by:

**Travel Efficiency Benefits –** Travel-time savings, route diversion, and transport cost savings;

**Direct Economic Impacts –** Reduced industry costs as well as economic development and tourism effects stemming from increased market accessibility;

[1] Wilbur Smith Associates, *Appalachian Development Highways Economic Impact Study*, Appalachian Regional Commission, July 1998.

**Total Economic Impacts –** Full economic development impacts on the economy of the ARC region in terms of employment by industry, gross regional product, and personal income;[2] and

**Benefit/Cost Analysis –** Benefit/cost ratios and net present value (NPV) to measure expected return on investment.

As described in the full report, significant care was taken to avoid the double-counting of benefits. Study results are generally presented for two perspectives – the ARC region (410 counties in 13 states) and the entire United States. Since the ADHS has specific objectives in terms of increasing economic development opportunities for the Appalachian Region, the regional perspective on benefits of completing the ADHS is essential and emphasizes regional economic impacts. In addition, U.S.-level economic efficiency benefits of completing the ADHS are provided to demonstrate the national benefits of ADHS investment, and thus the national-level results are focused on transportation efficiency and productivity gains.

# KEY STUDY FINDINGS

The remainder of this executive summary presents key study findings and results organized by the four benefit and impact categories mentioned above.

## Travel Efficiency Benefits

ADHS corridor improvements will produce significant dollar values of travel benefits to individuals and businesses both within and outside the ARC region. Total user benefits (travel time, fuel and nonfuel operating costs, and safety) are estimated to be valued at $1.6 billion annually by the year 2020, the hypothesized year of system completion, and grow to $5.1 billion annually by 2035 under a medium-growth scenario (see Table ES.1).[3] These are national-level benefits reflecting travel efficiency gains for all trips affected by ADHS completion.

Completion of the ADHS will result in a significant reduction in travel time for personal, business, and long-distance freight trips. By 2020, the aggregate savings in travel time is estimated to be over 84 million hours annually (equivalent to 303,000 hours daily of travel time saved), which will grow to almost 212 million hours of reduced travel time by 2035.

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[2] Personal (nonbusiness) travel efficiency benefits are not included in total economic impacts.

[3] It is worth noting that relatively conservative assumptions were used regarding value of time and the potential for additional reliability and logistics benefits. In addition, this study used an innovative travel modeling approach that incorporated terrain factors to capture the impacts of mountainous, and often steep, Appalachian corridors.

Table ES.1 Summary of User Benefits Due to ADHS Completion
*Medium-Growth Scenario*

| Million of 2007 Dollars | 2020 | 2035 |
|---|---|---|
| Freight | $444.0 | $2,993.9 |
| Non-freight | $604.0 | $1,140.9 |
| Business Automobile | $92.9 | $153.2 |
| Non-business Automobile | $463.3 | $764.1 |
| Total | $1,604.2 | $5,052.0 |

The improvements on the to-be-completed ADHS segments will result in a significant increase in traffic using largely rural interstates and expressways. Average daily traffic volumes are expected to increase by approximately 130 percent compared to what would occur if the remaining corridor segments are not completed. Despite the increase in traffic volumes, adding new capacity will result in lower total travel times with average speeds roughly doubling. This is especially true for freight truck trips which are projected to experience a 400 percent growth in miles traveled on ADHS corridors by 2035, doing so to gain shorter travel times and greater efficiency benefit.

Over 90 percent of automobile and non-freight truck benefits are estimated to accrue to the ARC region based on the origin-destination pattern of trips. Non-business auto user benefits include travel savings for reduced commute times (primarily within the ARC region). Meanwhile, over 65 percent of benefits to freight flows are *external* to the ARC region, reflecting the long-distance nature of the shipments affected and the national importance of completing the ADHS to facilitate goods movement into, out of, and through the ARC region.

## Direct Economic Benefits

Improvements in market accessibility for the ARC region will directly lead to increased economic development opportunities for the region. Accessibility gains were measured at the county level for labor, customer, tourist, buyer, and supplier markets, as well as reduced travel times to seaports, border crossings, airports, and intermodal rail facilities. The ARC region is estimated to gain $2.1 billion annually by 2035 in economic activity (as measured by value added) due to market accessibility gains by 2035. These accessibility benefits are estimated to gradually phase-in over time based on historic time-series analysis of economic gains from completed ADHS segments.

Over half of the travel efficiency benefits are expected to accrue to business-related travel – commodity-based freight truck trips, local nonfreight truck trips, and business (on-the-clock) automobile trips as shown in Table ES.1. This is partly due to relatively higher values of time for business travel and partly due to fast-growing projections of long-distance freight truck travel. Reduced travel

time and distance for business-related trips directly impact the costs of doing business and the economic competitiveness of firms in the ARC region and nationwide.

Completion of the ADHS also will result in market accessibility improvements for large segments of the ARC region. Two hundred thirty-five out of 410 ARC counties are expected to see reductions in travel time to the nearest commercial airport, with 26 counties experiencing an 8 percent or greater reduction in travel time. Three hundred twenty-five out of 410 counties are estimated to increase their accessibility to buyer and supplier markets within a three-hour drive, with 59 counties experiencing an improvement greater than 10 percent.

## Total Economic Impacts

Total impacts on the economy of the ARC region result from the direct effects of reduced business-related travel time and costs, along with increased regional growth made possible by market accessibility gains and associated multiplier effects. These impacts gradually increase over time and by 2035 are estimated to generate approximately 80,500 jobs, $5.0 billion in increased value added per year, including $3.2 billion in increased wages per year for ARC region workers as shown in Table ES.2. To avoid potential double-counting these results: a) are only reported for the ARC region, leaving the analysis of U.S.-level benefits focused on travel efficiency and productivity effects; and b) represent net economic gains for the region, subtracting inter-regional relocation of economic activity from other parts of the region.

Table ES.2 Total Economic Impacts of ADHS Completion in 2020 and 2035

| Impacts | 2020 | 2035 |
|---|---|---|
| Business Sales[a] | 4,245 | 10,102 |
| Value-Added[a] | 2,099 | 4,995 |
| Jobs | 33,823 | 80,491 |
| Wages[a] | 1,343 | 3,197 |

[a] Annual impacts in millions of 2007 dollars.

The industries in the ARC region projected to benefit most directly from ADHS completion in terms of business retention, expansion, and relocation include: warehousing and distribution, manufacturing, mining and utilities, professional services, and other business services.

As demonstrated by the three detailed corridor analyses completed for this study, there are numerous real world examples of businesses that will directly benefit from the completion of highway corridors. For example, there is a strong wood products industry in West Virginia along Corridor H that exports many of their goods to overseas markets in Europe and Asia. When that corridor is

completed (significant sections remain in both West Virginia and Virginia), companies will be able to directly ship products to key port destinations such as Norfolk, Baltimore and the inland port in Virginia and thus significantly cut shipping costs and travel time, increase reliability, and improve safety.

## Benefit/Cost Analysis

Total undiscounted capital costs to complete the remaining segments of the ADHS are estimated to be $11.2 billion (in 2007 dollars).[4] However, construction costs have been rising faster than the overall rate of inflation, so additional cost adjustments were added to the future time series of construction costs, raising the total undiscounted capital cost is $16.6 billion. In present value terms, applying a 5 percent real discount rate and incorporating future operations and maintenance costs, total cost is estimated to be $12.2 billion (in the high-cost scenario).

Table ES.3 presents cumulative impacts by category for the ARC region and the United States under a medium-growth scenario. These numbers represent the "present value" of a stream of annual travel efficiency or economic growth impacts over 30 years, using a 5 percent real discount rate.

Table ES.3 Total Present Value of ADHS Completion Impacts
*30-Year Analysis*

| Millions of 2007 Dollars | | Medium Growth | |
|---|---|---|---|
| Benefit Description | | ARC | United States |
| A | Industry Cost Savings | 17,310 | 29,114 |
| B | HH Out-of-Pocket Savings | 165 | 173 |
| C | HH Value of Time Savings | 5,482 | 5,718 |
| D | Market Access Growth[a] | 10,684 | 2,069 |
| E | Indirect and Induced Growth[a] | 9,551 | N/A |
| Total Impacts | | 43,192 | 37,074 |

[a] Value Added.

[4] This cost estimate is slightly lower than the total presented in the *ARC 2007 Cost-to-Complete Report* which included 129 ADHS miles that were under construction. For the purpose of this study these miles were treated as completed and not included.

Impact categories include:

A – Industry Cost Savings (travel benefits to business);

B – Household (HH) Out-of-Pocket Savings (reductions in fuel and nonfuel automobile-related costs for passenger travel);

C – HH Value of Time Savings (travel-time savings for passenger travel);

D – Market Access Growth (economic development); and

E – Indirect and Induced Growth (multiplier effects specific to the ARC region).

Traditionally, Categories A-C are considered to be measures of travel efficiency and Categories D-E are considered to be measures of regional economic impact. Since a key objective of the ADHS is to improve economic development in the ARC region, it is appropriate to compare total regional economic gains to cost to determine the likely economic return on investment.

Two types of benefit/cost (B/C) analysis are examined in this study to determine the economic return on investment for the ARC region and the entire United States – travel efficiency and total economic benefits (including economic impact categories D and E from above). While costs are the same from either perspective, benefits vary in two important ways. *Travel efficiency benefits* are significant for the ARC region but even higher from the U.S. perspective. National efficiency benefits are higher because a significant share of the affected trips are long-distance, high-value freight shipments with origins and destinations outside the ARC region. *Total economic benefits*, on the other hand, include benefits from increased market access and induced economic development, which accrue primarily to the ARC region,[5] in addition to all travel efficiency benefits (including personal, non-business travel benefits).

Table ES.4 (below) presents net present value and B/C ratio results for the ARC region and U.S. using a medium-growth forecast, conservative high-cost assumptions, and a 5 percent discount rate. For the travel efficiency benefits, the present value of benefits is estimated to be 2.9 times the cost at the U.S. level, with a B/C ratio of 1.9 for the ARC region. For the total economic benefits analysis, the present value of benefits for the ARC region is projected to be 3.6 times the estimated cost (with a range of 2.5 to 6.3 based on varying discount

[5] For purposes of benefit/cost analysis, total economic benefits for the ARC region include the value-added created via greater economic development opportunities in the region. To account for potential shifts in the location of future economic growth, at the national level, this measure only includes net productivity and export gains associated with regional economic development.

rate, cost and forecast assumptions).[6] At the U.S. level, using a medium-growth forecast, conservative high-cost assumptions, and a 5 percent discount rate, the estimated total economic benefit is 3.1 times the estimated cost (with a range of 2.2 to 5.4 based on varying discount rate, cost and forecast assumptions). Under all scenarios, including conservative cost and discounting assumptions, completion of the ADHS is expected to result in significant benefits in excess of cost from both the national and ARC regional perspective.

Table ES.4 Benefit/Cost Analysis of ADHS Completion
*Five Percent Discount Rate, Millions of 2007 Dollars*

| | | Net Present Value | Benefit/Cost Ratio |
|---|---|---|---|
| Travel Efficiencies | ARC Region | $10,800 | 1.9 |
| | United States | $22,850 | 2.9 |
| Total Economic Benefits | ARC Region | $31,030 | 3.6 |
| | United States | $24,910 | 3.1 |

These benefit/cost ratios are within the range usually found for individual highway projects. They appear stronger than those found for many rural corridors, primarily because: 1) the remaining ADHS segments complete important linkages in a long-distance network that serves a growing domestic and global trade environment, rather than just serving connections between individual rural communities; and 2) these highway segments provide necessary access and connections to/from isolated, mountainous Appalachian communities thus providing significant new economic opportunities as detailed in the three corridor analyses. It also makes ADHS completion particularly important for supporting the future economic competitiveness of the national and ARC regional economies.

[6] This range reflects various uncertainties inherent in any forecast such as discount rate, future cost escalation, the success of economic development initiatives, and baseline economic and demographic forecasts.

# 1.0 Introduction

## 1.1 BACKGROUND

The Appalachian Development Highway System was originally designated and funded to help generate economic development in the economically distressed Appalachian region by enhancing access in isolated areas and better connecting Appalachia to the interstate system. Significant transportation, trade and economic analysis of the Appalachian Development Highway System (ADHS) has been completed over the past 15 years, demonstrating the positive economic growth effects of the ADHS and the importance of trade route connections to domestic and international markets outside of the Appalachian Region. With 15 percent of the ADHS yet to be completed, this new study uniquely captures not only the economic benefits (and costs) of completing the remaining segments of the ADHS, but also the network benefits of a fully connected and linked ADHS, including national freight flows benefiting from this major highway system. See Figure 1.1 for a map of the ADHS corridors complete and yet to be constructed and thus open to traffic.

Prior to this current study, the most recent extensive economic impact analysis of the ADHS was a report from July 1998 that found positive economic and travel efficiency returns to ADHS investments.[7] It differs significantly from this current effort in several key ways that are worth noting so as to avoid unproductive comparison:

First, the 1998 study focused exclusively on the 12 completed ADHS corridors and corridor segments rather than completion of the entire system. The earlier study modeled segment-level traffic conditions rather than a fully networked system depicted by a travel demand model.

Second, freight flow data has improved significantly since the 1998 report, thus allowing for a more thorough and detailed estimation of local, regional, and national freight flows. The current study uses the most current Federal Highway Administration (FHWA) Freight Analysis Framework (FAF) historical (2002) and projected freight flow data (2020 and 2035) building on a county-level freight flow database developed for ARC by Marshall University and Wilbur Smith Associates.

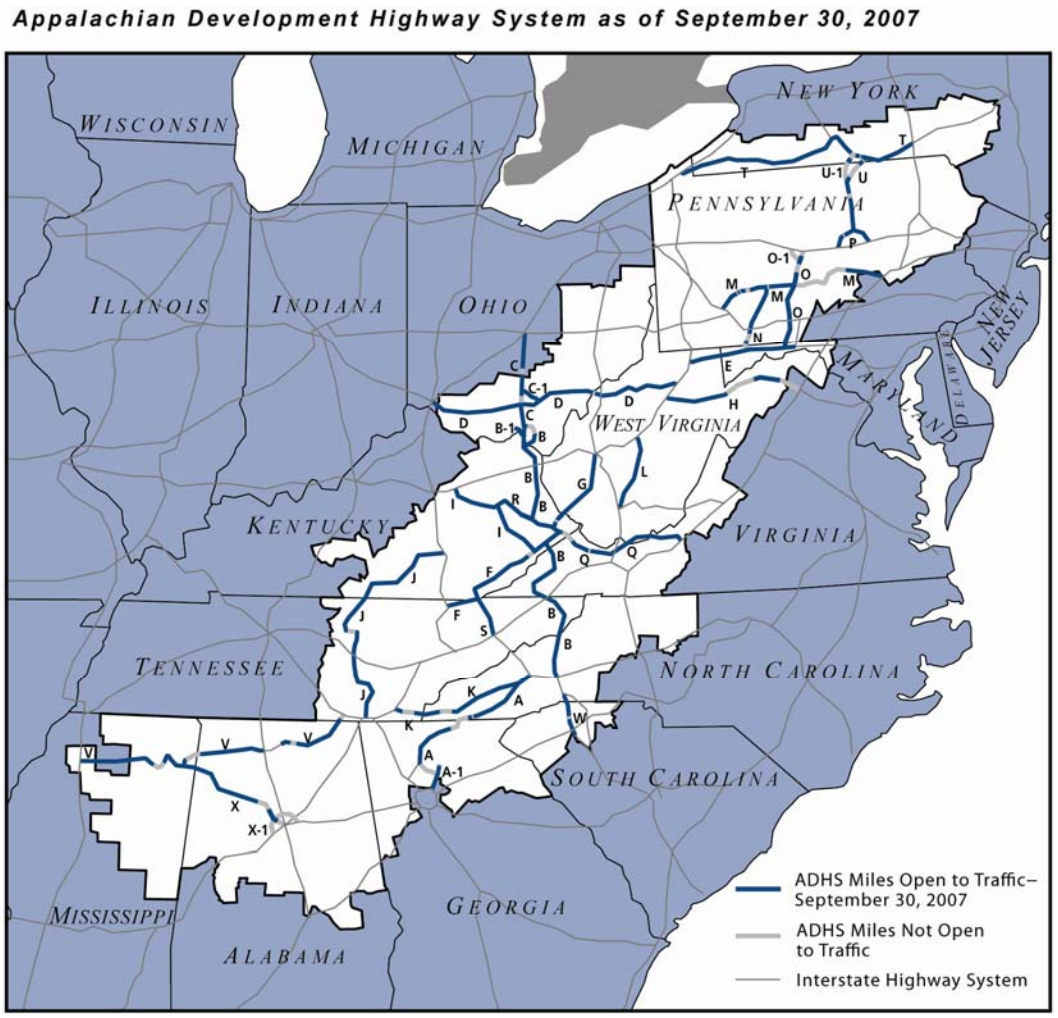
Third, while the 1998 study does estimate economic development effects based on travel efficiency gains, it does not include additional regional economic development gains due to improvements in market accessibility and

[7] Wilbur Smith Associates, *Appalachian Development Highways Economic Impact Study*, Appalachian Regional Commission, July 1998.

network connectivity. Further, this new study incorporates findings from recent statistical research on how ADHS economic development benefits vary in timing and magnitude depending on the type of county (rural, distressed, adjacent to metropolitan areas, etc.).

Fourth, this study includes three detailed case studies of ADHS corridors that provide real world context for the economic and trade benefits accruing to and expected from corridor completion. These detailed analyses, with input from local businesses, economic development officials and freight shippers and receivers was used to validate and calibrated the economic development benefits estimated in the quantitative modeling approach.

## Figure 1.1 ADHS Corridors




Source: Appalachian Regional Commission

Outputs from this study include a full range of transportation performance and economic development indicators, including:

Travel-time savings, route diversion, and market accessibility;

Direct user benefits, and additional economic development and tourism effects;

Total economic impacts (e.g., employment by industry, gross regional product, personal income); and

Benefit/cost ratios and net present value.

Results are presented for two perspectives – the ARC region (410 counties in 13 states) and the entire United States. Since the ADHS has specific objectives in terms of increasing economic development opportunities for the Appalachian Region, the regional perspective on benefits of completing the ADHS is essential and informative. In addition, U.S.-level economic efficiency benefits of completing the ADHS are provided to demonstrate the national benefits of ADHS investment. Reflecting the unavoidable uncertainty inherent in any forecast, estimates of future benefits are provided in terms of a range of likely effects.

The remainder of Section 1.0 provides an overview of the study approach, while the report is organized into the following sections and appendices:

Section 2.0 Methodology – Models and Data;

Section 3.0 Detailed Corridor Analysis Summaries;

Section 4.0 Travel Impacts, User Benefits and Accessibility;

Section 5.0 Economic Impacts;

Section 6.0 Benefit/Cost Analysis; and

Technical Appendices – (A) Travel Demand Model, and (B) Market Access and Economic Development Impacts.

## 1.2 STUDY OBJECTIVES AND OVERVIEW OF IMPACT MEASURES

The primary objective of this study is to estimate the economic impacts of a completed ADHS network, focused on the benefits of completing the final corridor segments. To do so requires the development of two travel and economic forecasts: 1) a "build" scenario with all remaining ADHS corridors fully completed; and 2) a "no-build" scenario that includes ADHS corridors already built or under construction, but does not include the remaining 15 percent of the system. Differences between these two future scenarios are estimated in terms of numerous factors:

**Travel Performance Impacts –** Comparisons of travel performance between the "build" and "no-build" scenarios within the networked travel demand model (which includes a thorough highway network of interstate, state, and local highways in and surrounding the ARC region) produces raw travel efficiency metrics such as vehicle hours of travel (VHT), vehicle miles of travel (VMT), and average speed for all trips (freight, nonfreight truck trips, and automobile).

**User Benefits –** Applying values of time and vehicle operating cost parameters to the travel performance impacts produces monetary benefits to the users of the ADHS corridors (and other regional highways experiencing changing traffic volumes). User benefits are measured in terms of travel-time savings, vehicle operating costs (fuel and nonfuel) and safety, varying by trip purpose (business, personal, commute) and vehicle type.[8]

**National, Regional, and Local Freight Flows –** As briefly mentioned above, this study incorporates comprehensive freight flow data based on FHWA's FAF historical and projected trade data, as well as detailed county-level origin-destination trade flows to allow the estimation of benefits to short- and long-haul goods movement. For example, over 65 percent of freight benefits are external to the ARC region, reflecting the long-distance nature of the shipments impacted and the national importance of completing the ADHS to facilitate goods movement throughout the ARC region.

**Improvements in Market Access –** In addition to more traditional travel efficiency user benefits, this study also estimated improvements in market accessibility due to increased travel speeds in parts of the ARC region. Measuring accessibility is especially important in more remote areas that typically do not have high-traffic volumes or congestion, but where improvements in accessibility to other transportation facilities or destinations can create a more competitive business environment. Market accessibility was measured in terms of:

- Increase in labor force accessible within a typical commute time (e.g., 60 minutes);
- Increase in buyers/suppliers within a three-hour one-way drive; and
- Reductions in travel time to nearest transportation facilities (e.g., airport, marine port, intermodal rail yard, international gateway).

**Economic Development and Tourism Effects –** Improvements in market access for ARC counties and communities increases regional competitiveness and thus can lead to expanded economic growth opportunities. These effects are estimated using the Local Economic Assessment Package (LEAP), a framework originally developed for ARC together with statistical analysis

[8] Reliability benefits were also estimated as part of this study but are not included in the results within this report based on what were deemed unrealistically large effects.

findings on the timing and size of ADHS economic benefits. These estimates also take into account regional and national offsets (i.e., the extent to which expanded growth in one part of the region could mean lower growth in other parts of the region).

**Total Economic Impacts –** Expansion of economic activity, driven by the direct effects on business cost savings, market access growth, intermodal connectivity improvements and associated economic multiplier effects. The Transportation Economic Development Impact System (TREDIS) was used to estimate both the direct effects on costs, market access, and connectivity, and the total effects on expansion of industry in the region. Economic growth was measured in terms of jobs, business sales, gross regional product (value-added), and wages.

**Benefit/Cost Analysis –** To gauge the economic return on investment and place these benefits in appropriate context, benefit/cost ratios and estimates of net present value are estimated from both the regional and national perspectives. The ARC regional perspective includes economic competitiveness gains not reflected in the national economy, while the national perspective includes all travel-related economic efficiency benefits (including ARC region through-trips). Future predictions of cost-to-complete the ADHS incorporate accelerated construction inflation assumptions consistent with recent historical data on cost escalation.

# 2.0 Methodology – Models and Data

This section describes the overall analysis approach used in the study, and describes how a set of state-of-the-art transportation and economic analysis models were applied to calculate impacts and benefits of completing the ADHS.

## 2.1 GENERAL APPROACH

The general approach for analysis in this study involves two steps:

1. ***Classification*** of the different ways in which completion of the ADHS can lead to transportation and economic impacts; and
2. ***Application*** of appropriate tools to estimate the travel efficiency and regional economic impacts of completing the ADHS.

In general, ADHS completion leads to a sequence of changes affecting travelers, households, and businesses that are either located in Appalachia or otherwise using Appalachian Development Highways. The resulting changes in transportation efficiencies, accessibility enhancement, and business productivity lead to broader impacts on the economy of the entire Appalachian region, as well as outside areas.[9] The classes of impacts and the analytical processes applied to estimate them are described below.

**A – Traveler Impacts.** All of the travel impacts are estimated by using a *highway network and travel demand forecasting model* to represent the changes in traffic volumes, distances, speeds, VMT, VHT and safety. This is more fully explained in Section 2.2. The model is applied to represent future conditions for both the existing highway network and an improved network in which all elements of the ADHS have been completed. To accomplish this, traffic growth also is forecast on the basis of population and employment growth projections, which are more fully explained in Section 2.4. This process captures the following effects.

**Travel Distances –** Completion of ADHS routes will reduce highway travel distances between some origins and destinations, which can save time and vehicle operating expense for all vehicles using these routes. The distance reduction effect can occur in three ways: 1) through development of new highway routes that are more direct; 2) through upgraded alignments on

[9] It is worth noting that the study has made explicit attempts to measure *net* economic changes by accounting for potential spatial reallocation of economic activity within and outside of the ARC region. This is described more fully in Section 2.5.

existing routes that reduce curves in the road; and 3) through development of safer and more reliable highways that divert traffic from alternative routes that are longer in length but previously used because of their safety and reliability. In addition, it is possible that some trips will be diverted to faster, but longer ADHS corridors rather than local highways. All of these impacts on travel distances are captured through use of a highway network and travel demand model that forecasts changes in traffic volumes, travel distances, and route selection – yielding systemwide measure of the change in *vehicle miles of travel (VMT)*.

**Travel Speeds –** Completion of the ADHS routes will reduce average travel times on many routes. The time savings effect can occur in three ways: 1) by raising highway capacity through additional travel lanes, which reduces congestion slowdowns and thus raises normal speeds; 2) by enhancing the capability to pass slow-moving vehicles through broader shoulders and special passing lanes, which also raises daily average speeds by reducing periodic slowdowns; and 3) by reducing highway travel distances and travel times. In addition, speed calculations explicitly account for terrain (flat, rolling, mountainous) which is especially relevant for the many steep ADHS corridors. All three impacts on travel times are captured through the use of that same highway network and travel demand model, as it accounts for changes in driving conditions affecting travel speeds, distances and volumes – yielding a systemwide measure of the change in total daily *vehicle hours of travel (VHT)*.

**Traffic Safety –** Completion of the ADHS routes will enhance safety by improving roadway design geometrics (i.e., curves, embankments and shoulders), as well as roadway capacity (through additional passing and travel lanes). Altogether, these factors act to reduce traffic accidents, including vehicle damage, human injuries, and deaths. Accidents are estimated by first using the highway network and travel demand model to: 1) represent how ADHS completion changes roadway classification in terms of lane width, curves, and inclines; and 2) estimate the traffic volumes (and volume/capacity ratios) along those various roadway classes. Then, average accident rates for the various types of roads are applied. The effective safety impact is expressed in terms of forecast changes in *average collision, injury, and death rates* (per thousand vehicle miles of travel).[10]

**B – User Benefits.** The value of travel benefits depends on the volume and mix of users of the highway system. In the case of passenger travel, users are drivers and passengers of cars, and the passengers of buses. In the case of freight

[10] It is worth noting that by using average accident rates by functional class, it is likely that safety benefits are understated in this study (which did not have the resources to do a segment-level safety analysis) since it is known that there are segments of the to-be-completed ADHS that have relatively high crash rates.

movement, the users are the shippers and receivers. In both cases, the user benefits are based on the dollar valuation of travel-time (VHT) savings, travel distance (VMT) savings, and safety improvement. However, characteristics of the traffic movement on Appalachian highways also affects user benefits in three ways: 1) the mix of trip purposes (personal or business travel) affects the valuation of time savings; 2) the car/truck vehicle mix affects vehicle operating cost and accident cost savings; and 3) the mix of commodities carried by trucks affects the value of time and reliability savings for shippers. These mix characteristics are tracked by the *highway network and travel demand model*, and generally accepted *unit valuation factors* are applied to calculate the total user benefits. In addition, a distinction is made between benefits that directly affect the flow of dollars in the economy (such as gasoline and business worker time savings) and societal benefits that have value but do not directly affect the flow of dollars (such as personal time savings). The traffic mix is discussed at the end of Section 2.2, freight flow mix is discussed in Section 2.3, and the benefit valuation factors are discussed in Section 3.0. This framework explains the different types of travel savings from which user benefits are computed:

**Business Worker and Vehicle Cost Savings –** Completion of the ADHS routes will save business costs for their "on-the-clock" worker travel, due to faster speeds and more direct routes. The benefits include reduced driver and/or worker labor time costs incurred while traveling for business, as well as measurement of changes to vehicle operating costs (e.g., less fuel costs from less VMT) and safety (e.g., fewer accidents and thus lower insurance costs). This is expressed in terms of reduced *business operating costs*.

**Business Freight Processing Cost Savings –** Completion of the ADHS routes also will save businesses travel-related costs for their freight shipments. This can be expressed as *labor cost* savings from reduced driver time or in terms of greater labor productivity (as more deliveries can be made per vehicle and driver in a given day). It also comes in the form of reduced *logistics-related costs* – which may be expressed as savings in idle loading dock worker time (while waiting for late pickups and deliveries) or in terms of savings in scheduling costs (as there is less padding of schedules to allow for freight delivery time uncertainty). There also may be *vehicle operating cost* and insurance savings for corporate truck fleets.

**Household Cost Savings –** Completion of the ADHS routes will save households vehicle fuel and maintenance expenses insofar as vehicle mileage is reduced, and they also may save on medical or insurance costs insofar as accident rates are reduced through safer roadways. This can be expressed as an increase in *disposable income*, or as a decrease in the *cost of living*.

**Personal Time Savings –** Completion of the ADHS routes, with shorter travel distances and faster travel speeds, also provides a time savings benefit for personal travel (that is not business-related). This is a societal benefit, as the value of *personal time savings* does not directly affect disposable income.

**C – Access Impacts.** Beyond saving time and money for travelers based on existing population and business forecasts, the ARC region will benefit from expanded transportation access and connectivity. These benefits are distinct from travel efficiency impacts in that they do not stem from changes in the routing or speed of trips that already are occurring (or forecast to occur in the future). Rather, they reflect a more dynamic and competitive economic environment in the ARC region, where businesses and consumers are better able to meet their needs. More specifically, ADHS will reduce isolation by enhancing *access* – including population access to jobs, medical care, shopping, and services, as well as business access to customer delivery markets and intermodal facilities. It also will improve transportation system *connectivity* to highway, intermodal rail facilities, airports, marine ports and international border and gateway facilities. In fact, the effects on access and connectivity were core elements of the justification for initial funding of the ADHS. For this study, the access impacts are measured in terms of expanded labor market size and delivery market size for each county population center. The connectivity impacts are measured in terms of travel time reductions to those intermodal connectors and facilities from each county population centers. All of these impacts are calculated using the *highway network and travel demand model* discussed in Section 2.2. This process captures the following effects.

**Job Market Access –** Completion of ADHS routes will provide the residents of Appalachian communities with greater job opportunities. This same effect can be seen as providing business locations within Appalachia with greater workforce access, thus making locations within the region more attractive for business investment. This effect is measured by the highway network model in terms of increased *population markets* within a 60-minute travel time of each county's population center. This same effect also can be viewed as an increase in availability of shopping and services to residents.

**Business Delivery Customer Market Access –** Completion of ADHS routes also will provide businesses in some locations with broader *truck delivery markets* to buyers and suppliers. This effect is measured at the county-level by the highway network model in terms of increased business activity (measured by employment) within a three-hour delivery time, which represents a maximum for same-day truck runs.

**Connectivity to Intermodal Facilities –** Completion of ADHS routes also will provide businesses improved *access to airports, intermodal rail facilities, marine ports, and international borders or air/sea gateways*. These effects are measured by the highway network model in terms of reduced travel times to the closest commercial facility of each type.

**D – Economic Impacts.** Improvements in the highway network – with their associated transportation efficiencies, user benefits and market access – all lead to changes in business activity and associated income and jobs. These effects occur insofar as ADHS completion affects business volume, operating costs, household spending, and business productivity. These impacts play out differently at both

the regional and national levels. All of these impacts are estimated using a *regional economic impact model*. That model is discussed in Section 2.5. This framework uses the estimates of business-related travel efficiency savings and improved accessibility to compute the economic impacts of completing the ADHS.

**Direct Cost Savings Effects –** Completion of ADHS routes will reduce travel times which will lead to reduced *business operating costs*, although these cost savings differ by the type of business due to variation in their reliance on trucks and workforce costs. In the economic model, the cost savings to business-related transport induce greater worker and business income as a result of enhanced business competitiveness, leading to increases in new investment and resulting industry growth.

**Direct Access Improvement Effects –** Completion of ADHS routes also will lead to enhanced business productivity by generating economies of scale from access to larger population, a more diverse workforce, and delivery markets, as well as enabling greater efficiency of operations with access to intermodal connectivity. In the economic model, these economies of scale generate greater *productivity* and *business attraction*, leading to increases in job and income growth. (Careful calculation is done to isolate the new effect of market and connectivity improvements from the effect of reduced travel times that already is captured under direct cost savings.)

**Regional Economic Adjustment Effects –** Completion of ADHS routes also will lead to additional effects on other sectors of the economy. These include *indirect effects* on expansion of businesses that supply goods and services to the directly benefiting businesses. They also include *induced effects* of greater worker spending on goods and services as a result of the increased jobs and income. In addition, the economic model adjusts for changes over time associated with shifts of business activity locations between the ARC region and rest of the United States, as well as within the ARC region.

**E – Benefit/Cost Analysis.** To place the estimation of economic and total benefits in proper context, standard benefit/cost analysis tools have been applied to measure the economic return on investment to the ARC region and nation as a whole in terms of pure travel efficiency gains and also total economic benefits. Benefit/cost ratios are presented in terms of a likely range, reflecting uncertainties in terms of future demographic forecasts, construction inflation rates, and the discount rate. State-by-state cost-to-complete estimates for 2005 were adjusted to future years by incorporating more realistic assumptions about construction cost escalation based on data from the Bureau of Labor Statistics' bridge and highway construction producer price index (BHWY PPI).

The remainder of this section describes the highway network and travel demand model, the forecasting assumptions, the freight composition calculations, and the economic model processes.

## 2.2 HIGHWAY NETWORK AND TRAVEL DEMAND MODEL

This section describes the preparation of the travel model that was used to analyze the impacts of interaction of automobile and freight truck travel as a result of the completion of the Appalachian Development Highway System (ADHS). The travel demand model allows the impacts on total travel to be quantified and to identify the travel-time and reliability benefits that will accrue to autos and trucks as a result of the completion of the ADHS.

### 2.2.1 Model Development

A Travel Demand Model highway network was created in TransCAD. TransCAD is standard package travel demand model software, commonly used in transportation planning that provided the attributes necessary to fully test the impacts of the ADHS completion and to provide measures of its performance as outputs to economic development models. The highway network was based on the TransCAD highway network created for FHWA's Freight Analysis Framework (FAF) project.[11] That highway network provides information, including origin and destination points, for all major highway movements beginning at counties in the ARC region and surrounding areas. By inspection it was determined that the FAF network includes either the ADHS corridors or the highways that ADHS corridor improvements are intended to replace. From the FAF highway network, a ring of major highways surrounding the ARC member counties was selected for inclusion in the ARC travel demand forecasting (TDF) model. The inclusion of highways beyond the ARC region allows the impact of ADHS completion on the diversion of trips to begin at major diversion points, such as the interstate system, outside the ARC region.

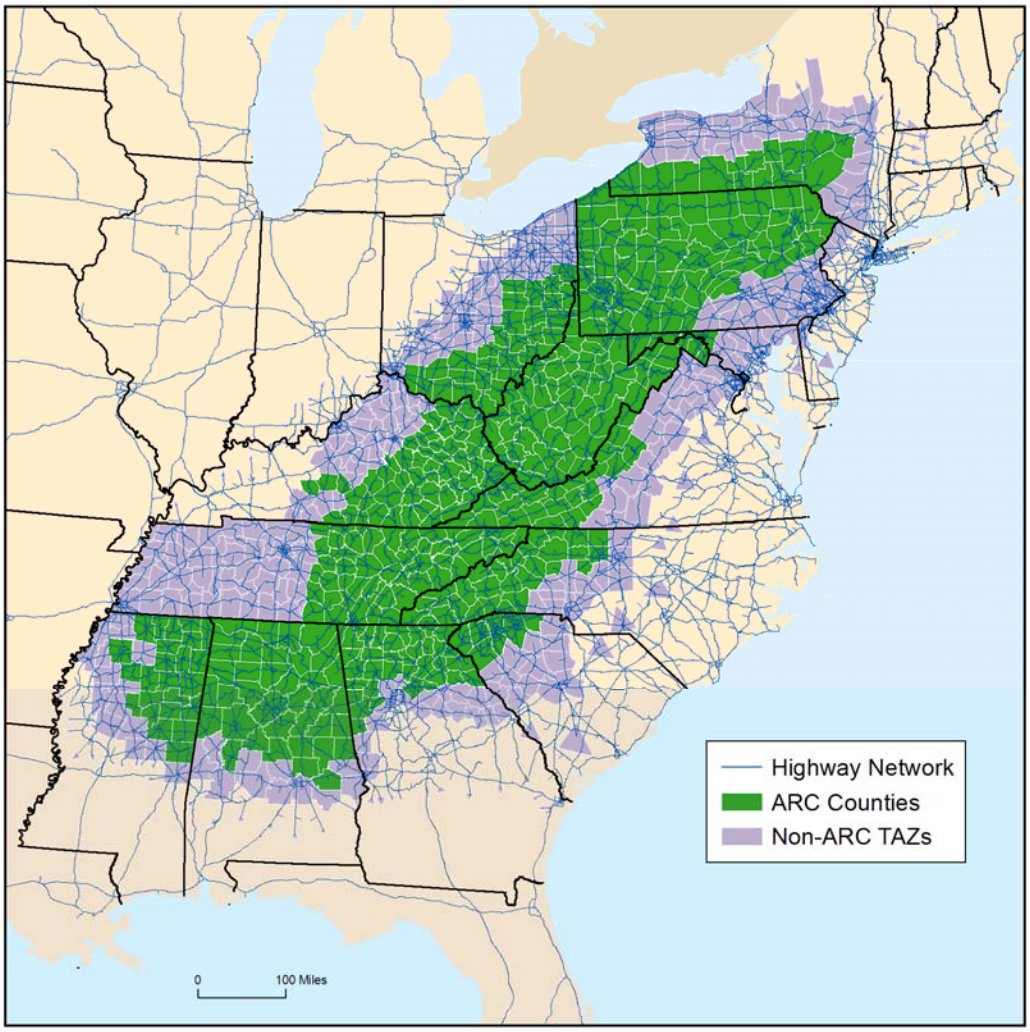
Accompanying the highway network, a set of Traffic Analysis Zones (TAZ) was defined at the county level, both inside the ARC region and outside the ARC region extending to the model boundary. These counties served as the points for assigning the origins and destinations of automobile and truck trips that were developed by the TDF model. The highway network and counties are shown in Figure 2.1.

External stations were coded at the edge of the highway network. These external stations serve as the means to assign automobile and truck trips between those counties included within the model and the remainder of the United States. The network of major highway outside of the model boundary was used with national commodity truck patterns (as discussed in the next section) that have an origin and/or a destination outside of the ARC region, to identify the external station(s) which are used to enter or exit the travel model.

[11] Freight Analysis Framework Version 1.0, TransCAD highway network, FHWA.

To support the analysis of the calculation of accessibility to airports, intermodal terminals, marine ports and international borders, these facilities were coded as zones in the travel demand model. Where the facilities were located within the travel demand model boundaries, the locations were coded directly within the model. When those locations were located outside of the model boundary (e.g., Port of Savannah, Brownsville, Texas border crossing), links representing the distance to these locations were coded into the network.

Figure 2.1 ARC Travel Demand Model Highway Network and TAZs




Links in the ARC travel demand model highway network have an attribute which indicates their status as an ADHS segment, including whether the link is "completed" or "yet to be completed." TransCAD maintains one master network file where links for scenarios (e.g., base, No-Build/ADHS completed, build/ADHS yet to be completed) were turned on or off as needed. These attributes allowed the travel and performance on the ADHS segments to be readily identified.

The TransCAD software includes a feature known as Origin Destination Matrix Estimation (ODME). ODME can allow the "reverse engineering" of the most likely trip table that would be consistent with treating the observed traffic counts as the assigned volumes of that trip table. The FAF1 highway network used in the development of the ARC travel demand model highway network includes automobile and truck average (annual) daily traffic (AADT) counts as attributes. The ADHS highway segments also include daily AADTs for automobile and trucks that were used to update the FAF1 counts. Since the ODME process estimates trips *between* TAZs, consistent with this process and the county TAZ structure, the counts used in the estimation process were those on links in the model network that cross zone/county boundaries. This estimation process does not include trips that travel completely within a county and, therefore, the estimation process excludes those counts that are likely to include a high portion of those trips.

Suitable preliminary trip tables for automobiles and trucks were developed from socioeconomic data for TAZ/counties quick response trip generation factors of automobile and truck trips per population and employee. The trips were distributed using a simple gravity model and the average travel times between zones. The trip table required no further adjustment since it is adjusted during the ODME process.

### *Non-commodity Trucks*

ODME was run separately for autos and total trucks. The non-commodity trucks were calculated by subtraction of the commodity trucks that are discussed in the next section from the estimated total truck tables.

The FAF2 commodity truck flows do not include trucks handling retail or commercial deliveries, construction equipment or supplies, service trucks, utility trucks, etc. Those trucks are included in the ODME estimate of total trucks. By subtracting the commodity truck table from the ODME truck table a table of non-commodity trucks was created.

### *Forecasting*

Forecast automobile and non-commodity truck trip tables were created by calculating future trip ends using the 2020 and 2035 socioeconomic forecast for the medium- and high-growth scenarios and quick response generation factors of automobile and truck trips per population and employee. The ratio of base year and future year trip ends were applied in an iterative proportional fitting process to create future year automobile and non-commodity truck trip tables.

The commodity truck trip tables were developed by first creating commodity growth rates in trips using the forecast years of the FAF2 and applying these growth rates to individual commodity truck shipments.

The future automobile, non-commodity and commodity truck trip tables were assigned in the travel demand model to the No-build and Build highway net-

works. These assignments were used to create performance measures (e.g., travel times and costs) that were used in the economic analysis.

## 2.3 FREIGHT FLOWS

This section describes the results of the analysis that developed freight flow projections for the study area. These freight flows were then included in the travel demand model in order to analyze the impacts of interaction of automobile and freight truck travel as a result of the completion of the Appalachian Development Highway System (ADHS). This inclusion of freight flows within the travel demand model allows their impacts on total travel to be quantified and to identify the travel-time and reliability benefits that will accrue to freight trucks as a result of the completion of the ADHS.

The analysis was based on two existing sources of freight flow data: the ARC Commodity Flow database developed by Marshall University;[12] and the FHWA's Freight Analysis Framework 2.2 database.

### 2.3.1 Marshall University Commodity Flow Database

A database of 1998 county to county flows to, from, and within (but not through) the ARC has was developed by Marshall University data. This database was developed from the FHWA's Freight Analysis Framework1. Those flows are only for commodities moved by truck. The Marshall University database, which itself was developed from the FAF1 trip tables, uses a commodity classification system known as the Standard Classification of Transported Commodities (STCC).

#### *Truck Data*

The Marshall database includes separate files for originating and terminating traffic for each two-digit STCC. The first letter of the file indicates whether the freight flow is originating, O, or terminating, T; traffic and the last two digits contain the STCC. For example, OFIP_27 contains records for STCC No. 27 originating in ARC counties or TFIP_14 contains records for STCC No. 14 terminating in ARC counties.

OFIP files contain the following variables:

OFIP – The originating ARC county;

TST – The terminating state;

[12] Rahall Transportation Institute, Marshall University and Wilbur Smith Associates, *Report No. 4 in a Series of Transportation and Trade Studies of the Appalachian Region Meeting the Transportation Challenges of the 21st Century: Intermodal Opportunities in the Appalachian Region Economic Benefits of Intermodal Efficiencies*, Appalachian Regional Commission, December 2004.

STCC – Two-digit STCC;

SUMTON – Estimated annual tonnage; and

OSTRESS – A 0/1 variable denoting whether or not the originating is ARC county designated as distressed.

TFIP files contain the following variables:

TFIP – The terminating ARC county;

OST – The origin state;

STCC – Two-digit STCC;

SUMTON – Estimated annual tonnage; and

TSTRESS – A 0/1 variable denoting whether or not the originating is ARC county designated as distressed.

### 2.3.2 Freight Analysis Framework 2.2

Beginning in 1997, and in all subsequent Commodity Flow Surveys (CFS) prepared by the U.S. Census Bureau, a different commodity classification system, the Standard Classification of Transported Goods (SCTG), was used. The update to the Freight Analysis Framework, know as FAF2, developed by the FHWA which has a base year of 2002 and forecast years of 2010 through 2035 in five-year increments, also uses the SCTG.

The FAF2 database includes geographic data, as origins or destinations, for 114 regions in the United States. Each record contains the originating region, the destination region, the mode of transport, and the annual tonnage for 2002 and each forecast year. The ratio of the base year and forecast year tonnage for records using the truck mode can be sued to develop growth factors for those flows.

### 2.3.3 ARC Commodity Truck Database

A crosswalk table between the Marshall STCC commodity Codes, the FAF2 SCTG commodity codes, and the summary commodity codes was developed for use in this study. This table, shown as Table 2.1, was used to accumulate the commodity totals into 11 basic truck commodity flows.

Tables of freight flows in terms of tonnage were obtained from FAF2 for the 2002 base year and for the 2020 and 2035 forecast years. The FAF2 has 114 U.S. zones. An equivalency table of U.S. counties to FAF2 zones was created (see Figure 2.2). This table was used to disaggregate the FAF2 tonnage flows to ARC counties using the 1998 ratios of county to FAF2 zone totals from the Marshall database.

## Table 2.1 Commodity Code Equivalencies

| SCTG2 | FAF2 Abbreviation | STCC2 | FAF1 Name | ARC Name | ARC Commodity |
|---|---|---|---|---|---|
| 1 | Live Animals/Fish | 1 | Agriculture | Agriculture | 1 |
| 2 | Cereal Grains | 1 | Agriculture | Agriculture | 1 |
| 3 | Other Agricultural Products | 1 | Agriculture | Agriculture | 1 |
| 4 | Animal Feed | 20 | Food | Food and Tobacco | 2 |
| 5 | Meat/Seafood | 20 | Food | Food and Tobacco | 2 |
| 6 | Milled Grain Products | 20 | Food | Food and Tobacco | 2 |
| 7 | Other Foodstuffs | 20 | Food | Food and Tobacco | 2 |
| 8 | Alcoholic Beverages | 20 | Food | Food and Tobacco | 2 |
| 9 | Tobacco Products | 21 | Tobacco | Food and Tobacco | 2 |
| 14 | Metallic Ores | 10 | Metallic Ores | Mining | 3 |
| 15 | Coal | 11 | Coal | Mining | 3 |
| 10 | Building Stone | 14 | Nonmetallic Minerals | Mining | 3 |
| 11 | Natural Sands | 14 | Nonmetallic Minerals | Mining | 3 |
| 12 | Gravel | 14 | Nonmetallic Minerals | Mining | 3 |
| 13 | Nonmetallic Minerals | 14 | Nonmetallic Minerals | Mining | 3 |
| 16 | Crude Petroleum | 13 | Crude Petroleum | Petroleum and Chemicals | 4 |
| 20 | Basic Chemicals | 28 | Chemicals | Petroleum and Chemicals | 4 |
| 21 | Pharmaceuticals | 28 | Chemicals | Petroleum and Chemicals | 4 |
| 22 | Fertilizers | 28 | Chemicals | Petroleum and Chemicals | 4 |
| 23 | Chemical Products | 28 | Chemicals | Petroleum and Chemicals | 4 |
| 17 | Gasoline | 29 | Refined Petroleum | Petroleum and Chemicals | 4 |
| 18 | Fuel Oils | 29 | Refined Petroleum | Petroleum and Chemicals | 4 |
| 19 | Coal-n.e.c.[1] | 29 | Refined Petroleum | Petroleum and Chemicals | 4 |
| 24 | Plastics/Rubber | 30 | Rubber/Plastics | Other Durable Manufacturing | 5 |
| 31 | Nonmetal Mineral Products | 32 | Clay, Concrete, Glass | Other Durable Manufacturing | 5 |
| 32 | Base Metals | 33 | Metal | Other Durable Manufacturing | 5 |
| 33 | Articles-Base Metal | 34 | Metal Products | Other Durable Manufacturing | 5 |
| 34 | Machinery | 35 | Machinery | Other Durable Manufacturing | 5 |
| 38 | Precision Instruments | 38 | Instruments | Other Durable Manufacturing | 5 |
| 40 | Miscellaneous Manufacturing Products | 39 | Miscellaneous Manufacturing Products | Other Durable Manufacturing | 5 |
| 25 | Logs | 24 | Lumber | Wood and Paper | 6 |
| 26 | Wood Products | 24 | Lumber | Wood and Paper | 6 |
| 27 | Newsprint/Paper | 26 | Paper | Wood and Paper | 6 |
| 28 | Paper Articles | 26 | Paper | Wood and Paper | 6 |
| 29 | Printed Products | 27 | Printed Goods | Wood and Paper | 6 |
| 35 | Electronics | 36 | Electrical Equipment | Electrical Equipment | 7 |
| 36 | Motorized Vehicles | 37 | Transportation Equipment | Transportation Equipment | 8 |
| 37 | Transport Equipment | 37 | Transportation Equipment | Transportation Equipment | 8 |
| 30 | Textiles/Leather | 23 | Apparel | Other Nondurable Manufacturing. | 9 |
| 39 | Furniture | 25 | Furniture | Other Nondurable Manufacturing. | 9 |
| 41 | Waste/Scrap | 40 | Waste | Waste | 10 |
| 43 | Mixed Freight | 41 | Miscellaneous Freight Shipments | Miscellaneous Freight Shipments | 11 |
| 42 | Unknown | 0 | N/A | N/A | |

Figure 2.2 FAF2 Zones and ARC Region


As can be seen from the map, while some FAF2 zones are completely within the ARC region (e.g., Pittsburgh, Pennsylvania; West Virginia; Birmingham, Alabama; Greenville, South Carolina) most of the ARC counties are located in FAF2 zones that also include areas outside the ARC region. It was necessary to estimate the portion of the tonnages for these split zones that is originating or terminating in counties outside the ARC region in order to develop allocation ratios from the Marshall database. The 2002 FAF2 zonal totals, by ARC commodity, back to 1998, was scaled using information from the Marshall University databases for those zones wholly with the ARC regions to develop estimated 1998 tonnages for the portion of the FAF2 zone outside the ARC region. Allocation ratios were developed for ARC counties and the non-ARC portion were applied to the 2002 FAF2 data.

The ARC county to county tonnages were converted from annual tonnages by trucks to daily trucks. The annual to daily conversion was 306 working days (6 days per week for 52 weeks less 6 major holidays). The tonnage totals was converted to trucks using payload factors (tons per truck) developed from the Vehicle Inventory and Usage Survey database.

By allocating the FAF2 database of national truck flows, converted from annual tons to daily trucks, to counties in the ARC by using the Marshall database, trip tables of daily truck vehicle flows to, flow, within and through, the ARC region were created for each of the Commodity Groups listed in Table 2.2 was created. These tables of truck flows were integrated with the table of all truck flows described in the Section 2.1 Travel demand Model. The development of the travel demand model created trip tables of autos and trucks. The trucks included those that carry freight, according to the definition of the Freight Analysis Framework which is primarily long-distance shipments and those trucks that carry local movements of freight not included in the FAF database and trucks that travel for other purposes (for example service trucks, utility trucks, construction trucks). The freight truck trip tables were subtracted from the total truck table to create a table of non-freight trucks. The freight and non-freight trucks were used in to report the forecast volumes and performance measures used in the economic modeling.

Table 2.2 Truck Payload Factors
*Tons per Truck*

| ARC Commodity Code | ARC Name | Payload |
|---|---|---|
| 1 | Agriculture | 16.75 |
| 2 | Food and Tobacco | 14.62 |
| 3 | Mining | 19.92 |
| 4 | Petroleum and Chemicals | 17.45 |
| 5 | Other Durable Manufacturing | 15.47 |
| 6 | Wood and Paper | 16.04 |
| 7 | Electrical Equipment | 13.61 |
| 8 | Transportation Equipment | 11.95 |
| 9 | Other Nondurable Manufacturing | 11.77 |
| 10 | Waste | 15.03 |
| 11 | Miscellaneous Freight Shipments | 15.03 |

## 2.4 ECONOMIC AND DEMOGRAPHIC FORECAST

A key input to the travel demand network model is the economic forecast for the relevant region. A forecast of future employment and population is needed to determine the number of automobile and truck trips through the ARC region and was essential in developing future year trip tables. The four concepts used within the travel demand model were: total population, number of households, total employment, and retail employment.

Since the ARC region is a fairly large area covering multiple states, it is important to consider the potential economic forecast options available for use in the travel model. In the past, ARC has used the REMI model to obtain vast historical and future year economic data. These efforts have typically grouped the ARC counties into south, central and north subregions comprising the entire 410 counties. In the tables presented below, recent regional REMI forecast data is presented along with other forecast options. However, it was cost-prohibitive to obtain a REMI model with every ARC county individually, so additional county-level forecasts were required.

Other readily available regional and county-level forecast options include:

**Woods and Poole –** This commercially available data covers all counties, MSAs, and states in the United States and can be combined with regional forecasts to produce county-level differentiation in growth rates. The forecast methodology is not as sophisticated as other options, and often produces aggressive projections.

**Economy.com –** This Pennsylvania-based company provides economic forecasts that are commonly used by states and counties. Its cost is more than Woods and Poole but typically less than REMI or Global Insight.

**Global Insight –** Typically considered the national leader in economic forecasting, though similar to REMI the costs make it an unlikely choice for every ARC region county individually.

For this study, we compared Global Insight and REMI regional data, and Woods & Poole county-level data for all of the ARC region. The tables provided below are for three options:

1. **Woods & Poole (W&P) –** Aggregating Woods and Poole county-level data to the three ARC regions;
2. **REMI –** Using the existing REMI regional forecast as control totals, and adjusting W&P county-level forecasts to match those regional totals; and
3. **Global Insight –** Using the obtained Global Insight regional forecast as control totals, and adjusting W&P county-level forecasts to match those regional totals.

**Forecast Ranges and Sensitivity Testing.** As mentioned in the study objectives above, an important analytical goal was to develop the ability to test the implications of different forecasts. For example, a careful critic of the analysis might suggest that the transportation and economic benefits are dependent on the forecast and that a lower or higher forecast of growth and fewer trips would result in lower benefits. For this study, the Global Insight regional forecast totals were deemed the most reasonable and generally fall between the more conservative REMI forecast and the more aggressive W&P forecast. Therefore, the Global Insight forecast was used as the primary forecast for this study. In addition and to provide contrast, the W&P forecast was used as a "high" forecast scenario.[13]

These economic and demographic data forecasts are used to construct current and future year automobile and non-commodity truck trip tables. These were created by calculating future trip ends from the socioeconomic forecast year data for each county TAZ in the model and applying quick response trip generation factors. These future trip ends were applied in an Iterative Proportional Fitting process (IPF) to create future year trip tables for both the medium (Global Insight) and high (Woods & Poole) forecasts.

[13]The "low" forecast from REMI could have also been tested in the travel model but the research team decided that it was not necessary for two reasons. First, that forecast was out-of-date compared to the more current Global Insight and W&P forecasts. Second, the relationship between the Global Insight and W&P forecast results are proportionally similar in a downward direction if comparing REMI and Global Insight.

## Table 2.3 Alternative Demographic and Economic Forecasts

| Population | | | W&P | W&P | REMI | REMI | GlobIns | GlobIns |
|---|---|---|---|---|---|---|---|---|
| | | POP02 | POP20 | POP35 | POP20 | POP35 | POP20 | POP35 |
| Count | Central | 2,165,769 | 2,410,785 | 2,669,888 | 2,323,094 | 2,433,729 | 2,309,899 | 2,427,303 |
| | North | 10,077,276 | 10,466,602 | 11,025,625 | 10,599,617 | 11,418,720 | 10,092,273 | 9,833,318 |
| | South | 10,971,926 | 13,391,408 | 15,770,329 | 13,428,789 | 14,893,420 | 13,239,487 | 14,750,803 |
| | Total | 23,214,971 | 26,268,795 | 29,465,841 | 26,351,500 | 28,745,869 | 25,641,659 | 27,011,423 |
| Growth | Central | | 11.3% | 10.7% | 7.3% | 4.8% | 6.7% | 5.1% |
| | North | | 3.9% | 5.3% | 5.2% | 7.7% | 0.1% | -2.6% |
| | South | | 22.1% | 17.8% | 22.4% | 10.9% | 20.7% | 11.4% |
| | Total | | 13.2% | 12.2% | 13.5% | 9.1% | 10.5% | 5.3% |

| Households | | | W&P | W&P | REMI | REMI | GlobIns | GlobIns |
|---|---|---|---|---|---|---|---|---|
| | | HH02 | HH20 | HH35 | HH20 | HH35 | HH20 | HH35 |
| Count | Central | 865,705 | 999,905 | 1,083,904 | 928,591 | 972,814 | 970,466 | 1,030,465 |
| | North | 4,013,531 | 4,278,849 | 4,362,083 | 4,221,567 | 4,547,795 | 4,157,974 | 4,067,324 |
| | South | 4,299,382 | 5,374,975 | 6,130,505 | 5,261,419 | 5,834,652 | 5,391,069 | 6,023,310 |
| | Total | 9,178,618 | 10,653,729 | 11,576,492 | 10,411,576 | 11,355,262 | 10,519,509 | 11,121,098 |
| Growth | Central | | 15.5% | 8.4% | 7.3% | 4.8% | 12.1% | 6.2% |
| | North | | 6.6% | 1.9% | 5.2% | 7.7% | 3.6% | -2.2% |
| | South | | 25.0% | 14.1% | 22.4% | 10.9% | 25.4% | 11.7% |
| | Total | | 16.1% | 8.7% | 13.4% | 9.1% | 14.6% | 5.7% |

Table 2.3 Alternative Demographic and Economic Forecasts (continued)

| Total Employment | | | W&P | W&P | REMI | REMI | GlobIns | GlobIns |
|---|---|---|---|---|---|---|---|---|
| | | TOTEMP02 | TOTEMP20 | TOTEMP35 | TOTEMP20 | TOTEMP35 | TOTEMP20 | TOTEMP35 |
| Count | Central | 966,345 | 1,170,517 | 1,387,724 | 1,032,674 | 1,056,712 | 1,074,091 | 1,236,565 |
| | North | 5,316,258 | 6,200,182 | 7,168,746 | 5,748,103 | 6,078,130 | 5,823,792 | 6,374,838 |
| | South | 5,975,375 | 7,534,110 | 9,118,174 | 6,701,051 | 7,065,052 | 7,051,703 | 8,213,877 |
| | Total | 12,257,978 | 14,904,809 | 17,674,644 | 13,481,827 | 14,199,895 | 13,949,585 | 15,825,280 |
| Growth | Central | | 21.1% | 18.6% | 6.9% | 2.3% | 11.1% | 15.1% |
| | North | | 16.6% | 15.6% | 8.1% | 5.7% | 9.5% | 9.5% |
| | South | | 26.1% | 21.0% | 12.1% | 5.4% | 18.0% | 16.5% |
| | Total | | 21.6% | 18.6% | 10.0% | 5.3% | 13.8% | 13.4% |

| Retail Employment | | | W&P | W&P | REMI | REMI | GlobIns | GlobIns |
|---|---|---|---|---|---|---|---|---|
| | | RETEMP02 | RETEMP20 | RETEMP35 | RETEMP20 | RETEMP35 | RETEMP20 | RETEMP35 |
| Count | Central | 165,581 | 196,529 | 228,022 | 168,166 | 148,596 | 174,003 | 188,022 |
| | North | 947,835 | 1,076,318 | 1,210,660 | 934,222 | 832,948 | 935,319 | 955,421 |
| | South | 1,025,637 | 1,264,088 | 1,492,874 | 1,088,815 | 1,000,942 | 1,094,403 | 1,170,236 |
| | Total | 2,139,053 | 2,536,935 | 2,931,556 | 2,191,203 | 1,982,486 | 2,203,724 | 2,313,679 |
| Growth | Central | | 18.7% | 16.0% | 1.6% | -11.6% | 5.1% | 8.1% |
| | North | | 13.6% | 12.5% | -1.4% | -10.8% | -1.3% | 2.1% |
| | South | | 23.2% | 18.1% | 6.2% | -8.1% | 6.7% | 6.9% |
| | Total | | 18.6% | 15.6% | 2.4% | -9.5% | 3.0% | 5.0% |

## 2.5 ECONOMIC DEVELOPMENT IMPACTS

Following the results of the travel demand model described in the previous section, economic impacts to the ARC region were estimated using the Transportation Economic Development Impact System (TREDIS). TREDIS is a computational framework for estimating economic impacts to a well-defined geography following a change in transportation facilities and operating conditions. The overall modeling framework is separated into four "modules" that interact to produce results. Figure 2.3 shows the relationship between four key economic modeling components:

The analysis of transport cost savings and associated travel efficiencies;

The analysis of market access improvements and associated economic growth;

The allocation of the above two benefits among various sectors in the economy; and

The application of an economic model to estimate total impact of the above factors on future economic growth.

Figure 2.3 Components of Economic Impact

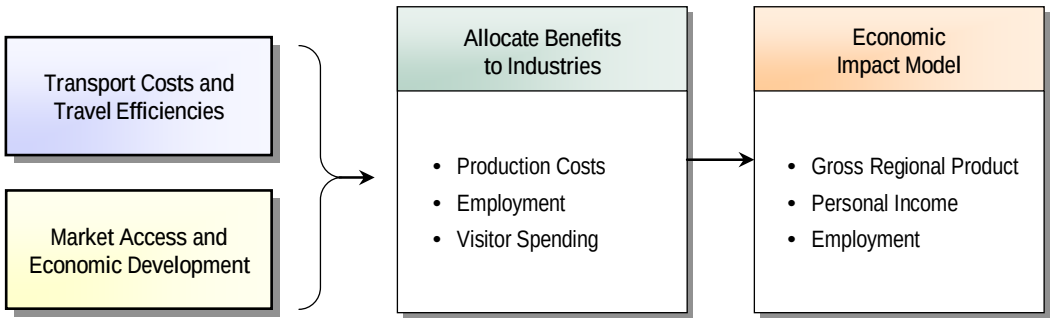
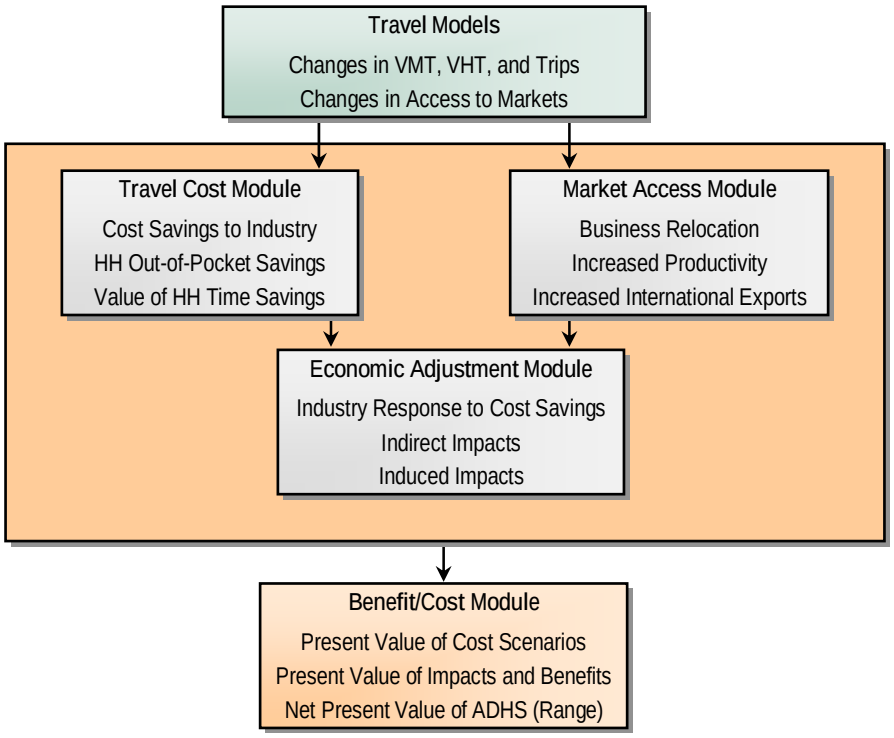



Figure 2.4 outlines the five steps in the economic impact analysis process:

1. A travel model and GIS system was applied to calculate changes in VMT (reflecting travel distance improvement) and VHT (reflecting speed improvement), as well as impacts on market access and connectivity improvements;
2. A travel-cost analysis was conducted to calculate the net value of the time and cost savings for businesses and households, based on forecasts of expected future trips;
3. A market access analysis was conducted to calculate how changes in access to population centers, delivery areas and access to intermodal terminals affect regional competitiveness and economic growth opportunities;

4. A regional economic model was applied to estimate the long-range economic impacts and adjustments expected to result from the regional business cost and regional access changes; and
5. A benefit/cost accounting process was applied to calculate benefits and impacts from alternative perspectives, and compare them to projected costs.

Figure 2.4 Economic Development Impact Modeling Approach




Results from Step 1 are covered in Section 4.0, the other steps are summarized in the rest of this section with results in Section 5.0. Appendix B offers a more detailed discussion of the economic analysis methodology with emphasis on market access.

### 2.5.1 Travel-Cost Response Module

The Travel-Cost Response Module translates travel demand characteristics for future scenarios into direct cost savings that accrue to households and businesses. The travel demand characteristics are derived from the travel model described above, and they include VMT, VHT, Trips, congestion levels, vehicle occupancy, and freight loads. These interact with values of time and operation costs of travel to determine direct dollar savings to households and firms. In addition, the module also estimates the benefits of improved travel-time reliability, as well as safety benefits. Industry benefits are further segmented among industrial sectors based on the region's commodity mix and each industry's utilization of different travel modes.

### 2.5.2 Market Access Response Module

The second module estimates benefits to the ARC region from improved transportation accessibility and connectivity. These impacts are distinct from those estimated by the Travel Cost Module in that they do not stem from changes in VMT or VHT. Rather, they reflect a more dynamic economic environment in the ARC Region. Because firms have better access to labor, inputs, and consumers, and because consumers have better access to goods, the region as a whole becomes more attractive place for business location. These changes further enable firms to sell more products abroad increase productivity. Results are estimated at the county level based on changes in the following five variables (see Appendix B for a more thorough description):

Access to population within 60 minutes;

Access to employment with 180 minutes;

Drive time to closest intermodal rail facility;

Drive time to closest commercial airport;

Drive time to closest marine port; and

Drive time to closest international land gateway.

The analysis of market access impacts on economic growth are estimated using the Local Economic Assessment Package (LEAP), an ARC-supported tool that is widely used by economic developers to assess regional competitiveness factors affecting future business attraction and economic growth opportunities. It has the unique feature that it distinguishes how changes in local access interact with other local characteristics of business cost and infrastructure quality to affect economic growth opportunities. It functions within the broader TREDIS framework that has been previously discussed.

Graphs describing the nature of local access changes associated with ADHS completion are shown in the Appendix. For each of the 410 ARC counties, these variables were estimated for build and no-build scenarios. Changes were used to estimate three types of impact: increased productivity, increased international exports, and growth through the relocation of productive factors.

**Productivity.** Transportation improvements have been linked to increased productivity by enabling economies of scale. Improved access can increase the industrial and labor force density in an area, which may in turn facilitate better labor force matching, enable businesses to share and build knowledge, and improve the quality of goods that firms depend on in production. These mechanisms can thereby increase the productivity of firms, raising output, value added, and wages per worker. For this type of impact, the first two access variables (to population within 60 minutes and to employment within 180 minutes) were used to estimate the change in effective density in labor, consumer, producer, and supplier markets. Impacts are based on the magnitude of those changes, characteristics of the county, and characteristics of other relevant nearby counties.

**International Exports.** Improved access to international gateways may enable firms to increase production by growing international exports. Empirical research has established functional relationships between access to international gateways (as measured by driving time) and the total amount of shipments to overseas locations on a port-specific basis. Based on this research, changes in drive time to an airport, marine port, or international land gateway (to Canada or Mexico) are used to estimate potential increased sales (output) in each county. Industry-specific impacts are estimated based on the county industry mix and utilization of freight modes by each industry.

**Relocation of Productive Factors.** Finally, changes in accessibility alter the relative profitability of location for businesses. By increasing access to consumers, producers, and intermodal facilities, firms may realize increased revenue potential or cost savings. For example, increased accessibility may expand the consumer-shed of a company, allowing it to increase sales, or firm may use the accessibility improvement to improve freight logistics (a process that is dependent upon, but distinct from direct travel savings). These changes in the economic landscape may induce firms to relocate to the more productive region. In practice, this relocation may be the result of physical firm migration, or firm expansion in one location at the expense of another (possibly coupled with sectoral decline). This type of impact is estimated by simulating the costs and sales for firms in different industries at various locations within and outside of the ARC region.

**Accounting for Interregional Effects.** The market access impacts described above reflect changes in international exports, increased business productivity, and the migration of industrial activity. However, because impacts are estimated at the county level, when aggregating the results to the broader study region (ARC), they must be integrated in such a way as to account for economic "reshuffling" to avoid double-counting impacts. Of the three types of impacts listed above, the first two are assumed to aggregate without double-counting. For the third impact type, net ARC impacts are estimated by subtracting interregional migration (inside the ARC region) from gross impacts. Any remaining (net) impacts, therefore, reflect migration of productive factors from outside the ARC region to within it. This is done following the same methodology described in the previous section, where inter-county migration is estimated for each pair of ARC counties (on an industry by industry basis). The final result is *net* market access impacts to the ARC region that do not double-count across counties (see Appendix for further description of methodology).

### 2.5.3 Economic Adjustment Module

The third module compiles the direct travel benefits and market access impacts described above, and then uses those results to estimate indirect and induced effects. Indirect effects reflect economic activity generated through regional business-to-business linkages through the supply chain. As an example, if the automobile manufacturing sector is forecast to grow in the ARC region, then businesses that supply materials and products to that sector also will benefit (as

well as their suppliers, etc.). To the extent that these "upstream" suppliers are located within the ARC region, it will gain additional benefit.

Induced impacts stem from increases in local consumer spending following a gain in personal income in the region. To follow the previous example, the automobile manufacturing sector also may increase total wage outlay. To the extent that the increase in wages is spent locally on goods and services, ARC gains an additional benefit. These "secondary" economic impacts were estimated by the Cost-Response Input-Output (CRIO) model, which uses recent research findings by Economic Development Research Group that show how various industries absorb costs, invest in their own growth, and/or pass on the costs to other industries. Then multipliers from a multiregional version of the IMPLAN® model are applied to calculate the indirect and induced impacts to the region.

## 2.6 BENEFIT/COST ANALYSIS

### 2.6.1 General Methodology for Comparing Costs and Benefits

As a final step, the Benefit/Cost accounting module was used to summarize the time streams of future impacts, benefits, and costs of transportation investment in the ARC region. This module gathers information from the first three modules and organizes them in terms of various economic impact and economic benefit measures. It then combines them with cost measures to develop net present values and benefit/cost ratios.

First, all impacts and benefits were estimated for the years 2020 and 2035 (the forecast years for travel modeling) and itemized by type: A) industry savings; B) out-of-pocket household savings; C) household time savings; D) market access impacts; and E) secondary economic (indirect and induced) growth. All benefit types were calculated separately for the ARC Region and for the Total U.S. For the first three (A through C) which comprise direct travel efficiency savings, the portion of benefits accruing to the ARC region was determined based on the number of local versus nonlocal trip ends. The last two (D and E) reflect additional sources of regional economic growth, and for those impacts it was assumed that all benefits to the ARC region related to the attraction of business activity will cancel out at the national level, leaving only productivity gains and increases in international exports.

Second, each type of impact or benefit was given a time path between forecast years and extending out to the year 2045 to facilitate analysis of the present value of future benefit and cost streams. These extended values were estimated on the basis of: 1) estimated growth rate in the underlying traffic volumes; 2) the planned program completion schedule; 3) empirical research on the timing of market access impacts (see below); and 4) research on the timing of indirect and induced impacts. The application of these phase-in schedules yields dollar levels for each impact type for all years in the analysis horizon.

In the third step, costs were estimated for each year between 2007 and 2045 based on two inflation scenarios. In the "low" inflation scenario, nominal price increases in the construction sector are assumed to parallel those of prices in general at 3 percent per year. In the second case, prices in the construction sector were assumed to increase faster than general inflation. This scenario assumes price increases of 10 percent per year between 2007 and 2010, and 4.5 percent thereafter. These rates follow from recent price trends in the construction sector.

In the fourth step, all values were converted to constant 2007 dollars, and a discount rate was applied to determine the present value of the benefit or cost stream. The discounting was performed for each of type of impact or benefit (A through E), for the high- and medium-growth scenarios, and for two cost inflation scenarios. In addition, calculations were made with two alternative real discount rates – 5 percent and 7 percent. The result of this step is a matrix of present values of impacts, benefits, and costs for all the scenarios.

Finally, impacts, benefits, and costs were compared to determine net present values (present value of benefits minus costs) and benefit/cost ratios. The analysis specifically calculated four types of comparisons:

Comparison of *regional travel efficiency benefits* to project costs – counting only benefits accruing to beneficiaries in the ARC region;

Comparison of *national travel efficiency benefits* to project costs – counting all travel benefits, including those accruing to beneficiaries outside of the ARC region;

Comparison of *total regional economic benefits* to project costs – counting net increases in economic growth projected for the ARC region regardless of whether they are due to economic productivity benefits or business relocation effects (in addition to personal non-business travel efficiency gains); and

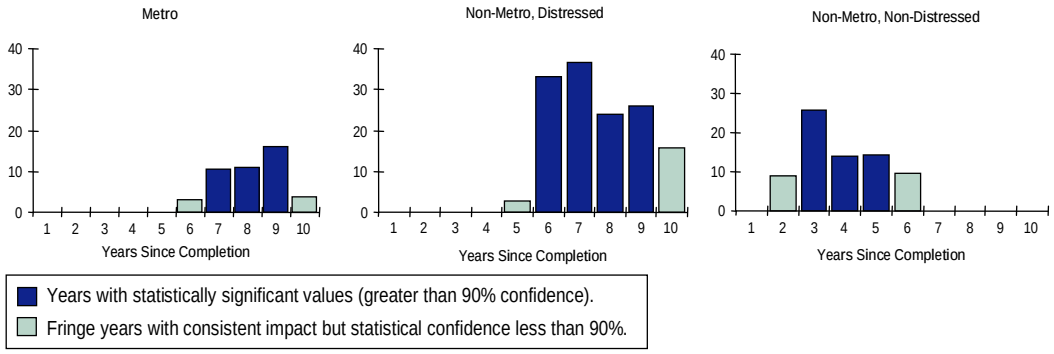
Comparison of *total national economic benefits* to project costs – counting only economic productivity benefits of improved market access and connectivity as an additional benefit to travel efficiency gains.

The first two comparisons represent benefit/cost analyses using traditional transportation efficiency concepts. The third comparison represents a mixed form of economic impact and benefit/cost analysis, but can here be considered an indicator of regional economic return on investment insofar as a primary goal of the ADHS is to promote of economic development in Appalachia. The fourth comparison effectively represents a more comprehensive economic benefit/cost analysis in which industry productivity benefits are added to the transportation efficiency benefits.

### 2.6.2 Estimation of Market Access Time Lag Effects on Economic Growth

To better support the analysis of economic growth impacts, a special analysis was done for this study to investigate the amount of time and size of impact that highway projects had in Appalachia from 1970 to 2000 (see Appendix B for further detail). This involved estimating the differences in effects based on ARC counties' level of distress and metropolitan status thus applying empirical findings of already completed ADHS corridors to help estimate future economic effects. The results, shown in Figure 2.5, show the number of years that a highway project took to affect a county's economic growth as well as the amount of impact that the project had on growth. The counties were assembled into three groups: *metro*; *non-metro – non-distressed*; and *non-metro – distressed*.

Figure 2.5 Years of Significant Impact Along with Fringe Years *Before and After Impact*




As seen in the charts, economic growth in non-metro and non-distressed counties was affected the earliest of the three groups, with primary impacts occurring in the first five years. Interestingly, metro counties (which showed no significant differences based on ARC's economic distress categories) took approximately the same time to react as non-metro distressed counties. Distressed counties took longer for economic growth impacts to be evident, with most impacts occurring in years 6 through 10. However, they ultimately showed a much larger impact when those impacts finally occurred.

The time lag results shown above were used to generate estimates of the economic growth impacts of improved market access over time. More specifically, market access impacts were phased in based on the anticipated project completion schedule and the timing of impacts based on the three categories of development.

# 3.0 Detailed Corridor Analysis Summaries

This section provides three detailed corridor analysis summaries undertaken during the course of this study to provide real world context to the economic impact analysis, and help guide and validate the economic development assessments of completing the ADHS. The three corridor analyses are:

Corridor T in New York which stretches 250 miles between I-90, just east of Erie, Pennsylvania to Binghamton, New York;

Corridor V in Northwest Mississippi – the full corridor travels from South Pittsburgh, Tennessee through Northern Alabama and into Northwest Mississippi; and

Corridor H in West Virginia and Virginia which is approximately 150 miles between I-79, near Weston, West Virginia to I-81 in Strasburg, Virginia.

The analysis of each corridor is part of a broader effort to assess the economic impact of the completion of the ADHS. Specifically, the purpose of each case study was to develop an understanding of the economic effects of an area in which highway corridor have either been largely completed, or partially completed with significant segments still to construct. The detailed corridor analyses assessed the transportation and economic development issues as communicated through a series of interviews with local stakeholders in May and June 2007.

# 3.1 CORRIDOR T (NEW YORK) ANALYSIS SUMMARY

## 3.1.1 Background

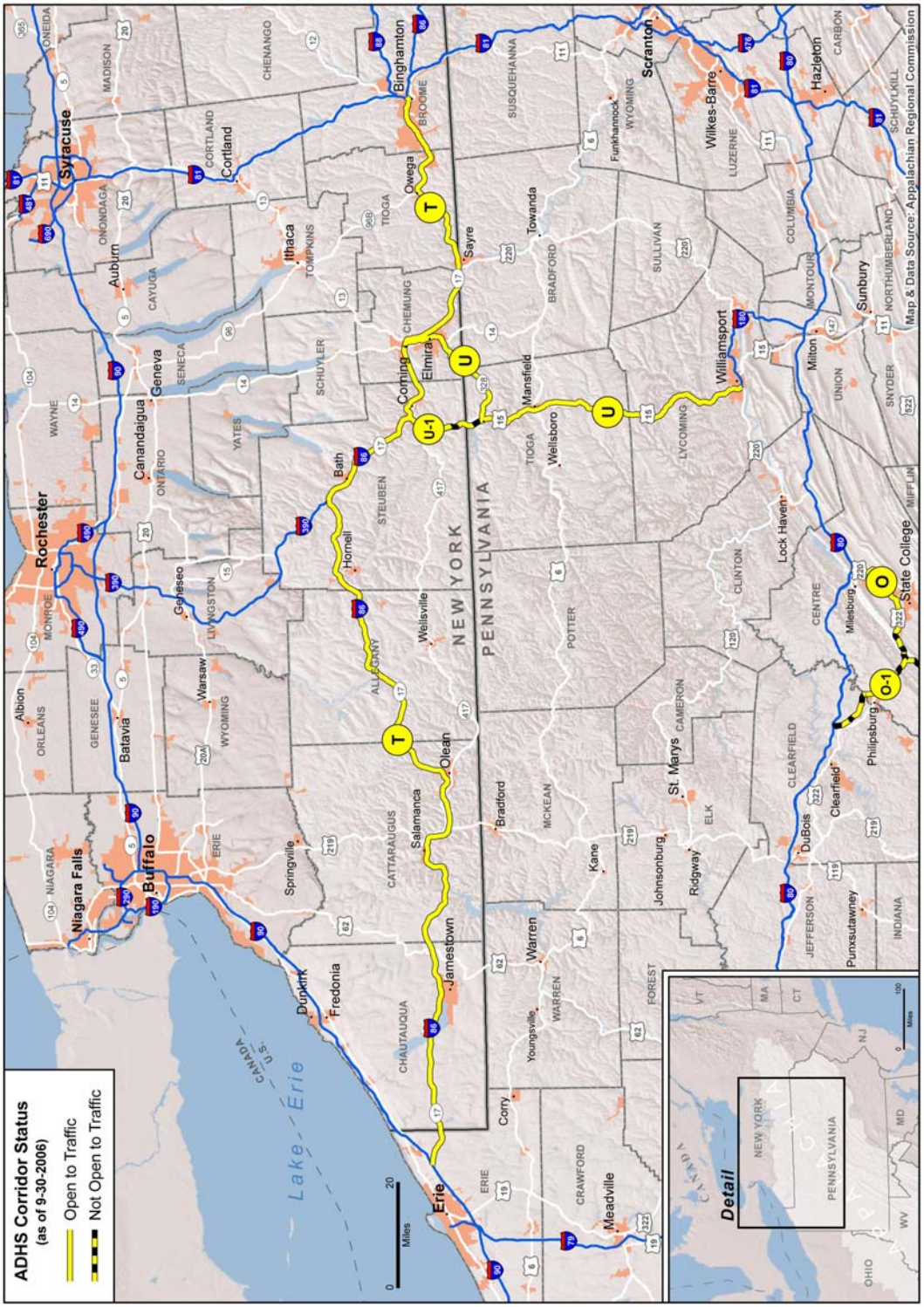
The Appalachian Development Highway System-designated "Corridor T" stretches 250 miles between I-90, just east of Erie, Pennsylvania to Binghamton, New York (see Figure 3.1). Much of this segment, also known as the "Southern Tier Expressway," has been upgraded from NY 17 to interstate status and is now designated as I-86. However, despite the change in designation, considerable portions of I-86 between Salamanca and Cuba, New York (32 miles) are still being constructed as of summer 2007, with only two lanes of traffic (one direction each way) in operation. These improvements, once completed (expected by October 2008), will provide trucks and other vehicles with close to a full interstate travel experience between Erie and Binghamton.[14] A major intersection in Horseheads, north of Elmira, opened in June 2007, and is expected to bring major improvements in travel performance to the area. Small parts of NY 17 east of Binghamton also have been upgraded to interstate standards (and designated I-86).

Longer term, improvements (mostly grade separation projects) to NY 17 between Binghamton and I-87 in eastern New York (Orange County), will develop I-86 into a 380-mile interstate between Erie and New York City's northern suburbs. With the possible exception of a handful of antiquated interchanges (grade separated, but not conforming to interstate standards), I-86 is expected to be completed by 2014. In addition to the upgrades already taking place on Corridor T, these downstream improvements will go a long way toward improving access to the New York City region and lower New England from Upstate New York.

The economic impacts analyzed in this case study focus on the upgrade of NY 17 to I-86 between Chautauqua County in the west and Broome County in the east. The study area also includes Cattaraugus, Allegany, Steuben, Chemung, and Tioga Counties. Together, these counties comprise an area known as the "Southern Tier." Although the majority of the highway improvements are complete, it must be kept in mind that the full potential of Corridor T cannot be appraised completely until construction on several segments is completed.

[14] NY 17 between Elmira and Binghamton (55 miles) is mostly a four-lane, grade-separated highway. A small number of improvements are being planned to address curb cuts and substandard geometries that prevent the road from fully complying with interstate design standards.

## Figure 3.1 Corridor T in New York and Pennsylvania



### 3.1.2 Current Economic Transportation Conditions

The Southern Tier maintains economic assets in its skilled workforce, advanced technological capabilities, scenic landscape, fertile land, and a location between the Northeastern Megalopolis, stretching from Boston to Washington, D.C., and the Midwest industrial heartland. Despite these strengths, the Southern Tier has confronted economic headwinds for years, at least in part due to its long-term reliance on manufacturing. As manufacturers have shifted production from the Northeast and Midwest to lower cost locations, the Southern Tier has seen jobs leave and a prolonged out-migration of its population to regions possessing stronger employment growth. Today, with the combined strengths of the Southern Tier's technological base, centered on the advanced skill sets of its people and the cutting edge research taking place at its corporations and universities, the Southern Tier is now showing more economic resilience and is better situated for growth in the future. The recently completed and nearly completed improvements to the region's transportation infrastructure – namely the conversion of NY 17 into I 86 – is paramount to supporting the area's economic revitalization. The added ability to connect efficiently to large markets, both in terms of the movement of goods and the movement of people, is bringing renewed economic optimism to the Southern Tier. For example, regional leaders are promoting the region as a crossroads, well-connected economy, highlighting connections to I-81 and large surrounding markets.

The Southern Tier continues to have a significant manufacturing presence, with major producers of truck engines, furniture, helicopters, subway cars, glass, ceramics, avionics, electronics, dairy products, and fabricated metals. After years of job losses in manufacturing, many of the region's larger employers have recently made major investments in the region to accommodate expansion and to increase research and development activity. Corning, the largest company headquartered in the Southern Tier, saw job losses earlier this decade but has used innovation to develop a new stream of products that have succeeded in keeping the company at the forefront of the advanced materials technologies used in electronics, telecommunications, motor vehicles, and medical equipment. Recent expansions on the Southern Tier have been launched by large employers, including Cummins Engine, Corning, Alcas, Alstom, TTA, Lockheed-Martin, and BAE Systems (see Table 3.1 for size and industry information for these companies). The expansions by existing large employers have been complemented by companies, such as Sikorsky (helicopters), Vulcraft (structural steel), Best Buy (distribution) and Shop-Vac (industrial vacuums), choosing the Southern Tier for relocation.

Table 3.1 Major Employers in the Southern Tier

| County | Company | Industry | Number of Employees |
|---|---|---|---|
| Chautauqua | Cummins Engine | Truck Engines | 1,100 |
| Chautauqua | Bush Industries | Furniture | 1,000 |
| Chautauqua | Valeo Engine Cooling | Truck Parts | 300 |
| Cattaraugus | Dresser Rand | Turbines, Compressors | 2,200 |
| Cattaraugus | Seneca Allegany Casino | Casino | 1,200 |
| Cattaraugus | Alcas | Cutlery | 1,000 |
| Allegany | ABB Air Preheater | Air Heaters/Oxidizers | 620 |
| Steuben | Corning, Inc. | Advanced Materials | 4,800 |
| Steuben | Dresser Rand | Oil Field Equipment | 875 |
| Steuben | Hon Furniture | Office Furniture | 850 |
| Steuben | Alstom | Subway Trains | 1,275 |
| Steuben | Mercury Aircraft | Metalwork, Pellet Stoves | 800 |
| Steuben | TTA | Subway Trains | 1,000 |
| Tioga | Lockheed-Martin | Aircraft and Avionics | 4,250 |
| Broome | BAE Systems | Aircraft Control Systems | 1,250 |
| Broome | Endicott Interconnect | Electronics | 1,900 |
| Broome | Maines Paper and Food | Food Distribution | 1,500 |

Source: Information obtained through interviews with regional and local economic development officials.

## *Competitive Advantages of the Corridor Region*

The Southern Tier combines quality of life attributes (lakes, waterways, culture, natural attractions) with historically strong school systems and a productive workforce. More than a century of manufacturing expertise has helped provide a strong work ethic and gives the region a range of skills needed by industry. While the labor force is highly skilled, it is lower cost compared with larger metropolitan areas. The region is advantageously positioned to access the Northeast, the industrial Midwest, and Ontario, the center of Canadian economic activity. The Southern Tier's location is particularly advantageous for the manufacturing, tourism, and distribution industries.

The Southern Tier also possesses world-class research in several high-technology fields, including ceramics and electronics, supported by corporations such as Corning, Inc., Lockheed-Martin, and Endicott Interconnect. Major universities, including Binghamton University (SUNY) and nearby Cornell University, also lead in innovation and supply the region with specialized skills, particularly in electronics and engineering. Several other institutions lining the Southern Corridor, including Jamestown Community College, Alfred University, and St. Bonaventure University also provide the region with skilled workers and advanced research capabilities (e.g., Alfred University in ceramics).

### *Competitive Disadvantages/Obstacles of the Corridor Region*

Although the conversion of NY 17 to I-86 has helped improve mobility and the visibility of the Southern Tier, other transportation enhancements are needed to more fully leverage the interstate improvements. These include improved north-south highways, such as NY 60 and U.S. 219 to better reach I-90 and the Buffalo region, notably its airport. Air service is poor in the Southern Tier (low frequency and high fares at commercial airports in Jamestown, Elmira, and Binghamton), making access to larger airports such as Buffalo-Niagara all the more important. Numerous major companies as well as colleges and universities located on the I-86 Corridor have expressed a need for improved access to major airports to support their operations.

There also is a need to invest in the Southern Tier's infrastructure capacity, including cost-competitive local water and wastewater systems, natural gas and electric service, and broadband telecommunications. Numerous intersections on I-86 are not prepared to accommodate growth and the villages farther from the interstate often lack adequate infrastructure to compete. Prospective companies are looking for "shovel-ready" sites at intersections, but relatively few have infrastructure put in place. The region, in many instances, needs to develop plans to more fully capitalize on the I-86 improvements, including coordinated transportation planning with other modes (e.g., rail and intermodal), land use planning combined with infrastructure improvements to direct growth, and economic development packages to secure business investment.

The slow pace of population growth in the Southern Tier also is a concern. The primary contributor to the slow population growth is domestic out-migration – people leaving the region for other parts of the United States. This outflow has coincided with the long-term decline in manufacturing jobs and has pushed thousands of people to seek opportunities in faster-growing parts of the United States. In coming years, the lack of growth combined with an aging population raises concerns about the availability of a working age population – people that can supply businesses in the region with needed labor.

High taxes (property and income), high energy costs, and other expenses (unemployment insurance and workers compensation) in the State of New York make it more challenging for the Southern Tier to compete with Pennsylvania (and other locations) on the basis of cost, especially in attracting manufacturers. Economic incentives, including Empire State Development's "Empire Zone" program has proved instrumental to help counteract New York's high costs of doing business by providing tax breaks. Major companies in the Southern Tier have been beneficiaries of this program and have brought additional jobs into the region. This includes BAE Systems, which plans to consolidate a portion of its California operations in the Binghamton area. Until New York State's onerous structural costs (taxes and energy) are brought down to levels similar to competitor states, it will be important for these incentives to be maintained, particularly as the Southern Tier competes with other locations to attract and retain manufacturers.

### 3.1.3 Economic Impact of Corridor

#### *Industry Opportunities*

**Tourism.** The completion of I-86 will provide a new east-west corridor and travel alternative to I-90 and I-80. The increase in through-traffic can be tapped into as a tourism market and I-86 could be marketed (signage, marketing materials, information centers, travel plazas, etc.) as a corridor, similar to initiatives already in place for the New York Thruway (I-90). The increase in the end-to-end usage of I-86 is expected to spur travel to area attractions such as Chautauqua Institution (160,000 visitors per year), Peek'n Peak (400,000), Allegany State Park (1 million), Seneca Casino (over 1 million), the Holiday Valley/Ski areas (1.2 million), Corning Glass Museum (350,000), Finger Lake wineries and cultural attractions (e.g., Dr. Frank's Vinifera Wine Cellars in Hammondsport, one of 94 wineries in the Finger Lakes Region, has about 60,000 visitors annually) and Tioga Downs (opened mid-2006).

**Manufacturing.** The completion of I-86 allows for the development of industrial corridors in the Southern Tier. These include a ceramics/advanced materials corridor, going from Alfred to Corning, rail equipment and diesel engines from Jamestown to Elmira, and an aerospace corridor from Elmira to Binghamton. The aerospace cluster includes helicopter manufacturing in Owego and Elmira and simulators and avionics (aircraft control equipment) in Binghamton. Recently, the Lockheed Martin facility in Owego was awarded with a contract to build the presidential (U.S.) helicopter fleet. In order to improve production efficiencies for helicopters, Lockheed and other aerospace-related companies are seeking to source more products, such as precision machinery and fabricated metals, locally. Improvements on I-86/NY 17 are helping to support the growth of an aerospace cluster in the region as it allows for supplies to be shipped and delivered more quickly and with greater reliability.

#### *Facilitating Trade and Market Access*

**Tourism and Community Development.** The emergence of I-86 has helped to boost tourism in Western and Central New York. Visitors seek security and reliability when they travel and will choose to use interstates when possible. People prefer to drive on I-86 over state highways, and this has helped the resort areas in New York (e.g., Peek'n Peak, Lake Chautauqua, and the Finger Lakes). Additionally, I-86 has tied the Southern Tier together as a tourism region, allowing visitors to easily reach the diverse range of attractions, including lakes, waterways, viniculture, performing arts, and nature that stretch along the corridor.

As an example, the old NY 17 (now NY 352) in the Town of Corning, went through a densely settled downtown area, and was a choke-point for trucks and a blight for tourism-related traffic – conditions that fostered neither manufacturing nor tourism. Aware of imminent improvements to I-86 that would ease the flow of truck traffic by shifting them from downtown to the interstate, companies such as Corning Inc. have chosen to invest more intensively in towns like Corning and the

Southern Tier region. For Corning, this has included new plants and a $50 million expansion to its glass museum, a major tourist draw. Coinciding with the development of I-86, the Town of Corning initiated substantial public-private investments to improve its downtown commercial core, turning it into an area that attracts workers, residents, and tourists. The attractive downtown helps to attract a new generation of workers that is much more attuned to the livability of a community. These types of highly educated workers choose where they want to live and Corning's downtown helps attract them to the region. These efforts, crucial to the vitality of the Southern Tier's technologically advanced companies, would not have succeeded and investments would not have been made without the relocating of NY 17 to I-86 and the removal of trucks from the downtown streets.

**Manufacturing.** The development of I-86 is considered a crucial factor behind the expansion of several major manufacturers along New York's Southern Tier. Cummins, a world-leading manufacturer of diesel engines, is expanding again after consolidating a division of its manufacturing operations at its Chautauqua County facility several years ago. Cummins is supplied entirely by truck (150 per day) and has a global supply chain. I-86 provides Cummins with a direct interstate link to Midwestern suppliers and the company's expansion in Chautauqua County would not have been as likely without the interstate improvements. Interstate access also was pivotal to Bush Industries, also in Chautauqua County, which returned furniture manufacturing jobs to the Southern Tier.

Corning Incorporated, a company focused on the research and production of advanced materials found in telecommunications and other uses, has invested $100 million to manufacture state-of-the-art diesel exhaust treatment systems in Erwin, and has made additional investments in robotics. The company is research intensive and is undergoing a $300 million expansion of its research facilities, a project that will bring an additional 300 scientists into the region. These new and expanded facilities are located in industrial parks on I-86 in the Corning-Elmira area.

Economic development officials believe these and other manufacturing investments would not have occurred without the I-86 upgrades. In fact, I-86's effect on the retention of manufacturing jobs was a main theme reiterated by Southern Tier economic development officials. Without I-86, it was believed that 25 to 40 percent of the large manufacturers in the region would have been lost and the potential for growth would have been effectively eliminated. The older roads in the Southern Tier are not reliable for shipping or receiving goods and do not work well for "just-in-time" (JIT) logistics strategies. I-86 now provides the roadway infrastructure and connectivity needed to compete in the United States and global economies.

Throughout the Southern Tier, numerous business expansions across a wide range of industries were fostered by proximity to I-86, including: tobacco, wood pallets, potato processing, robotics, ceramics, and artificial joints.

**Distribution and Logistics.** Corridor T's location between major Eastern and Midwestern markets has helped grow and attract several of the largest distribution companies in the United States, as well as the logistics operations of some the country's best-known retailers. This includes the distribution of food products along the entire Eastern Seaboard and consumer electronics for the Northeast. Several of these companies have made very large investments in Southern Tier locations in recent years, underlining their commitment to remain in/expand within the region in the future. I-81, I-88, and NY 17/I-86 provide the Southern Tier with excellent access to major markets throughout the Northeast Corridor, the eastern part of the Midwest, and points south. I-86 is developing into a more viable east-west alternative, allowing truckers to save on I-90 tolls, a further enhancement for distributors operating from locations in the Southern Tier.

Ohio Logistics has recognized the advantages of the region and has located a distribution center in Painted Post, and is anticipating future growth with the completion of the I-86 improvements as well as the conversion of U.S. 15 to I-99, providing it with north-south interstate access, as well as east-west.

On the western segment of Corridor T, Kaman Industrial Technologies, a distributor of bearings, power transmission, electrical, fluid power, and motion control products, opened a new branch location in Olean. The company plans to serve both regional and national manufacturers from the location. Improvements to U.S. 219 and better access to the Buffalo market will help southwestern New York become more competitive as a distribution location.

The completion of improvements to NY 17 east of Binghamton as part of the NY 17 upgrade to interstate standards will further improve access to the New York City area and Southern New England while the conversion of U.S. 15 to I-99 in Pennsylvania will provide a new north-south route that will further enhance accessibility for the Southern Tier. Additionally, new interstates will add visibility to the region, making it more likely that other distributors will consider sites in the Southern Tier as prospective locations for expansion.

### *Connecting People to Jobs, Tourist Attractions, and Services*

I-86 has improved connectivity to markets (labor force, suppliers) and business and non-business destinations outside the region. It also has improved commuting and other business travel within the region, benefiting businesses operating within the area. Improved mobility in the western part of the Southern Tier has helped attract delivery companies (e.g., FedEx), providing parcel delivery services that are crucial (and expected by businesses) to compete both domestically and worldwide.

Health services have become more accessible and major new healthcare facilities on the 285-mile corridor are being built on sites immediately adjacent to the interstate (e.g., in Steuben County). In a similar fashion, new libraries, also in Steuben County are being built on sites next to the I-86 corridor.

Educational institutions, likely due to improved access by students and teachers, are selecting locations adjacent to I-86 for expansions. Jamestown Community College's Olean branch recently expanded to a site near the highway and future plans call for another satellite campus close to I-86 in Belvidere.

I-86 serves two major tourist districts, the Lake Chautauqua/Allegany State Park area in Southwestern New York and the Finger Lakes region in Central New York – both popular for visitors and second homes. Lake Chautauqua, and its venerable Chautauqua Institution, has been a popular destination for well over a century. I-86 aids access to the institution from the Cleveland area, as well as from Central New York. The improved highway also has been a factor spurring a $280 million investment at Peek'n Peak to convert the facility into a high-end year-round resort, combining ski, golf (including a PGA tour quality course), spas, new hotels, and a conference center. Nearby, the Village of Sherman, also on I-86, has received a grant to improve its Western-appearing downtown as a tourist draw, and the town of Mayville on the north shore of Lake Chautauqua has experienced a sharp increase in tourism-related development.

New hotels and restaurants are being built throughout the I-86 Corridor, both to accommodate tourists and increased through-traffic. A well-placed rest stop on I-86 with a view of Lake Chautauqua has become a popular spot for drivers, attracting 220,000 vehicles in 2006. Many of these people are headed for the Seneca Casino in Salamanca, and tourist information has helped raise the awareness of the region as a place to visit beyond the casino. Directly on I-86 frontage in Salamanca, the Seneca Casino has emerged as a leading tourist draw in Southwest New York. Cleveland is a key market for the region and I-86 is considered a lifeblood. In Central New York, the Finger Lakes Region is experiencing rapid growth as a tourist destination and I-86 is a key route for reaching the area from Cleveland, Philadelphia, Pittsburgh, and New York City – cities targeted by Finger Lakes' marketing efforts.

### *Overall Economic Development Impacts*

The I-86 improvements help the region's employers by expanding the labor market. People can cover longer distances in less time and with greater reliability (less congestion, fewer unanticipated delays, and better snow removal) on I-86 than on state and local roadways. For large manufacturers, the ability to draw on a bigger, more diverse labor pool is an important competitive factor that helps to keep them in the Southern Tier. For example, I-86 has enabled Olean employers to attract workers from as far away as Hornell, helping to meet labor needs.

Distribution and logistics companies have recognized the advantages of locating on I-86 and further expansions are expected as I-86 and I-99 are completed, giving the Southern Tier an east-west and north-south interconnection. The completion of I-86 will improve access to Boston and New York, while I-99 in conjunction with I-390 and I-81 will provide interstate connections from the Southern Tier to Washington, Baltimore, the U.S. South, and the large Canadian markets. This future east-west and north-south interconnection already is being

marketed by Southern Tier economic development agencies even though I-99 will not be completed until 2010 or 2011.

Manufacturing companies, as previously discussed, also have been drawn to the I-86 corridor and more are expected as the interstate is completed. Industrial parks, such as the Airport Corporate Park in Elmira, offering access to both I-86 and Elmira-Corning Regional Airport, are helping to attract a more diverse manufacturing base (e.g., aircraft, steel, and pharmaceuticals) to the Southern Tier region. In Elmira, both Sikorsky, a manufacturer of helicopters, and Vulcraft, a maker of steel joists, required proximity to an interstate as a condition for expansion. Investments such as these are expected to not only bring economic growth to the region but also will help the Southern Tier weather economic downturns.

Jamestown, New York economic development officials describe I-86 as a boon to their area and pivotal for retaining its manufacturing jobs and manufacturing suppliers. Looking into the future, the city plans to redevelop it riverfront area into a major recreational attraction that would attract thousands of people on a yearly basis. The details of the project are being developed but it is clear that the prospects for such a proposal would be greatly reduced without the improved access that I-86 provides the city.

### 3.1.4 Other Issues and Stakeholder Comments

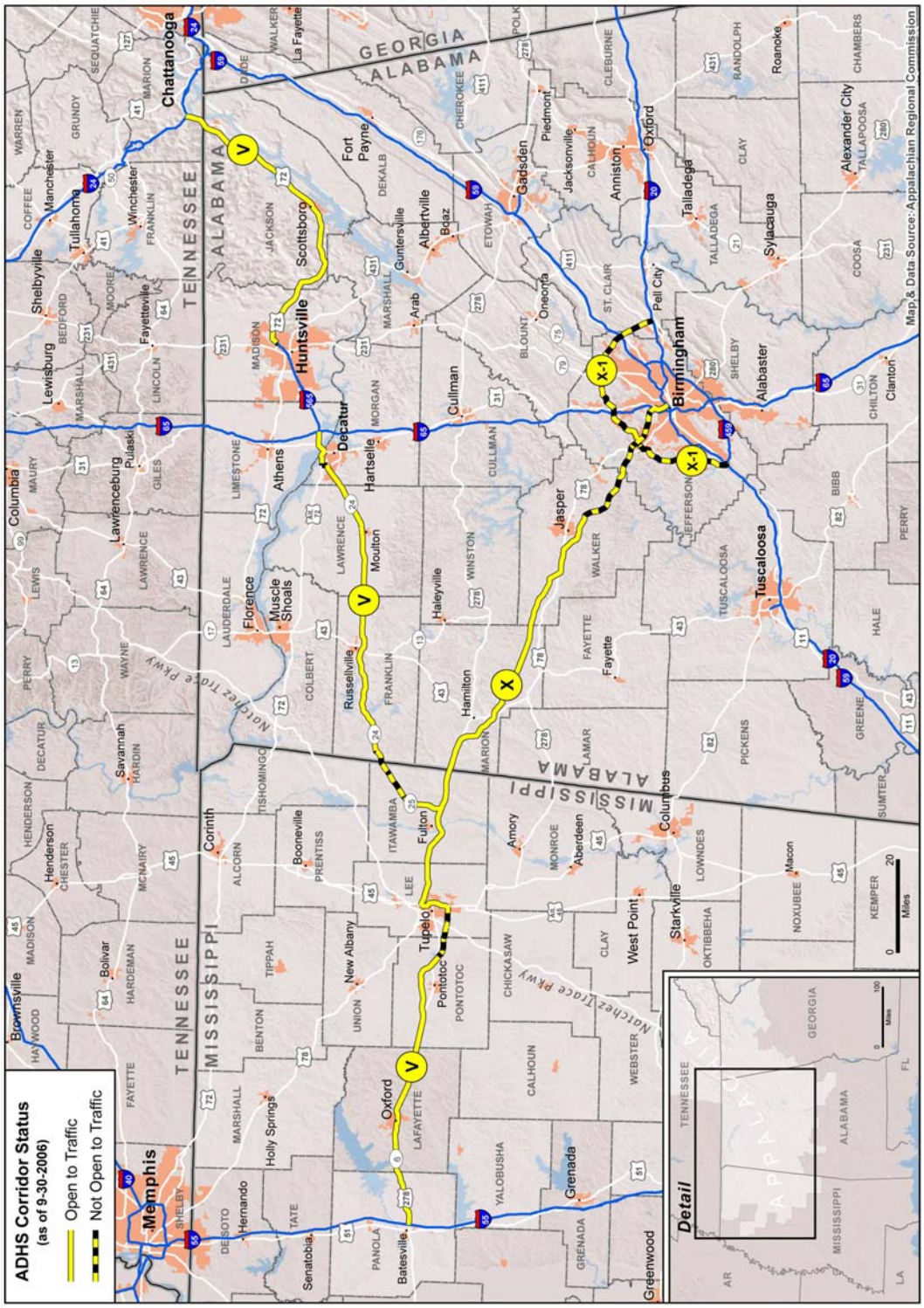
The towns and attractions nearby I-86 are trying to attract people from the highway, and are dependent on highway signage for marketing, but much of the through traffic is not aware of the recreational opportunities in the region. Through traffic on I-86 represents the most cost-effective way to market to potential visitors and higher traffic levels translate to more tourism dollars. However, it has proven very difficult and expensive to add signage to I-86. The area needs more signs showing how to obtain information (800-CALLNYS) and logo signs at exits pointing to area attractions and services. The logo signs are very expensive ($10,000 or more per year) and the process to post a sign is slow.

## 3.2 CORRIDOR V (MISSISSIPPI) ANALYSIS SUMMARY

### 3.2.1 Background

Appalachian Corridor V stretches from South Pittsburgh, Tennessee through Northern Alabama and into Northwest Mississippi (see Figure 3.2). The area that was the focus for this case study, however, is the segment between Tupelo and Pontotoc, Mississippi. The upgrade of this part of the corridor from a rural two-lane road to a separated four-lane highway would provide a four-lane connection between I-55 to the west and U.S. 45 to the east. The current upgrade plan has the four-lane highway divert from the old path of Route 6 and connect to U.S. 45 Southwest of Tupelo.

## Figure 3.2 Corridor V in Mississippi, Alabama, and Tennessee



Much of the economic development in the region was due to the partial completion of Corridor V according to local experts and stakeholders. The completion of the remaining 8.5 miles of this corridor segment is likely to spawn a renewed development effort in Lee and surrounding counties especially in light of the close proximity to Corridor X and the recent decision of the Toyota Corporation to locate a major manufacturing facility just North of Tupelo.

### 3.2.2 Current Economic and Transportation Conditions

The corridor expansion falls primarily within Lee and Pontotoc Counties in Northern Mississippi. Both of these counties have traditionally lagged behind overall growth in the U.S. economy but have seen improved economic conditions in recent years. As of April 2007, the unemployment rates in Lee and Pontotoc County were 5.8 and 6.1 percent, respectively. These rates were the lowest among the eight neighboring counties in Northeast Mississippi but still nearly two percentage points higher than the national average of 4.3 percent in the same month. Census data from 2000 indicate median household incomes of $32,055 and $36,165 in Pontotoc and Lee County, respectively, which was significantly below the average of $41,994 for the entire United States in the same year. Population in Lee County grew from 65,575 in 1990 to 75,755 in 2000 according to Census data.

Lee County (and Tupelo, in particular) has established itself as the retail trade magnet for the surrounding counties. As of March 2007, total retail sales receipts in Lee County amounted to $1.3 billion. A large regional mall is located north of the city and provides shopping opportunities for residents in nearby towns and counties. Access from the south is somewhat more difficult because of increased congestion on local roads.

The completion of Corridor X in Northern Mississippi and Alabama has made transportation easier and allowed for improved connectivity in the area. The corridor connects with U.S. 78 and combined will be renamed I-22 once all interstate requirements have been met. The new I-22 will further provide connectivity to Memphis and other Southern states, also providing direct benefits to Lee and Pontotoc Counties. However, one key area of concern for the area is the lack of connectivity between what will become I-22 and Corridor V. Route 15 which runs north-south from Pontotoc to North Albany is significantly congested during peak periods. One of the reasons is the location of the largest furniture manufacturer along this route. Safety is an additional concern according to local stakeholders due to the existence of several schools along the same route. Route 9 connecting with the future I-22 at Blue Springs, the site of the future Toyota plant, also is suffering from increasing congestion. According to local stakeholders, these two routes and their respective levels of traffic provide significant transportation problems for the region.

### *Major Employers and Trends*

The case study area is traditionally known for its furniture manufacturing. Roughly one-third of total employment in Lee County is a result of manufacturing employment. As of January 2007, Lane Furniture Industries was the second largest employer in the region with 2,850 employees. Only the North Mississippi Medical Center located in Tupelo was a larger employer with 4,286 positions as shown in Table 3.2.

**Table 3.2 Major Employers in Lee County**

| Companies | Number of Employees |
|---|---|
| North MS Medical Center | 4,286 |
| Lane Furniture Industries | 2,850 |
| Cooper Tire and Rubber | 1,550 |
| Tupelo Public Schools District | 1,200 |
| JESCO, Inc. | 1,000 |
| Wal-Mart, Sam's | 979 |
| MTD Products | 950 |
| Bancorp South | 800 |
| Lee County Schools | 751 |
| Super Sagless Corporation | 720 |
| Day-Brite Capri Omega | 700 |
| Tecumseh Products Company | 670 |
| HM Richards, Inc. | 620 |
| City of Tupelo | 575 |
| Berkline Corporation | 400 |
| Hancock Fabrics | 400 |
| Renasant Bank | 390 |
| Lee County | 339 |
| Alan Whit Furniture Company | 300 |

Source: Community Development Foundation, Executive Profile, January 2007.

Furniture manufacturing, however, has gone through challenging times in recent years. Since 1994, one-third of all manufacturing jobs in this sector have been lost. Due to increased competition from China and other Southeast Asian countries, local companies had to lay off workers and generally downsize operations. Comprehensive furniture manufacturing has been replaced with assembly of products and production of higher value items. The shipping and importing of assembled furniture items is difficult because of their size. Hence, local firms have increasingly adopted the approach of importing segments and then assem-

bling items themselves. This is one of the reasons why the loss of jobs in this industry has been halted in recent years. In addition, consumers in the United States demand relatively short delivery times. The average currently is about 18 days after the receipt of the order according to local economic development and business experts. Production and shipment from competitors in China takes more time and, therefore, provides an advantage for local firms.

The main recent development shaping the economic profile of the region is the decision of the Toyota Corporation to locate a major assembly plant just north of Tupelo. Current estimates are that the first car may be produced in mid-summer 2009. The development of the plant is being completed in two phases. Phase 1 includes a total capital investment of $1.3 billion and will create 2,000 plant-based and another 2,000 supplier jobs. Phase 2 is still being developed but current estimates are that the completion of this phase will likely double the Phase 1 investment and employment estimates.

Toyota will be manufacturing Highlander Sport Utility Vehicles at this site. This is the first time that Highlanders will be built in the United States and, therefore, it will require a new network of parts suppliers, ideally located in or near the region. Local economic development experts further estimate that in addition to the direct jobs, up to three jobs per one direct job will be created through indirect and induced multiplier effects. The siting of the Toyota plant is, therefore, a significant economic development change for the region with potentially very beneficial short- and long-term consequences.

### *Competitive Advantages of the Corridor Region*

The Corridor region can be characterized by having several distinct advantages that may further facilitate economic development. Generally, the area has good school systems, including K-12 as well as higher education. Specifically, the University of Mississippi located in Oxford on Corridor V provides a large pool of graduates on an annual basis. In addition, the area also has several community colleges which allow students to obtain two-year associate degrees or more vocational education. This makes for a relatively skilled workforce and consequently an attractive pool of workers for current or future employers.

In addition, most companies in the study are non-unionized resulting in more competitive wage levels. These lower payroll costs combined with what has been perceived as high productivity due to good work ethic also are very attractive for employers.

The location of the corridor also may be advantageous to economic development. In addition to local factors, freight traffic is routed through the area via rail and the overall volume of rail and truck shipments will likely increase in the future according to local experts. Toyota's decision to manufacture cars in this area is evidence that industry leaders also have discovered the location advantages of Northeastern Mississippi and the connectivity to markets such as in Tennessee and Alabama.

### *Competitive Disadvantages/Obstacles of the Corridor Region*

Local stakeholders have primarily identified transportation issues as the key obstacle for the corridor. In particular, Route 15 is now experiencing significant peak-hour congestion which has negatively affected freight and logistics of the large furniture manufacturers along this route. This has restricted the feasibility of North-South connections between the two highways in the eastern (I-55), and western (I-45) parts of the State.

The completion of Corridor X and the relocation of Corridor V, from north of Tupelo to south of the City adjacent to the Regional Medical Center have further exacerbated the problem. No direct connection between Corridors X and V is planned and with Toyota having located along Corridor X north of Tupelo, this may only further worsen the traffic volumes on Routes 15 and 9 which currently function as the connectors between these corridors. Also, with most retail trade and manufacturing located north of the city, areas to the south may have to catch up economically. An industrial park is being developed but the success of such a venture will directly depend on the completion of Corridor V.

## 3.2.3 Economic Impact of Corridor

The partial completion of the corridor prompted economic development along the old Route 6 all the way from Oxford to just west of Tupelo. This has created the need for additional retail trade establishments in the area. For example, a Wal-Mart Supercenter is located in Pontotoc County, just adjacent to Corridor V, and the retail store clearly makes use of the transportation infrastructure by attracting customers from a broad area, especially west of Lee County. Completion of the corridor is likely to continue this trend and some of the additional benefits of the completed corridor are described below.

### *Industry Opportunities*

The completion of Corridor V is expected to have significant positive impacts for local industries. Whereas currently all freight truck traffic going east-west has to go west from Tupelo on the old Route 6 in order to ultimately reach four-lane roads, the completed corridor would allow freight movements through Tupelo. Routing traffic through the city currently is very limited because all through traffic needs to go through the downtown area in order to connect Corridor V with I-45.

The largest development opportunities may be south of Tupelo once the corridor is completed. The city has provided the infrastructure in the form of a developed industrial park and other available land. Planning has taken into consideration that the City's objective is to balance economic development on the northern side with direct job creation on the southern periphery. As a result of this planning effort, new automotive parts suppliers for the Toyota facility are expected to be attracted to the industrial land south of Tupelo.

The completed corridor also would benefit the existing industries, such as furniture manufacturers, because of the improved connections to markets to the east, plus I-45. Finally, the Regional Medical Center will gain access to a much wider service area and residents in counties beyond Lee and Pontotoc will be able to make use of high-quality medical services without incurring large travel costs.

### *Facilitating Trade and Market Access*

Together with the completion of Corridor X, Corridor V serves an important purpose in the local transportation and distribution system. As a result of the improved highway, travel times from the west will be significantly lower. This applies to both the through traffic and traffic ending in Tupelo. Trade between the different areas of Lee County as well as the surrounding counties and the entire State will see improvements. For example, retail trade will benefit from improving access to areas west of Tupelo. At the present moment, the retail trade catchment area is primarily north and northwest of Tupelo. Retail outlets in Tupelo can attract shoppers from as far as Memphis according to some local stakeholders. However, only limited access exists from other directions. Since there is no good east-west connection, shoppers from the west, for example the Greater Oxford area, may prefer to travel north towards Memphis for their retail purchases.

In addition to any retail trade benefits, freight patterns and logistics also will be improved for regional and national markets. Much of the freight traffic originating at the Gulf Coast and heading towards Memphis (and points beyond) also is directed through Tupelo and currently has no other option but to take Corridor X up to Memphis. The completed Corridor V will provide an alternative to that route especially for trucks whose ultimate destination is not Memphis but rather points further North and West.

The completion of the corridor also will benefit the connectivity in regard to freight. Approximately 400 trucks each day enter and leave the Ashley furniture manufacturing plant. These trucks are in part limited by the incomplete corridor infrastructure and experience delay especially on Routes 15 and 9. A lot of the congestion in an around Tupelo is driven by these heavy volumes of freight movements. A completed Corridor V would allow all freight to avoid the downtown area and use the limited access highway to connect to other highways in the East or West.

However, local stakeholders have pointed out that expansion of Route 15 from a two- to a four-lane road is at least as important as completion of Corridor V. Especially now that the Toyota site has been chosen, a connection between Corridor V and X would bring immediate benefits according to local experts. Local stakeholders anticipate that the alternative of moving along a completed Corridor V east, then north on I-45 would be an inferior travel route.

### *Connecting People to Jobs, Tourist Attractions, and Services*

The completion of Corridor V will significantly improve connectivity in the region. For example, commuters from western parts of the county or counties west of Lee County currently face a lengthy commute to Tupelo employers. With the opening of the corridor, travel times should fall and commuting to large employers in the area will become less congested. At the moment, workers from 11 different counties commute to the furniture manufacturing plant owned and operated by the Ashley Corporation. This is a sign that commuting behavior in the area has changed to the point where workers are willing to accept longer trips, partially due to a relatively scarcity of jobs and potentially higher wages in employment centers. Another contributing factor can be found in zoning practices. Much of the residential growth has been driven by land use policies such as increased numbers of subdivisions in Lee and Pontotoc County.

Improved corridor connectivity also will improve the access to services in the region. For example, the completed corridor will allow for better access to the businesses in downtown Tupelo. Being a center for economic activity in the region, Tupelo is home to businesses such as several financial institutions, office complexes, and the regional medical center. Hence, residents of the area will be able to access these businesses more easily via a completed Corridor V. The medical center is one of the largest rural hospitals in Mississippi. It serves both the immediate area and also population within a wider radius around Tupelo. The completed corridor will consequently allow a larger share of the regional population to take advantages of the services offered by the medical facility.

Tourism has not been identified as a significant issue by most stakeholders. The exception is the area around Oxford, on the western end of Corridor V. The local economy in Oxford is supported by both the University of Mississippi and tourism and the many small hotels and bed and breakfast establishments. Even though the completion of the corridor will improve east-west accessibility for visitors, it was pointed out that most tourists may actually reach Oxford via Memphis or the Gulf Coast and, therefore, depend primarily on the north-south corridor of I-55 to the west of Oxford.

### *Overall Economic Development Impacts*

The overall expected economic impact is seen as very positive. A completed Corridor V will allow for better connections of freight trucks and employees to the employment and manufacturing centers in the area. Some of these centers are still in development and it will take several years for the full impact to be felt. In addition, there will be a significant benefit from improved transportation to retail trade locations.

However, the incremental impacts of the completion of the corridor will be difficult to measure because of the potentially simultaneous completion or expansion of the Toyota plant North of Tupelo. It is this aspect that will likely be the

driving force behind future economic growth and development in the Northeastern Mississippi region.

In order to stimulate economic growth and development opportunities, it seems essential that Corridor V is completed as soon as possible. There is much economic activity going on in the area and most of its success depends on the flexibility and efficiency of the local transportation system.

### 3.2.4 Other Issues and Stakeholder Comments

The stakeholders that were interviewed for this case study consisted of local elected officials and their respective staff, economic development professionals, transportation experts, as well as other experts in the field. Without exception, the importance of completion of the corridor was identified as a very high priority. However, the capacity of local roads, such as Route 15, was further identified as one of the key bottlenecks which could restrict economic growth opportunities in the future.

Mississippi Department of Transportation officials pointed out that due to the changed layout of Corridor V; there is now a lack of funding even if the capital improvements were funded as originally planned. Additional funds need to be included in the planning in order to allow for a complete four-lane segment of highway to be constructed South of Tupelo.

## 3.3 CORRIDOR H (WEST VIRGINIA) ANALYSIS SUMMARY

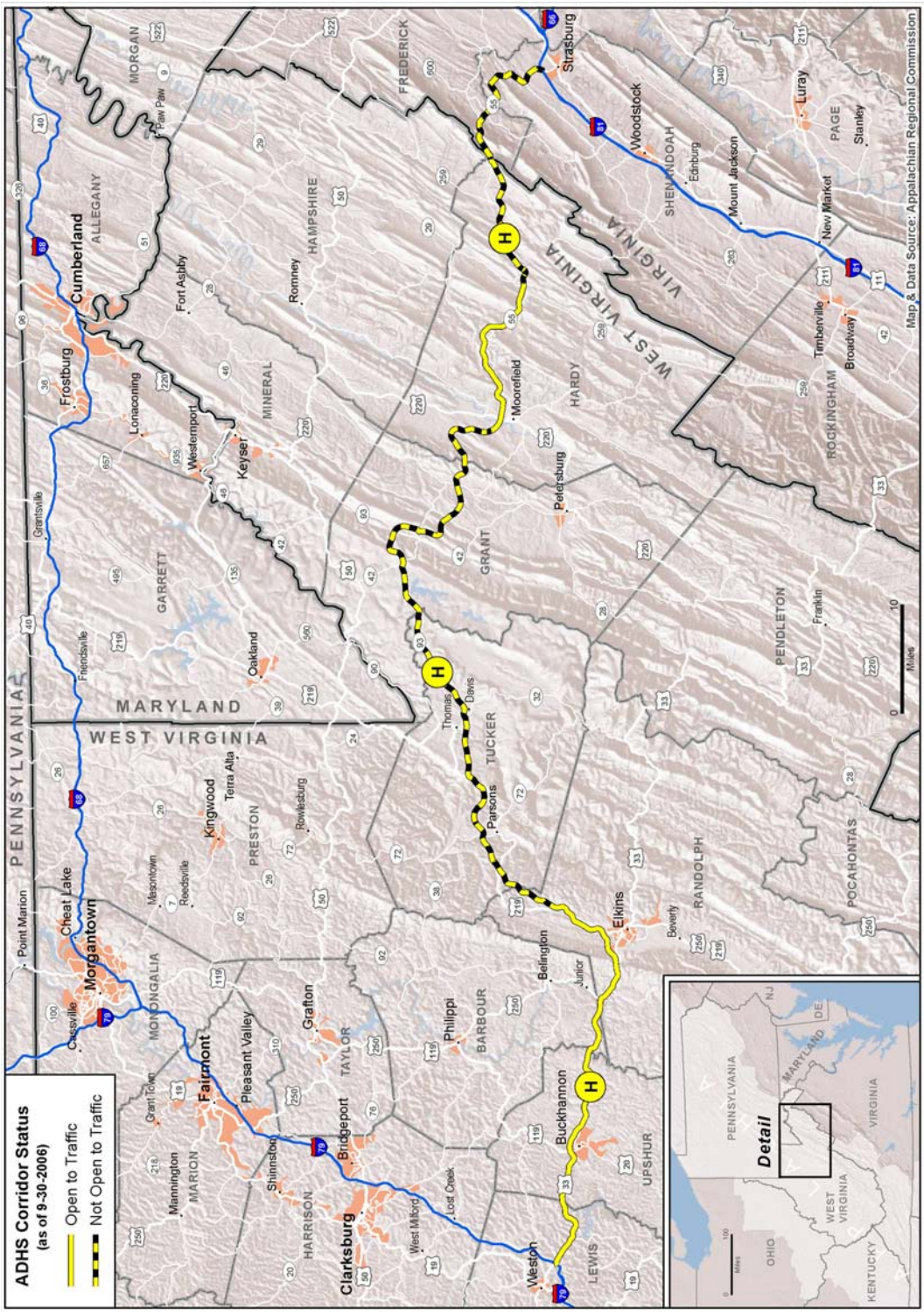
### 3.3.1 Background

The ADHS-designated "Corridor H" is approximately 150 miles between I-79, near Weston, West Virginia to I-81 in Strasburg, Virginia (see Figure 3.3). Portions of this highway corridor have been completed but much remains to be built. Completed segments include:

- The western portion of the Corridor (about 40 miles) from I-79 through Buckhannon to Elkins and north to Kerens; and
- An approximately 20-mile segment in eastern West Virginia from Moorefield to Wardensville (with uncompleted segments to the east and west).

Significant work on this corridor remains, thus limiting the current effectiveness of completed segments. For example, the uncompleted segment from Kerens to Moorefield is necessary to more efficiently and cost-effectively ship products to eastern markets and seaports such as Baltimore and Norfolk. Furthermore, while the completed segment from Moorefield east to Wardensville substantially improves travel time and safety, the rural, mountainous two-lane highway that remains to the east (connecting to I-81 and Strasbourg in Virginia) limits the attractiveness of this route for freight and passenger travel.

## Figure 3.3 Corridor H in West Virginia and Virginia



Feedback from all stakeholders in West Virginia indicates that the environmental review process has been completed for the remaining West Virginia segments and that the location of the highway corridor alignment is finalized.[15] The constraining factor appears to be financial. The State is moving forward, but full funding and construction may take upwards of 10 to 12 years to complete. The segment from Moorefield west to Scherr currently is under construction. Less encouraging, funding and final plans to complete the Virginia section of Corridor H are still lacking for the critical connection to I-81, the nearby Inland Port, and I-66 connections east to the Washington, D.C. metro market.

The economic impacts analyzed in this case study focus on the anticipated benefits of completing the entire Corridor H. The study area for this case study is focused on the West Virginia counties along the corridor: Lewis, Upshur, Barbour, Randolph, Tucker, Grant, and Hardy counties. These counties comprise a combination of the Region VII and Region VIII planning and development councils. In fact, the top priority of the Regional VII Planning and Development Council in their Comprehensive Economic Development Strategy (CEDS) is completion of Corridor H and thus there is widespread support locally and regionally for this project. Although major segments of the highway corridor are incomplete, examples of economic development and industry success stories related to the existing segments of Corridor H are provided as indication of potential economic effects.

### 3.3.2 Current Economic and Transportation Conditions

Economic and demographic trends in Corridor H West Virginia counties are largely flat. Both employment and population are largely unchanged over the past five years, though the labor force has grown slightly and the unemployment rate has decreased. For a rural section of West Virginia, this is not bad news. Indeed, employment gains and retention in various service industries and selected manufacturing and natural resources industries are preventing overall declines that might be expected with traditional industries such as mining and agriculture that have experienced declining employment. Industries and initiatives with developmental potential include:

The wood products industry, with a mix of raw and finished goods is strong in the Corridor with the Appalachian hardwood forest providing in-demand wood resources. Many of the larger manufacturing and exporting businesses within the region are directly related to wood products, including Armstrong and American Woodmark (see Table 3.3).

[15] Current alignment is a northern route through Parsons, Davis, Bismarck, and Scherr before heading east to connect in Moorefield. Earlier Corridor H alignment plans called for a more southern route from Elkins east to Petersburg and then to Moorefield.

## Table 3.3 Major Private Sector Employers in Corridor H

| County | Company | Industry | Number of Employees[a] |
|---|---|---|---|
| Randolph | Armstrong Wood Products | Hardwood Products | 950 |
| Tucker | Kingsford | Charcoal | 125 |
| Upshur | Weyerhaeuser | Wood Products | |
| Upshur | Appalachian Forest Saw Mill | Wood Products | 75 |
| Lewis | Dominion | Energy | 150 |
| Lewis | Lynn Energy | Energy | 153 |
| Lewis | Viking Swimming Pools | Manufacturing | 125 |
| Tucker | Timberline Four Seasons Resort Management | Tourism | |
| Tucker | Canaan Valley Resort | Tourism/Ski | 277 (Peak Season) |
| Randolph | Davis Memorial Hospital | Health Care | |
| Randolph | Colonial Millworks | Lumber | |
| Hardy | American Woodmark | Cabinet Making | 300 |
| Hardy | Fertig Cabinet Company | Cabinet Making | |
| Hardy | Pilgrim Pride Corporation | Food Processing (Poultry) | |
| Hardy | Conagra Poultry | Food Processing (Poultry) | |

Source: Information obtained through interviews with regional and local economic development officials; the Region 8 PDC Comprehensive Economic Development Strategy 2004-2008; and Region VII PDC Annual Report FY 2006-2007 CEDS.

[a] As available.

The cities and towns along the completed section of Corridor H from I-79 to Elkins are showing signs of economic vitality with new commercial investment, new housing starts, and positive employment trends. While some of the new investment is in industries not normally associated with growing the base economy (retail, hotels), the investments by national chains (Lowe's, Hampton Inn, etc.) are an indicator of the economic prospects of the region.[16]

The poultry and other manufacturing industries near Moorefield have been able to offset other business departures with gains partly due to the completed section of Corridor H to the east.

Relatively new industrial parks are either under development, expansion, or being built in most Corridor H counties, as the region leverages completed sections of the Corridor or anticipates future growth opportunities by focusing on all-important "shovel ready" sites at industrial parks.

[16] This is especially relevant given the recent emphasis on attracting prison facilities which highlights how the Corridor region, as recently as 5 to 10 years ago was willing to recruit any industry that could help provide job opportunities.

The Corridor H towns and counties between Kerens and Moorefield remain largely rural but with the completion date of the entire Corridor stretching out, this very rural, isolated economy struggles to grow and retain its traditional industry strengths such as tourism (including two nearby ski resorts) and the coal industry. For example, the Canaan Valley Resort in Tucker County has recently been losing money and has an out-dated facility. At the same time, the State sees the economic benefit of that facility and is working with the resort on a major renovation project. The success of that renovation project, however, largely depends on the ability of the resort to attract more visitors from the booming, large Washington, D.C. metropolitan area, which continues to stretch westward. Thus, the completion of Corridor H will enhance these destination tourism businesses.

Another economic area that currently lags behind is the warehousing and distribution industry. Economic development officials note the lack of distribution centers or larger trucking companies along Corridor H, and are quick to point out that until the Corridor is completed and freight can move efficiently in the region, no significant gains in this industry are expected.

### *Competitive Advantages of the Corridor Region*

Similar to other areas within Appalachia, Corridor H combines quality of life attributes (mountains, lakes, rivers, historic villages, and natural attractions) with relatively strong school systems and a productive workforce. A tradition of mining and manufacturing expertise has helped provide a strong work ethic and gives the region a range of skills needed by industry. While the labor force is relatively well-regarded by the private sector and economic development officials, it is still lower cost compared with larger metropolitan areas. It should be noted, however, that there is some concern of late about job-ready skills and work ethic of younger workers just out of high school, and some counties (e.g., Tucker) have such low population that it can be difficult to find enough quality workers.

The state's traditional energy industry, together with the more recent wind farm industry, help to keep energy costs reasonable. Other cost factors, such as land and buildings, also tend to be lower than average, though that has changed recently along the completed sections of Corridor H.

Perhaps the region's biggest competitive advantage currently is the Appalachian hardwood forest and the range of wood products industries located in the region. Many of these, including Armstrong, Coastal Lumber, and Appalachian Forest, produce highly sought wood products that are exported to a range of international destinations (Europe and Asia) in addition to other domestic destinations. The success, and in many cases growth, of these industries highlights the quality of their product given the tremendous transportation disadvantage faced by area industries due to a lack of efficient, safe, cost-effective transportation routes to access international markets.

Another major asset for the region, especially on the eastern half of the Corridor, is proximity to the Washington, D.C. metropolitan area. Already, housing growth (retirees and second homes) in Hardy and to some extent Grant County is occurring related to D.C. market proximity. The natural beauty of the area's mountain ranges and valleys combined with relatively low-housing costs and the ability to live close enough jobs and business opportunities to the east is increasingly appealing to homebuyers.

While the Corridor H region does not possess significant high-technology or research and development firms, the western part of the region has benefited from completion of Corridor H, which allows commuters the chance to access high-paying, high-skill jobs in the Clarksburg Federal laboratories and biometrics industry (north along I-79).

### *Competitive Disadvantages/Obstacles of the Corridor Region*

Without a doubt, the lack of a completed Corridor H is the biggest impediment to broader economic growth throughout the region. While congestion in a traditional sense (traffic volumes) may not be a problem on the two-lane roads that travel east-west from Elkins to I-81 in Virginia, the windy, mountainous nature of those roads creates very slow driving conditions, especially for freight trucks (and the vehicles behind them). These limitations lead to increased transportation costs, reduced reliability, and longer distances when shipping via alternative routes:

> Local lumber product companies estimate that it is three times more costly to ship their wood products to east coast ports (primarily Baltimore and Norfolk) than to ship the product from the port to Europe.
>
> Avoiding the windy two-lane east-west roads to use I-79 and I-68 increases travel distance to east coast ports by over 300 miles.
>
> Local wood products businesses consistently score poorly on customer service because of the unreliability of their shipments, tied to poor east-west connections.

Other competitive disadvantages include infrastructure capacity, particularly the availability of cost-competitive local water and wastewater systems, natural gas and electric service, and broadband telecommunications. Increasingly, economic development officials are developing "shovel-ready" sites near the Corridor, and working to provide sufficient water/sewer facilities.

Another concern is the relative lack of alternative modes of transportation for passenger and freight movement. In general, freight rail and air infrastructure and service levels are below average. The region, in particular near Buckhannon, is working to expand air transport facilities such as extending runways to allow for a broader range of private and commercial airplanes. Freight rail service is provided by CSX in parts of the Corridor H region, but is infrequent and not fully connected to east coast markets.

The Virginia Inland Port near the intersection of I-81 and I-66 is the most promising freight facility near the region, providing advanced logistics and customs services such that a shipment can flow seamlessly from the Inland Port to a ship via rail and containers. However, until Corridor H is completed, the benefits of the Inland Port largely are escaping the region's exporters (e.g., wood products industries note that at least 25 percent of their goods are exports).

A final competitive disadvantage is not specific to the region but is a West Virginia statewide issue, as multiple economic development officials note that the State has relatively high business taxes.

### 3.3.3 Economic Impact of Corridor

This section of the Corridor H summary is focused on the expected economic and industry benefits of completing the entire highway corridor.

#### *Industry Opportunities*

**Manufacturing.** The completion of Corridor H will provide immediate benefit to the region's manufacturing industries. With a projected 25-year stock of Appalachian hardwood forest, the various wood products firms should expect lower shipping costs and increased international export potential as the connections to east coast ports such as Norfolk will be greatly enhanced. The region is attempting to develop and recruit more value-added, downstream wood products firms, but the lack of east-west transportation hinders those opportunities. In addition, the Corridor region's other manufacturing industries, such as aluminum, the Kingsford charcoal company, and food products also should benefit significantly from Corridor H completion.

**Tourism.** Every section of completed Corridor H reduces travel time and increases travel safety for visitors to the region. In addition to numerous hiking, camping, and other natural attractions, the region's two major ski resorts – Canaan Valley and Timberline – stand to benefit greatly from Corridor H completion. The Canaan Valley Resort employs up to 275 people in peak season (February) and is Tucker County's largest private employer. The State recently agreed to partner with the resort for major renovations that will expand services, including a year-round conference center. Their business plan and the State's investment partnership explicitly incorporate Corridor H completion into their plans to attract increasing numbers of visitors from the D.C. market.

**Retail and Services.** While traditional economic development analysis focuses on "economic base" industries that export goods and services, recent investments in a mix of retail, service and hotel industries (Lowes, Wal-Mart, Kmart, Arby's, Pizza Hut, Hampton Inn) along completed Corridor H segments from I-79 to Elkins represent a net economic gain for the region. These retail and services businesses benefit the region because they provide more accessible retail services to local residents and they support the positive population and economic trends in this region. These major chain investments may be representative of addi-

tional economic investment potential upon full completion of Corridor H. While not all areas and towns in the Corridor region are likely to see these kinds of developments, towns with some commercial base (like Kerens, Parsons, Elkins, and Moorefield) are likely to benefit.

### *Facilitating Trade and Market Access*

Completion of Corridor H will directly improve market access and trade potential, especially those industries in the Corridor region that already participate heavily in international (and domestic) trade. The most likely direct effects include:

**Greatly Reduced Shipping Costs for Inbound and Outbound Goods Movement –** Current freight shipments face cost premiums due to: a) longer distances (especially when avoiding two-lane roads) and thus higher costs; 2) longer transport times (Armstrong estimates that the 48-mile stretch to Virginia can take 3 to 4.5 hours); and 3) unreliable delivery windows. Many of the region's firms need access to east coast ports like Baltimore and Norfolk and Corridor H will greatly improve access and reduce costs.

**Connections to the Expanding Washington, D.C. Market Area –** Whether it be tourists, commuters, or suppliers and buyers, Corridor H will greatly improve connections to the Washington, D.C. market and the generally affluent Virginia suburbs.

**New Industry Opportunities –** The lack of a completed Corridor H, while not the only restraining factor for economic development, is a major impediment to economic growth in industries such as distribution centers, or high-tech value added manufacturing and services. Without Corridor H completed, much of the region simply doesn't qualify for the early stage site location assessments for potential business expansions or relocations.

Along these lines, it is worth noting some of the current operations and transportation constraints faced by **Armstrong Wood Products**, by far the largest private sector employer in the Corridor region.[17] Armstrong is located in Beverly, West Virginia, near Elkins and the eastern part of the completed Corridor H from I-79 traveling east. They are part of a national company with other facilities in nine other states and thus compete for future expansions and capital investment and must remain productive and profitable. They have grown rapidly from 68 employees in 1990 to 950 employees today with an average hourly wage of $12.60 for production workers. They are now the largest producer of prefinished hardwood floors in North America, producing more than 1.5 million square feet of finished product per week.

[17] Much of the information in this section is derived from a presentation on Armstrong Wood Products provided and given by Donnie Staten (shipping manager).

Armstrong has significant inbound and outbound shipments. Incoming truck loads of lumber total 350 per week, with at least 50 percent from West Virginia suppliers and the remainder from 10 states and Canada. Armstrong ships 800 full or partial truckloads per month primarily to the Northeast U.S. and Canada via private carriers, with an additional 50 to 100 truckloads per week of by-product (sawdust) to Virginia (near I-81). Incredibly, total shipments for 2007 were estimated at over 10,000 compared to 1,700 in 1993 with total inbound and outbound shipments at approximately 25,000. Consistent with findings from other firms, Armstrong envisions significant shipping benefits from completion of Corridor H, including: 1) improved safety, especially in the winter; 2) reduced transit times, lower costs and improved customer service; 3) improved contract negotiations with private carriers and lumber suppliers; and 4) reduced consumption of fossil fuels as Armstrong currently pays fuel surcharges.

### *Connecting People to Jobs, Tourist Attractions, and Services*

Economic development officials and private employers throughout the Corridor region noted that many workers commute a significant distance to jobs, and employers often recruit a labor force within a 60-mile radius. The completion of Corridor H will directly benefit the ability of employers to draw from a larger labor force and hopefully reduce turnover during the winter months among workers who commute longer distances.

Completing Corridor H also will provide significantly improved connections to the D.C. market area, which is a primary market for tourist attractions in the region. They also provide a growing share of new residential development for second homes and workers with flexible schedules/locations. Canaan Valley Resort noted that their visitors greatly appreciated the completed section of Corridor H to their east and the need to finish other sections to draw the number of visitors necessary to return to profitable operations.

Finally, major hospital facilities and specialized health care facilities are relatively sparse along the Corridor region (notably in Barbour County). A completed Corridor H will enhance access to facilities such as Davis Memorial Hospital in Elkins for both patients and the workforce.

### *Overall Economic Development Impacts*

As noted previously, completion of Corridor H is consistently the top priority for local and regional economic development officials, and they tend to be optimistic about the likely positive economic benefits of the highway project. This is generally supported by direct input from private employers in the manufacturing and tourism industries. Completed segments, namely I-79 to Elkins and Kerens via Buckhannon, provide evidence of new private investment, higher traffic levels, and the development of "shovel-ready" industrial sites and new/expanded companies. A visit to the region and driving the existing windy, mountainous two-lane roads makes abundantly clear the transportation constraints voiced by various stakeholders. Completion of Corridor H will dramatically lower travel

times and provide access to east coast markets that is likely to aid in the retention and attraction of business activity.

At the same time, these encouraging future economic benefits need to be placed in context regarding the nature and conditions of the Corridor region's communities. Many sections of the Corridor region, namely in Grant and Tucker counties, appear unlikely to either want or have the capacity to significantly expand economic activity. Consequently, it is appropriate to temper future projections of economic development effects of completing Corridor H to those counties most likely to fully leverage this future asset.

### 3.3.4 Other Issues and Stakeholder Comments

While work continues on Corridor H to the west of Moorefield, local stakeholders expressed significant concern regarding the political and funding conditions necessary to complete the entire highway project. Consequently, most stakeholders are proceeding with their plans mindful of Corridor H but not dependent on the completed roadway. The concerns voiced by multiple respondents focused on:

**The Virginia Section of Corridor H from the Border to I-81 –** This stretch of roadway currently is a fairly windy, two-lane road with limited capacity, no passing lanes, and limited shoulders. Stakeholders note that this section of Corridor H does not appear to be a priority for Virginia and regularly is not included within the State's near-term program of funded or planned projects. A key to Corridor H full connectivity is reaching I-81 (a major north-south truck route) and the Virginia Inland Port, and until all sections are complete, large trucks will seek to avoid this two-lane facility.

**The West Virginia Section from Kerens to Davis –** Stakeholders note that this segment of Corridor H within national and state forest territory is likely to be the final segment completed within West Virginia. There are a number of expensive bridges and land grading projects that are needed to upgrade the existing highways, and stakeholders fear that it could take years to secure the funding and complete the engineering/construction of this section.

# 4.0 Travel Impacts, User Benefits, and Accessibility

This section describes results of completing the Appalachian Development Highway System (ADHS) in terms of:

**Travel Impacts.** The highway capacity additions that corresponded to the completion of ADHS corridors were coded into the multi-region travel model described in Section 2.0. The model measures changes in the driving conditions for autos and trucks (further separated into non-freight trucks and commodity-based trucks), generating estimates such as traffic volume, aggregate travel time, and speeds.

**User Benefits.** Based on the results of the travel network model, user benefits due to highway improvements (travel-time savings, operating costs, emissions cost, and safety) are estimated in monetary terms and compared to the no-build scenario. The value of time varies depending on trip purpose and vehicle.

**Accessibility.** In addition to monetized user benefits, the travel model results also are used to determine accessibility gains to workforce, employment centers, transportation facilities such as airports, and other regional points of significance. The theory behind this analysis is that by improving highway speed, travelers would be able to access destinations and markets farther away within the same drive time radius.

## 4.1 TRAVEL IMPACTS

The travel model for the ADHS study area was run using several population growth scenarios. As pointed out earlier in this report, Woods & Poole (W&P) provided a scenario that was slightly more aggressive than the forecast supplied by Global Insight (GI). As a result of the two forecast alternatives, the travel model produced two alternative travel impact scenarios. In essence, travel impacts are measured by determining the difference in total VMT and VHT in the no-build and the alternative build case (ADHS completion). The resulting difference is the effect that the ADHS completion has on transportation system performance. Travel impacts are reported for two forecast years – 2020 and 2035. Table 4.1 shows VHT results for the Global Insight forecast.

Table 4.1 Daily VHT Based on Global Insight Forecast
*Thousands*

| Thousand VHT | Total | All Trucks | Automobile | Non-freight Trucks |
|---|---|---|---|---|
| *2020* | | | | |
| No-Build | 11,966 | 2,852 | 8,024 | 1,091 |
| Alternative | 11,664 | 2,741 | 7,895 | 1,028 |
| Difference | -303 | -111 | -128 | -63 |
| *2035* | | | | |
| No-Build | 20,658 | 7,163 | 11,695 | 1,801 |
| Alternative | 19,901 | 6,728 | 11,491 | 1,681 |
| Difference | -758 | -435 | -203 | -119 |

Source: Cambridge Systematics, Inc.

Travel impacts based on the Global Insight forecast show a decline in daily travel-time savings (VHT) for all vehicle categories (trucks, autos and non-freight trucks) in 2020 reflecting the travel efficiencies of completing the system. The VHT impacts for 2020 were approximately equal for all trucks and automobiles. Total VHT reduction in 2035 is projected to be significantly larger, reflecting the growth of traffic volumes and benefits from completing the ADHS. In 2035, truck VHT reductions constitute more than half of total VHT decline in that year.

In Table 4.1, the VHT difference for the Global Insight forecast across all vehicles types is estimated to be approximately 303,000 per day in 2020 and 758,000 per day by 2035. In annual terms, this corresponds to approximately 212 million fewer hours of travel in 2035 as the growth in travel-time savings from 2020 to 2035 reflects savings compared to traffic volumes and congestion without the completed corridors. A significant share of the total VHT savings is for freight truck trips due to: a) the long-distance nature of the trips; b) strong annual growth in freight truck tonnage (2.5 percent per year); and c) strong diversion to significantly faster and/or more direct routes.

Over the same time period, total VMT across the entire highway network is projected to increase slightly by 2035 after an initial decline in 2020. This increase in traffic was driven by the growth in vehicle miles traveled for the automobile trip category. Route diversion for auto trips onto the ADHS corridors is projected to substantially increase projected VMT on ADHS highways. The increase in VMT on ADHS completed corridors is 124 percent in 2020 and 142 percent in 2035, indicative of improved travel performance on these routes.

Changes in VMT due ADHS completion can stem from two dynamics: 1) reductions in VMT based on the use of more direct routes offered by ADHS corridors; and 2) increases in VMT as some trips divert from more direct but slower local roads to faster but less direct ADHS corridors. In the case of truck trips, the resulting drop in VMT in 2020 and 2035 for both forecast scenarios

implies that on net, the more direct routes offered by ADHS corridors reduces truck VMT as compared more circuitous routes often chosen by trucks to stay on major (e.g., Interstate) roadways. While truck VMT in the entire ARC region are estimated to fall slightly, freight truck VMT on ADHS corridors is estimated to increase dramatically. Consistent with the travel efficiency-based user benefits, freight truck VMT on to-be-completed ADHS corridors is expected to be four times greater in 2035 than under no-build conditions.

The travel impacts based on the Woods & Poole population and economic forecasts (Table 4.2) show a similar pattern. VHT decreases significantly across all categories over the study period. Additionally, VMT decreases slightly for all modes by 2020 while in the longer term VMT goes up as a result of the increase in VMT for autos.

Table 4.2 Daily VHT Based on Woods & Poole Forecast
*Thousands*

| Thousand VHT | Total | All Trucks | Automobiles | Non-freight Trucks |
|---|---|---|---|---|
| *2020* | | | | |
| No-Build | 12,467 | 2,967 | 8,322 | 1,178 |
| Alternative | 12,136 | 2,840 | 8,195 | 1,102 |
| Difference | -330 | -127 | -127 | -76 |
| *2035* | | | | |
| No-Build | 20,321 | 7,607 | 12,714 | 2,074 |
| Alternative | 19,540 | 7,115 | 12,426 | 1,919 |
| Difference | -781 | -493 | -289 | -155 |

Source: Cambridge Systematics, Inc.

It also is worth noting that the inclusion of terrain factors was a significant adjustment factor in this analysis. States, such as Tennessee, are increasingly including terrain factors into their travel models to reflect slower speeds (especially for trucks) with mountainous, steep grades. Visits to the selected corridors (e.g., Corridor H in West Virginia) confirms the exceptional differences in travel speeds between completed and uncompleted corridor sections due to steep grades on two-lane roads.

## 4.2 USER BENEFITS

User benefits as a result of the completion of the ADHS consist of a variety of different factors:

**Travel-Time Savings.** The travel model estimates the difference in VHT as a result of the to-be-completed ADHS corridors. The time savings are monetized by using values of time differentiated for autos, $13, and trucks, $29 consistent

with values from FHWA's Highway Economic Requirements System (HERS). These are relatively conservative assumptions compared to other published reports (e.g., Texas Transportation Institute's Urban Mobility Report uses an hourly commercial vehicle operating cost of $77.10/hour in 2005 dollars).

**Fuel and Nonfuel Costs.** These costs are calculated by using the difference in VMT for the build and no-build scenario and applying it to cost factors. For example, fuel costs are valued at $2.98 per gallon for autos and $2.83 per gallon for trucks.

**Safety Benefits.** Highway crash fatalities and injuries can be significant costs for businesses and households. In the case of capacity expansion of the ADHS network and changes in functional class, accident rates are expected to decline and the resulting difference in accidents (segmented by property damage only, injuries, and fatal accidents) is monetized using estimates for such costs from FHWA, differentiated by travel modes.

**Travel-Time Reliability.** Reliability can be measured by assessing the variability of travel time or the time that is needed to be on time at least 95 percent of the time. These time savings, such as reduced planning time due to system improvements, can be monetized by applying the same unit costs as for travel-time savings calculations.

Total user benefits in 2020 for both population and employment forecast scenarios, as well as differentiated by trip purpose and vehicle type are shown in Table 4.3. In total, both scenarios show approximately $1.4 billion in user benefits with a significant share of benefits accruing to the nonfreight truck categories. Travel-time reliability benefits have been excluded from this table.

Table 4.3 Summary of User Benefits in 2020

| Million 2006 Dollars | Global Insight | Woods & Poole |
|---|---|---|
| Freight | $375.87 | $400.81 |
| Nonfreight | $511.29 | $614.56 |
| Business Automobile | $78.63 | $77.60 |
| Nonbusiness Automobile | $392.20 | $387.05 |
| Total | $1,357.98 | $1,480.01 |

Source: Cambridge Systematics, Inc.

As shown in Table 4.4, user benefits net of reliability benefits are significantly larger in 2035 compared to 2020. More than half of total user benefits are now generated by freight trucks, which is consistent with the strong growth rate of goods movement projected by the FAF data, strong diversion of freight trucks to newly completed ADHS corridors, as well as the long-distance hauls impacted. When the two growth scenarios are compared, the Woods & Poole scenario creates total user benefits that are nearly 20 percent greater than the Global Insight numbers based on higher volumes of traffic.

Table 4.4 Summary of User Benefits in 2035

| Million 2006 Dollars | Global Insight | Woods & Poole |
|---|---|---|
| Freight | $2,534.36 | $2,708.79 |
| Non-freight | $965.76 | $1,259.34 |
| Business Automobile | $129.67 | $186.36 |
| Non-business Automobile | $646.81 | $929.57 |
| Total | $4,276.61 | $5,084.07 |

Source: Cambridge Systematics, Inc.

Over 90 percent of automobile and non-freight truck benefits are estimated to accrue to the ARC region based on the mostly local origin-destination pattern of trips. However, over 65 percent of benefits to freight flows are external to the ARC region, reflecting the long-distance nature of the shipments impacted and the national importance of completing the ADHS to facilitate goods movement into, out of, and through the ARC region.

**Reliability Benefits.** In addition to the traditional user benefits, the impacts from improved reliability of transportation as a result of the project have been estimated. Reliability benefits are based on the concept that extra time needs to be planned in order to be on time at least 95 percent of the time. Hence, reliability benefits are measured by calculating the time savings due to the reduction in "planning time" as a result of the transportation improvements. In short, these benefits are the sum of monetized time savings due to the improved travel conditions stemming from ADHS completion.

For the entire ADHS region, these reliability benefits were estimated as equal to between $2.2 and $2.4 billion in 2020 and figures roughly five times as large in 2035 (Tables 4.5 and 4.6). The majority of these reliability benefits in 2035 accrue to freight trucks. The estimation of reliability benefits is relatively new and untested, and is, therefore, viewed as a standalone component of this analysis and has not been included in the benefit/cost analysis or the development of regional economic impacts in TREDIS.

Table 4.5 Summary of Reliability Benefits in 2020

| Million 2006 Dollars | Global Insight | Woods & Poole |
|---|---|---|
| Freight | $756.78 | $815.20 |
| Non-freight | $843.85 | $1,041.61 |
| Automobile | $575.78 | $573.05 |
| Total | $2,176.41 | $2,429.85 |

Source: Cambridge Systematics, Inc.

Table 4.6 Summary of Reliability Benefits in 2035

| Million 2006 Dollars | Global Insight | Woods & Poole |
|---|---|---|
| Freight | $9,195.74 | $9,977.73 |
| Nonfreight | $2,144.38 | $2,876.69 |
| Automobile | $1,083.98 | $1,692.99 |
| Total | $12,424.10 | $14,547.41 |

Source: Cambridge Systematics, Inc.

## 4.3 ACCESSIBILITY

Improved accessibility to labor, customer, buyer, supplier, and tourism markets can lead to net business attraction/retention gains. Expanded markets are gauged by determining the additional population and employment that is accessible within a given travel time due to ADHS highway network completion (e.g., population that is within a one-hour drive for customer and labor markets; employment that is within three hours for buyer and supplier markets). By reducing travel times, the completion of ADHS will effectively enlarge the catchment areas on which businesses can draw labor, customers, and suppliers. In the analysis, the size of the employment and population catchment areas was compared for the build and no-build scenarios in both growth scenarios. The differences, in percentage terms, show the gains in market accessibility (access to a larger number of consumers), and business attraction (in response to improved access to labor, suppliers, buyers, and other modal facilities) resulting from the interstate improvements. The accessibility measures include the following:

**Labor and Consumer Markets –** Percentage change in population accessible within a 60-minute drive time, which is a rough indicator of the impact of ADHS completion on the size of labor markets (representing available work-force and job opportunities), as well as the size of typical shopper markets; and

**Buyer and Supplier Markets –** Percentage change in employment (by place of work) accessible within a three-hour drive, representing the likely reach of same-day truck deliveries for parts suppliers to manufacturers and distributors.

Table 4.7 shows the aggregate results of this analysis. For the Global Insight growth scenario, the analysis shows improved accessibility for both labor and consumer markets, as well as buyer and supplier markets. Specifically, population accessibility increased by 3.7 percent due to ADHS completion while employment accessibility increased by 4.6 percent.

Table 4.7 Increased Accessibility 2035
*Build versus No-Build*

| | Global Insight | Woods & Poole |
|---|---|---|
| Population | 3.71% | 3.91% |
| Employment | 4.58% | 4.64% |

Source: Cambridge Systematics, Inc.

For the Woods & Poole scenario, the growth in population and employment accessibility is equal to 3.9 and 4.6 percent, respectively.

In addition to the employment and population measures, the accessibility analysis also includes connectivity measures to specific transportation system components. This analysis is based on the average drive time reduction in each county to transportation facilities. This study includes the following four connectivity measures:

Intermodal Rail Terminals;

International Gateways;

Marine Ports; and

Airports.

The results of the accessibility analysis, i.e., the incremental changes resulting from the completion of the ADHS, are presented in maps presented in Section 4.2 and Appendix B.

Regardless of which forecast was used, the overall benefits attributable to the ADHS completion across the study area are measurable and demonstrate the positive economic impacts the system has on the counties that are part of the network.

# 5.0 Economic Impacts

Using the methodology from Section 2.0 and the travel impacts from Section 4.0, this section presents the estimated economic impacts on the region and United States due to the completion of ADHS highway corridors. The direct effects are derived from travel-cost savings and market access impacts. These effects were run through the economic model in TREDIS to arrive at the total economic impact. The regional economic effects are presented in terms of:

**Travel-Time and Cost Impact –** Includes travel-time and travel distance impacts, which in turn also affect traveler fuel use, safety, cost of living, and business operating expenses. User benefits in this section of the report are narrowed to focus on those accruing to the ARC region based on origin-destination patterns, while full national-level user benefits are incorporated within the benefit/cost analysis.

**Market Access Impact –** Includes effects beyond the cost of travel, that affect the nature of freight delivery markets, logistics, labor markets and the business productivity of operating in alternative locations.

**Total Economic Impact –** Represents: 1) travel cost savings to industries; 2) market access impacts; and 3) spin-off economic activity from these effects, including multiplier effects. Total economic impacts are measured in terms of jobs, value added, and wages to the ARC region.

The impacts were generated for the "medium" (Global Insight) and "high" (Woods & Poole) growth scenarios to account for uncertainty in future population growth and travel demand. These scenarios are subsequently used to form ranges of likely benefits in the benefit/cost analysis. They also are provided for three regions of Appalachia: North, Central, and South.

## 5.1 DIRECT TIME AND COST TRAVEL IMPACTS

Direct travel impacts reflect savings to industry (both time and expense), time savings to households, and out-of-pocket household savings. However, the results indicate that large benefits accrue primarily to industry due to the magnitude of freight volume moving through the region, the high number of miles per trip, and the relatively high value of time for freight operations. Businesses are affected through reduced travel time for workers who are "on-the-clock" and for the value of freight which includes time reliability for deliveries. Households are affected through commuting and personal trips mostly by reduction in travel time. They may not have high "out-of-pocket" savings (e.g., gas costs) but they do show significant benefits from reduction in travel time. This savings in time is translated into monetary benefits based on their value of time.

These impacts phase-in gradually as highway construction projects are completed. After the construction completion, they are assumed to be growing at a constant rate until 2044; this is due to population and traffic levels growing over time. For purposes of this study, the year 2035 was chosen. By this time, the full impacts will have been phased in.

The total annual traveler savings for 2035 in the ARC region, seen in Table 5.1, range from $3.1 to $3.9 billion for the medium- and high-growth scenarios for the ARC region. These numbers do not include pass-through traffic – trips that do not start or end in the ARC region – which account for $2 to $2.1 billion in savings.

## Table 5.1 ARC Traveler Cost Impacts in 2035

| | Annual Travel Impact in 2035 (Millions 2007 Dollars) | | | | |
|---|---|---|---|---|---|
| Cost Savings Category | North | Central | South | ARC Total | Rest of Nation |
| *Medium-Growth Scenario* | | | | | |
| Industry Savings | 951 | 192 | 1,185 | 2,328 | 1,925 |
| Household Cost Savings | 8 | 2 | 13 | 22 | 1 |
| Household Value-of-Time Benefit | 261 | 58 | 419 | 737 | 38 |
| Region Total | 1,220 | 252 | 1,616 | 3,088 | 1,964 |
| *High-Growth Scenario* | | | | | |
| Industry Savings | 1,140 | 233 | 1,455 | 2,828 | 2,073 |
| Household Cost Savings | 15 | 3 | 24 | 42 | 2 |
| Household Value-of-Time Benefit | 371 | 83 | 596 | 1,050 | 55 |
| Region Total | 1,526 | 319 | 2,075 | 3,920 | 2,130 |

Source: Economic Development Research Group and Cambridge Systematics, Inc.

The benefit measures include the dollar value of all congestion-related travel time, travel expense and travel safety impacts that are averted by implementing the highway projects in Appalachia. These traveler impacts in turn affect *industry savings*, *household cost savings,* and *household value-of-time benefit*. When combined, these groups of benefits represent the measure of "transportation system efficiency" used in the benefit/cost analysis.

**Industry Savings ($2.3-$2.8 Billion).** Businesses save travel costs due to faster, more direct routes than would otherwise occur under current conditions. The benefits include reduced driver or traveler time spent en route, as well as reduced scheduling costs related to delivery time uncertainty.

**Household Cost Savings ($22-$42 Million).** Households save incurring the higher out-of-pocket travel expenses than would otherwise occur under previous conditions due to improved conditions. The benefits include lower vehicle operating expenses (fuel, etc.) and accident costs; this avoided cost represents

additional disposable income. In Appalachia, this is relatively small for households because most of their savings comes from driving times rather than distances.

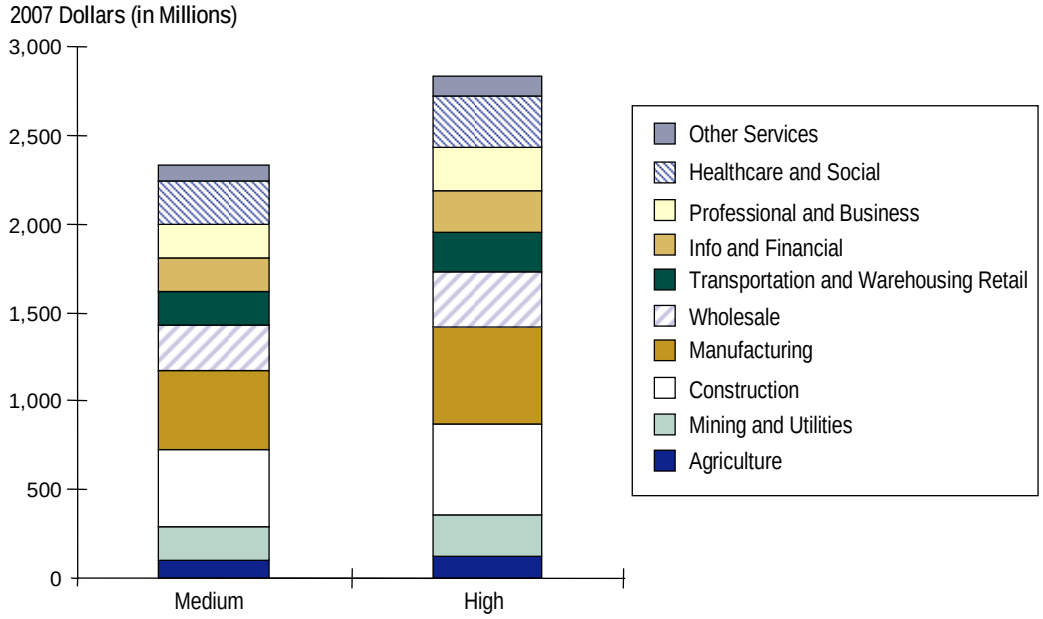
**Household Value-of-Time ($737-$1,050 Million).** Households receive a benefit in the form of time savings for personal travel (that is not business-related) from highway improvement. It should be noted that although household travel-time savings are a measurable (and real) benefit to the region, these benefits do not enter into the calculus of economic impacts, as they typically are not capitalized into any economic exchange. These benefits are included in the benefit/cost analysis.

**Rest of Nation (Pass-Through) ($1.96-$2 Billion).** These are generated from trips that go through the ARC region or those trips that either originate or terminate outside the region. This mostly affects longer truck routes who incur less travel costs due to faster routes. They are taken into account in the national benefit/cost analysis as they are benefits for the United States but not Appalachia.

The distribution of benefits is concentrated in the North and South regions in Appalachia, consistent with the number of counties, corridor projects, and economic size of those regions. Correspondingly, the Central region has 8 percent of the total user benefits.

Figure 5.1 shows the distribution of savings by industry for both the medium- and high-growth scenarios. The total magnitude of savings is higher for the high-growth scenario while the relative impact amongst industries is the same. Wholesale trade and manufacturing are the industries that receive the largest cost savings. These industries rely heavily on freight movement by truck. Service sectors such as healthcare and education, professional and business serves, and retail trade also are highly affected; most likely due to the reduction in time for the commute of workers in these industries.

Figure 5.1 Distribution of Direct Business Cost Savings by Industries
*Medium- and High-Growth Scenarios*




Source: Economic Development Research Group.

## 5.2 MARKET ACCESS IMPACTS

In the previous section, travel-time and cost savings represented benefits to existing households and industries in the region. This section provides access benefits to the region which are mostly due to businesses relocating to the region – these are a benefit to Appalachia but not to the United States. However, market access impacts also include benefits from access improvements to existing businesses that are over and above the travel-cost savings – these are benefiting both the region and the United States.

Figure 5.2 shows the changes in access to markets for consumers and labor force and Figure 5.3 demonstrates reductions in travel time to the nearest commercial airport (see Appendix B for maps of other accessibility measures). While the market access changes to most counties were negligible, there were 50 counties (in the medium-growth scenario) with more than a 10 percent increase in access to labor and consumer markets, seen in the dark shaded counties in map. Beyond the impact on costs for existing travel, improved highway access can have an additional impact of on regional competitiveness for business attraction and expansion. The ease of access to delivery and labor markets are of the utmost importance to businesses deciding where to locate. Other transportation linkages are important and taken into account in the model, including: access to airport, marine port, intermodal rail facility, other international border.

Figure 5.2 Percentage Change in Population Accessible within a 60-Minute Drive in 2035
*Labor and Consumer Markets*

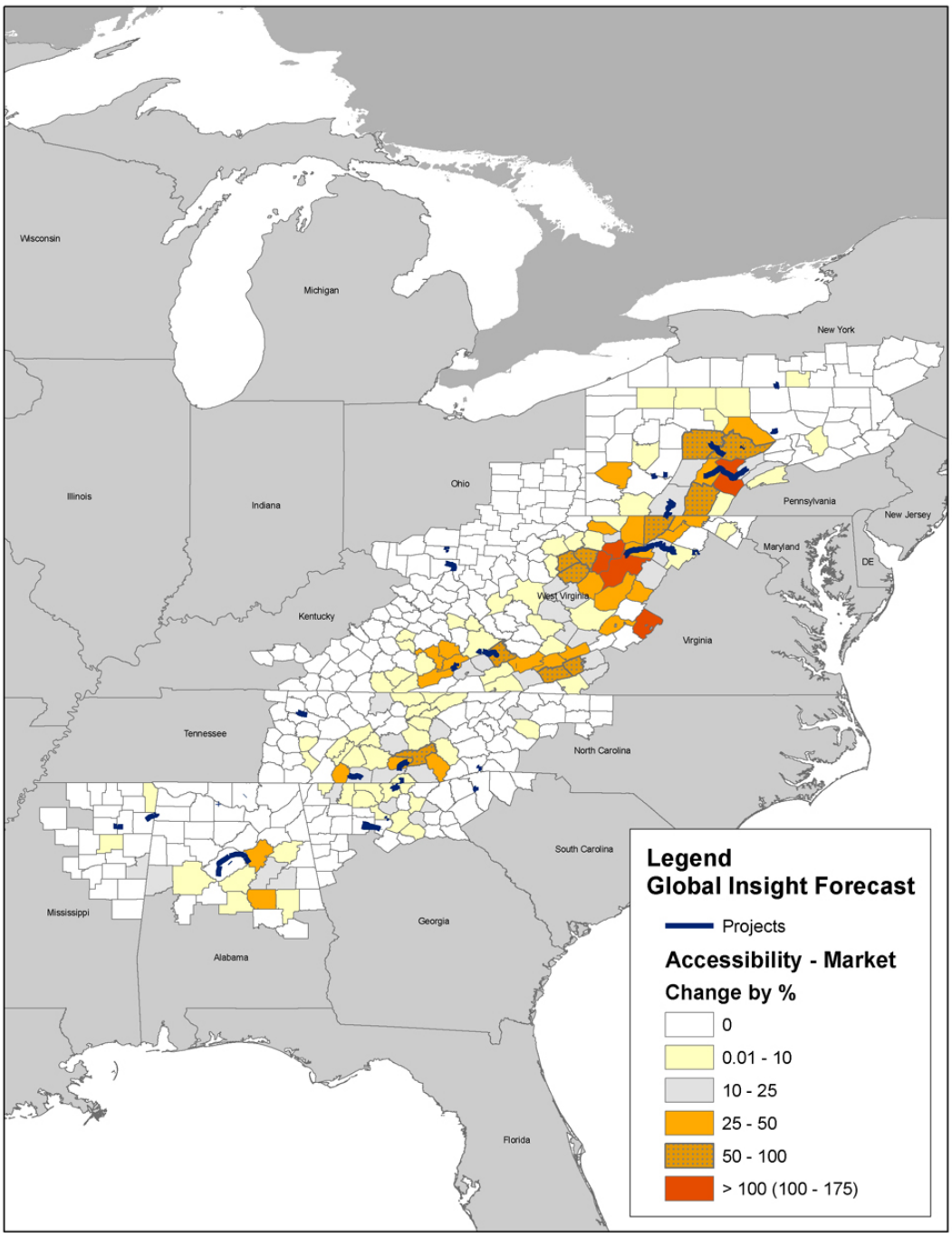
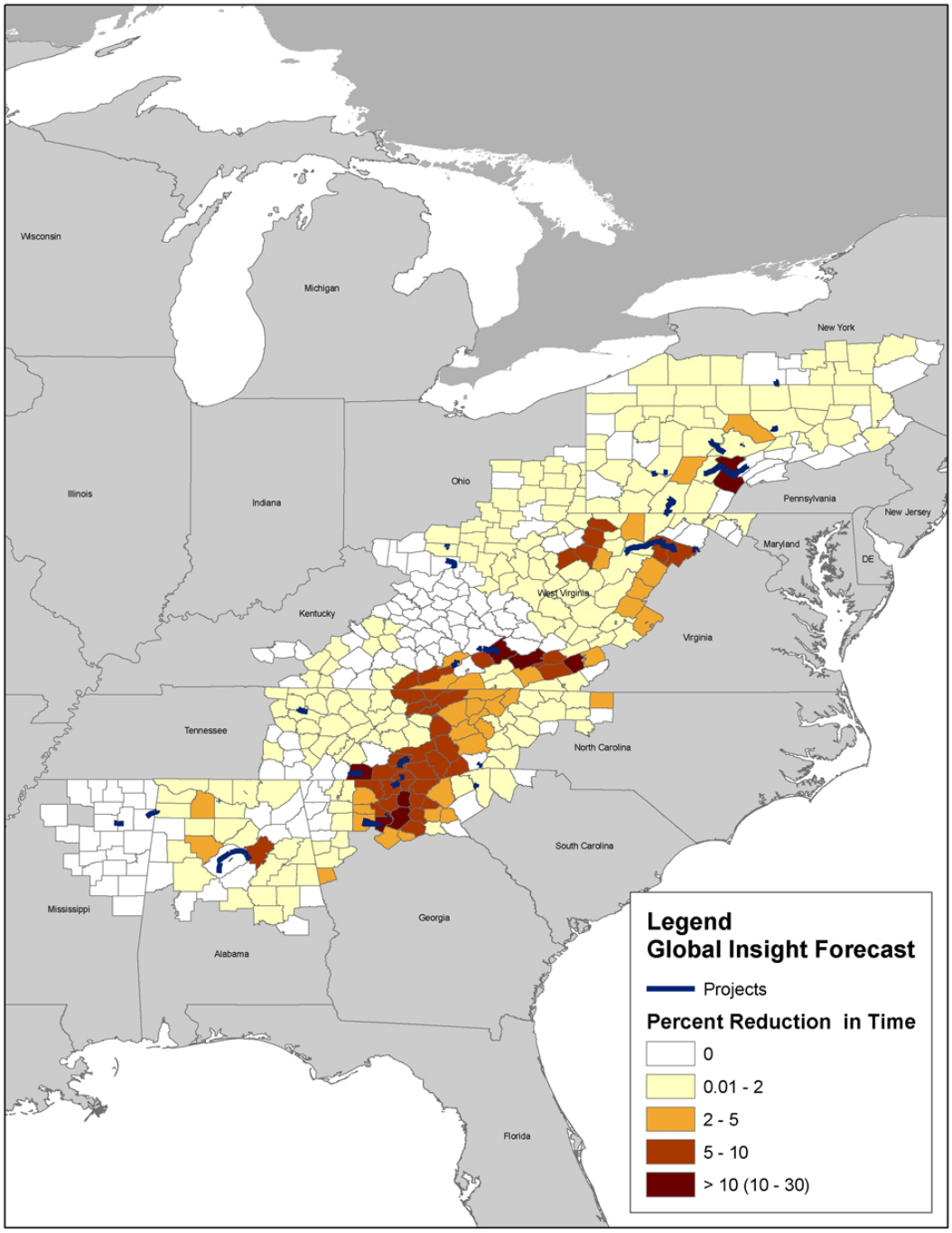


Figure 5.3 Percentage Reduction in Travel Time to Nearest Airport in 2035




The blue markings on the map indicate the location of new ADHS projects. As expected, most of the counties receiving a significant improvement in access lie near a highway project. When faced with difficulties in market access businesses can adjust their warehousing and logistics processes to stock more inventories, provide distribution from a larger number of locations, deploy more delivery

vehicles and drivers, or reduce guarantees for delivery times. All of these adjustments still involve increased costs or reduced revenue that go beyond the direct change in travel time and expense.

The market access impact for the ARC region includes the added activity from business that moves from outside Appalachia to within the region due to economies of scale associated with further market reach. Table 5.2 shows the projected direct business growth impact associated with improved access for Appalachia. This represents the net impact on new business investment in Appalachia. Business relocations within Appalachia are not counted. When viewed at the national level, the market access benefits associated with economic migration (relocations) cancel out, and only the *productivity* and *export* components of market access impacts remain. In all cases, the market access impacts are measured in terms of "value-added" economic activity (aka Gross Domestic/Regional Product), which represents the sum of worker income and business profit income generated in the region.

## Table 5.2 Projected Market Access Growth in Appalachia for Medium and High Scenarios in 2035

| Annual Market Access Impact for 2035 (Value Added Millions 2007 Dollars) | | | | | |
|---|---|---|---|---|---|
| | | North | Central | South | Total |
| Medium-Growth Scenario | Potential | 1,127 | 145 | 1,242 | 2,513 |
| | Probable | 935 | 115 | 1,010 | 2,060 |
| High-Growth Scenario | Potential | 1,130 | 169 | 1,430 | 2,729 |
| | Probable | 940 | 137 | 1,193 | 2,270 |

Source: Economic Development Research Group, using the Local Economic Assessment Package (LEAP).

There are two scenarios for market access benefits – "potential" and "probable" – in addition to the medium and high estimates of underlying economic and population growth. The estimates for "probable" market access impact represent a more conservative estimate, as it assumes that the region successfully achieves some but not all of the "potential" opportunities. It is a more realistic assumption as it accounts for the likelihood that some of the region's current constraints to economic competitiveness (such as workforce characteristics) may remain after the ADHS addresses the major access limitations.

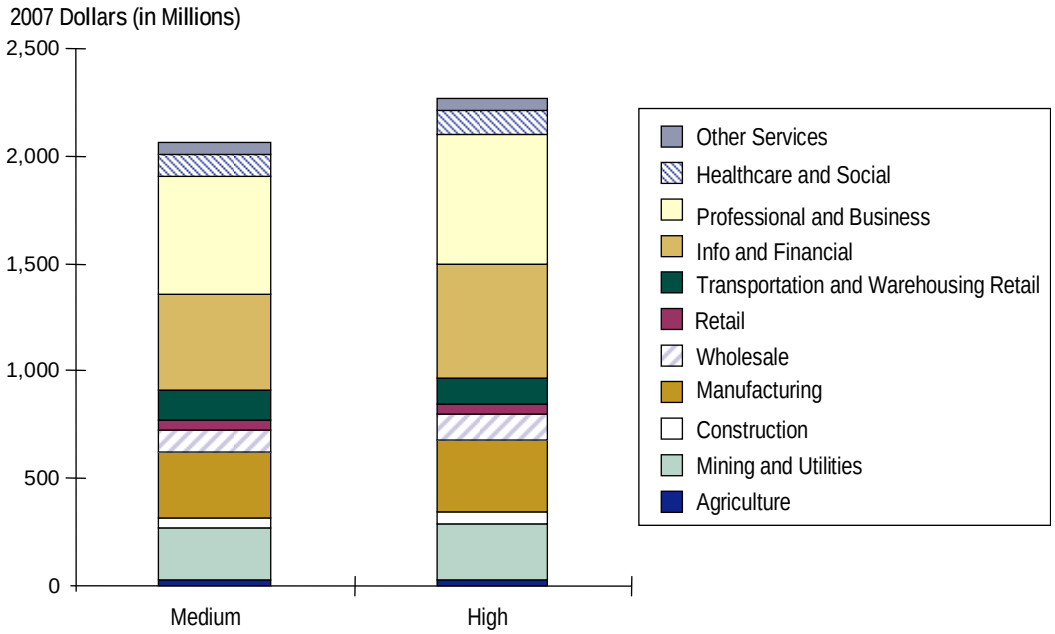
The market access impact of ADHS completion is estimated to yield business growth that will increase over time, rising to the range of $2.1 to $2.3 billion annually by the year 2035. As with the travel-cost savings, most of the impacts are expected to occur in the North and South parts of the ARC region. This reflects the location of the highway projects remaining to be completed, as well as the smaller size of population and employment base in the Central region.

Figure 5.4 shows a breakdown of market access impacts by industry, which are largely those dependent either on access to skilled labor (information, financial, and professional services) or delivery access (manufacturing) to broader national markets. These results are for the previously mentioned "probable" scenario for both medium and high growth. They are less evenly distributed than the results for travel-cost and time savings in the previous section. This is an indication of how much more important access to markets is to the select industries that show a large market access impact.

As previously noted, market access impacts consists of three elements: *exports*, *productivity*, and *relocation*. The analysis results in Figure 5.5 show the distribution of those impacts (applicable for both medium and high scenarios). The three elements of impact are defined as follows:

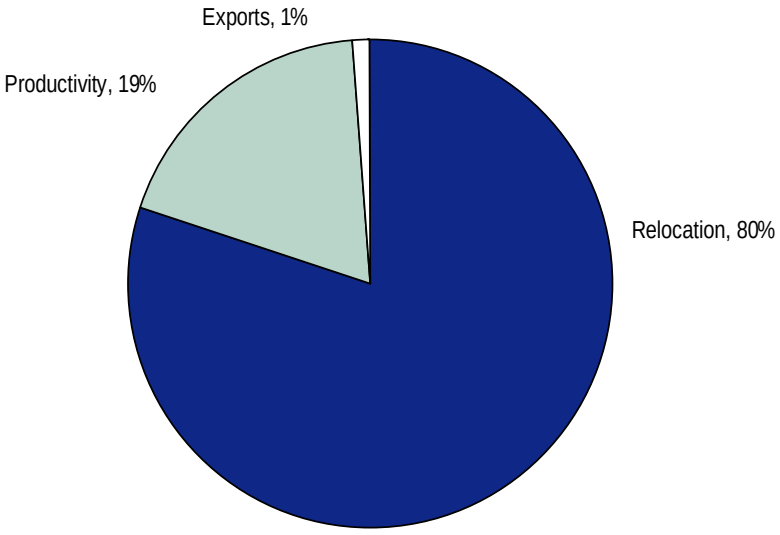
1. **Exports –** Impacts on business growth from exports arise due to improved access to airports, marine ports, and international borders. These represent benefits both to the region and to the U.S.
2. **Productivity –** Impacts on business productivity (output per unit of dollar input cost enabled by the logistics and scale economies in production and distribution systems that result from travel-time and reliability enhancement for isolated areas. They also may reflect access to a more diverse workforce and set of suppliers, which may reduce costs and increase quality of those inputs. This impact also is a benefit for the nation, as well as for the region.
3. **Relocation –** This category represents the bulk of the market access benefits. This occurs when access to markets is improved and businesses are more attracted to locate in the region. This affects businesses that rely on close proximity to labor, consumer and delivery markets. This represents a benefit to the region but not to the United States since it is assumed that business relocate from elsewhere in the United States.

## Figure 5.4 Distribution of Market Access Benefits by Industries for "Probable" Scenario




Source: Economic Development Research Group, using the Local Economic Assessment Package (LEAP).

## Figure 5.5 Components of Market Access Impact



## 5.3 TOTAL ECONOMIC IMPACTS

This analysis included the evaluation of regional economic growth impacts, reflecting the impacts of travel-cost savings as well as market access effects. The direct travel-cost savings accrue to existing (and projected future) trip patterns, while the market access effects enable new activities and trips that would not otherwise occur. Both increase economic competitiveness and hence lead directly to the expansion and attraction of additional business activity in the region. They also lead to "spin-off" activity through indirect effects (spending on suppliers) and induced effects (spending of worker income). All of these effects are calculated using the regional economic simulation and forecasting model in TREDIS. The following is a more detailed explanation of the components of the total economic impact which includes only those effects on Appalachia not on the United States.

**Economic Impact of Travel-Time and Cost Savings –** Business-related travel time and expense changes affect local cost of doing business, while household expense savings affect local cost of living. Changes in these cost savings end up shifting local spending patterns and prices, affecting local business activity and investment, and thus employment for some industries. The economic analysis system also recognizes that not all of these changes are absorbed in the local economy; some are passed on to customers outside of the region.

Changes in travel time for personal (non-business) trips have a value to society. However, they do not directly affect the flow of dollars in the economy, so their value is counted in the benefit/cost analysis but is not counted in the calculation of impact on the regional economy.

**Economic Impact of Market Access Changes –** Changes in access times also lead to effective changes in labor market and product delivery market areas, as well as access to intermodal transportation connections. These access changes end up shifting productivity and thus regional competitiveness for attracting various manufacturing, service, and office industries. Only the "probable" market access impacts were used which allowed for a more conservative impact.

Table 5.3 shows the economic benefit of implementing the new ADHS projects as opposed to current road conditions remaining in place. Therefore, it also could be construed as the loss to the region if the projects were not implemented. All numbers shown here reflect annual impacts as of the analysis year 2035. Benefits for earlier years will be smaller and benefits for later years will be even larger.

Table 5.3 Total Economic Impacts for Medium and High Scenarios in 2035

| | Total Economic Impact for 2035 (Millions 2007 Dollars) | | | |
|---|---|---|---|---|
| | North | Central | South | Total |
| *Medium-Growth Scenario* | | | | |
| *Economic Measure* | | | | |
| Business Sales | 4,165 | 555 | 5,382 | 10,102 |
| Value-Added | 2,129 | 264 | 2,602 | 4,995 |
| Jobs | 33,232 | 5,306 | 41,953 | 80,491 |
| Wages | 1,345 | 178 | 1,674 | 3,197 |
| *High-Growth Scenario* | | | | |
| Business Sales | 4,433 | 667 | 6,429 | 11,529 |
| Value-Added | 2,251 | 317 | 3,112 | 5,679 |
| Jobs | 35,260 | 6,282 | 50,128 | 91,670 |
| Wages | 1,421 | 213 | 2,001 | 3,635 |

Source: Economic Development Research Group.

This table shows impacts on the regional economy, which can be measured in terms of total business sales, value-added, jobs, and wages. The impact on *business sales* is between $10.1 and $11.5 billion annually; this is not entirely felt in the region since the cost of intermediate inputs is included. The impact on *value-added*, the amount of revenue minus intermediate inputs, is between $5 and $5.7 billion. Arguably, the most important effect – *employment* – is increased in range of 80,491 to 91,670. In turn, these new jobs would generate between $3.2 and $3.6 billion in *wages* annually to Appalachia.

These total impacts were phased in gradually based on the time lag effects and growth rates that research implies for the completion of highway projects (see Section 2.5.1 for further description). Impacts are expected to be generated as soon as construction is completed and to be fully realized by 2035. The market access impacts were phased in based on the time lag effect and multiplier effects (indirect and induced) which were implemented based on a review of economic development literature and specific regional research conducted for this report (see Section 2.6.2 above). After 2035, the impacts grow at a constant rate based on assumed travel demand. Figure 5.6 shows the phase-in of total economic impact in terms of jobs in the entire ARC area for the medium-growth (Global Insight) and high-growth (Woods & Poole) scenarios.

Figure 5.6 Estimated Phase-In of the Economic Impact
*Jobs*

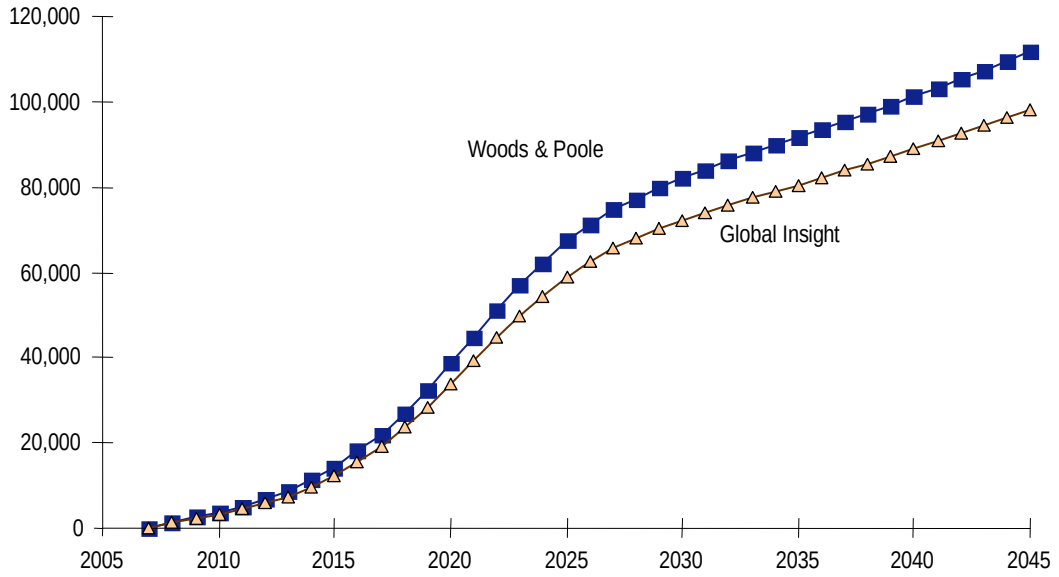
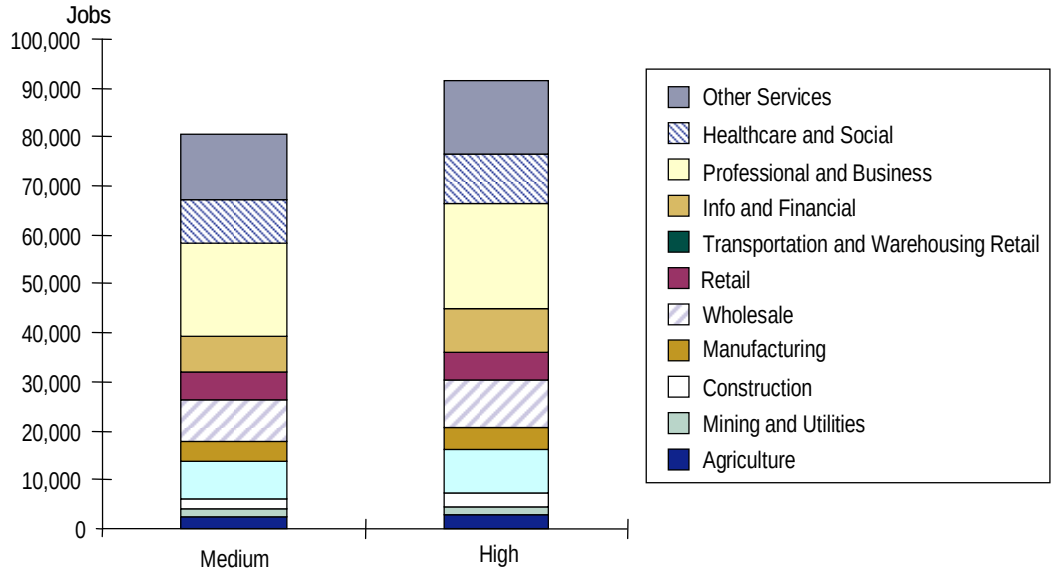



Figure 5.7 shows the breakdown of projected regional employment impacts by industry. That breakdown reflects a combination of the travel-cost incidence, the market access impact incidence, the response of affected industries to enhanced productivity and competitiveness, and the pattern of indirect (supplier) and induced (worker spending) effects.

Figure 5.7 Distribution of Employment Impacts
on the Region for Medium and High Scenarios



# 6.0 Benefit/Cost Analysis

## 6.1 COST TO COMPLETE SUMMARY

This section describes the estimate of the cost-to-complete the Appalachian Development Highway System (ADHS), the scheduling of these capital expenditures and the expected operation and maintenance cost once the road network is completed. In total, the total project calls for the addition of 453.2 miles of highway to the ADHS as shown in Table 6.1.

Table 6.1 Miles to Complete by State

| State | Total Miles | Miles Completed until FY 2012 | Remaining Miles beyond FY 2012 |
|---|---|---|---|
| Alabama | 69.9 | 6.4 | 63.5 |
| Georgia | 31.6 | 0.0 | 31.6 |
| Kentucky | 22.6 | 15.8 | 6.8 |
| Maryland | 2.5 | 0.0 | 2.5 |
| Mississippi | 20.5 | 16.3 | 4.2 |
| New York | 7.7 | 6.6 | 1.1 |
| North Carolina | 24.7 | 1.4 | 23.3 |
| Ohio | 23.3 | 5.3 | 18.0 |
| Pennsylvania | 125.2 | 20.6 | 104.6 |
| South Carolina | 4.3 | 0.0 | 4.3 |
| Tennessee | 26.4 | 25.0 | 1.4 |
| Virginia | 32.2 | 1.0 | 31.2 |
| West Virginia | 62.3 | 29.6 | 32.7 |
| Total | 453.2 | 128.0 | 325.2 |

Source: Cost-to-Complete Study, Appalachian Regional Commission.

The table shows that the State of Pennsylvania is the recipient of the largest portion of infrastructure with 125 miles, approximately one-third of the total. West Virginia and Alabama are projected to receive additions in excess of 60 miles. New York and South Carolina are planned to receive the smallest addition to the ADHS in their respective states. A little less than one-third of the capacity will be added by FY 2012 with the remaining capacity planned to be in construction and completed by FY 2020.

The total capital expenditures are projected to be approximately $10.5 billion of which $2.4 billion will become state obligations. The total cost estimate, also broken down by state, is shown in Table 6.2. The allocation of costs among states

mirrors the scheduled capacity additions. By far, Pennsylvania and Alabama are projected to incur the greatest share of cost with expenditures in excess of $2.5 and $2.8 billion, respectively. Virginia is projected to incur the third largest cost burden with roughly $1.2 billion.

## Table 6.2 Total Cost to Complete ADHS

| | Projected ADHS Annual Obligations | |
|---|---|---|
| | Total ADHS Completion Cost (Thousands) | Total State Obligations (Thousands) |
| Alabama | $2,806,978 | $256,400 |
| Georgia | $369,339 | $0 |
| Kentucky | $736,707 | $514,480 |
| Maryland | $145,036 | $0 |
| Mississippi | $79,721 | $63,200 |
| New York | $99,198 | $85,600 |
| North Carolina | $715,880 | $41,260 |
| Ohio | $413,253 | $94,000 |
| Pennsylvania | $2,592,429 | $426,450 |
| South Carolina | $41,315 | $0 |
| Tennessee | $577,742 | $546,720 |
| Virginia | $1,178,875 | $36,800 |
| West Virginia | $790,461 | $375,840 |
| Total | $10,546,934 | $2,441 |

Source: Cost-to-Complete Study, Appalachian Regional Commission.

The project costs are allocated on an annual basis between FY 2007 and FY 2019 based on estimates and construction plans provided by the Appalachian Regional Commission (ARC). According to ARC, 26 percent of the planned capacity additions will be completed by 2012. No detailed construction schedules exist beyond FY 2012. For the purpose of this assumption, it has been assumed that the remaining miles will be evenly allocated over the next seven fiscal years with all construction completed in FY 2020.

Transportation infrastructure needs to be properly maintained in order to maximize its useful life and minimize the life-cycle cost of owning the facilities. Operation and maintenance expenditures as well as repavement costs have been scheduled between FY 2007 and FY 2045 in order to account for the appropriate annual cost that will have to be incurred by individual states. These cost estimates for O&M and repavement have been developed using the Highway Economic Requirement System (HERS). In particular, it has been assumed that each mile scheduled for construction consists of two lanes and that the annual

cost of maintenance per lane mile is $2,000. Repavement of the road is assumed to occur every 15 years of operation with an expected cost of $351,500 per lane mile.

The projected ongoing cost estimates result in figures presented in Table 6.3. For instance, in FY 2015, the cost of capacity expansion is equal to $1.1 billion and annual operations and maintenance costs are equal to $1.07 million.

Table 6.3 Summary of Cost Schedule

| Million 2005$ | FY 2007 | FY 2010 | FY 2015 | FY 2020 | FY 2025 | FY 2030 | FY 2040 |
|---|---|---|---|---|---|---|---|
| Capital Expenditures | $1,008 | $392 | $1,071 | $0 | $0 | $0 | $0 |
| O&M Expenditures | $0.17 | $0.38 | $1.07 | $2.00 | $2.00 | $2.00 | $2.00 |
| Repavement | $0 | $0 | $0 | $0 | $12 | $33 | $12 |
| Total Cash Flow | $1,008 | $392 | $1,072 | $2 | $14 | $35 | $14 |
| Percent of Mileage Completed | 0% | 18% | 49% | 100% | 100% | 100% | 100% |

Source: Cost-to-Complete Study, Appalachian Regional Commission, and Cambridge Systematics, Inc.

## 6.2 BENEFIT/COST ANALYSIS RESULTS

This section provides a comparison of the costs, impacts, and benefits of completing the entire ADHS network. The nature of this analysis is discussed in the text that follows.

### 6.2.1 Costs

Cost-to-complete the remaining ADHS corridor projects are estimated under two different scenarios. The first assumes that the purchasing power of spending in the construction sector will parallel overall inflation, which is assumed to be 3 percent per year. As such, this is the "low-cost" scenario. The second assumes that purchasing power of spending in the construction sector declines relative to other sectors. In this second scenario, we assume that prices in the construction sector rise at 10 percent per year over the period 2007 through 2010, and prices will rise at an average rate of 4.5 percent thereafter.[18] The accelerated price increases over the early period reflects a continuation of recent trends in the construction sector. Table 6.4 shows costs by year for each scenario, including the present value of costs discounted at 5 percent per year.[19]

[18] The Bureau of Labor Statistics' bridge and highway construction producer price index (BHWY PPI) grew by 35.3 percent from 2003 to 2006, equivalent to 10.6 percent per year.

[19] The application of a discount rate is standard practice within benefit/cost analysis to account for the time value of money (i.e., money today can be invested for a return in the future) and thus prepare costs and benefits in present value terms.

## Table 6.4 Total Spending on Proposed Improvements to ADHS System in ARC Region under Two Inflation Scenarios

*All Values in Millions Constant 2007 Dollars*

| Year | Total Outlay (2007 Million Dollars) | | Percent of Spending on | | |
|---|---|---|---|---|---|
| | Low-Cost Scenario | High-Cost Scenario | Capital Expend | Operation and Maintenance | Refurbishment |
| 2007 | 1,070 | 1,233 | 100.0% | 0.0% | 0.0% |
| 2008 | 424 | 525 | 99.9% | 0.1% | 0.0% |
| 2009 | 520 | 692 | 99.9% | 0.1% | 0.0% |
| 2010 | 416 | 594 | 99.9% | 0.1% | 0.0% |
| 2011 | 553 | 801 | 99.9% | 0.1% | 0.0% |
| 2012 | 256 | 377 | 99.8% | 0.2% | 0.0% |
| 2013 | 1,137 | 1,695 | 99.9% | 0.1% | 0.0% |
| 2014 | 1,137 | 1,720 | 99.9% | 0.1% | 0.0% |
| 2015 | 1,137 | 1,745 | 99.9% | 0.1% | 0.0% |
| 2016 | 1,137 | 1,771 | 99.9% | 0.1% | 0.0% |
| 2017 | 1,138 | 1,797 | 99.9% | 0.1% | 0.0% |
| 2018 | 1,138 | 1,824 | 99.8% | 0.2% | 0.0% |
| 2019 | 1,138 | 1,851 | 99.8% | 0.2% | 0.0% |
| 2020 | 2 | 3 | 0.0% | 100.0% | 0.0% |
| 2021 | 2 | 4 | 0.0% | 100.0% | 0.0% |
| 2022 | 34 | 57 | 0.0% | 6.3% | 93.7% |
| 2023 | 15 | 25 | 0.0% | 14.5% | 85.5% |
| 2024 | 17 | 31 | 0.0% | 12.1% | 87.9% |
| 2025 | 14 | 26 | 0.0% | 14.7% | 85.3% |
| 2026 | 18 | 33 | 0.0% | 11.5% | 88.5% |
| 2027 | 10 | 18 | 0.0% | 21.9% | 78.1% |
| 2028 | 37 | 68 | 0.0% | 5.8% | 94.2% |
| 2029 | 37 | 69 | 0.0% | 5.8% | 94.2% |
| 2030 | 37 | 70 | 0.0% | 5.8% | 94.2% |
| 2031 | 37 | 71 | 0.0% | 5.8% | 94.2% |
| 2032 | 37 | 72 | 0.0% | 5.8% | 94.2% |
| 2033 | 37 | 73 | 0.0% | 5.8% | 94.2% |
| 2034 | 37 | 74 | 0.0% | 5.8% | 94.2% |
| 2035 | 2 | 4 | 0.0% | 100.0% | 0.0% |
| 2036 | 2 | 4 | 0.0% | 100.0% | 0.0% |
| 2037 | 34 | 71 | 0.0% | 6.3% | 93.7% |
| 2038 | 15 | 31 | 0.0% | 14.5% | 85.5% |
| 2039 | 17 | 38 | 0.0% | 12.1% | 87.9% |
| 2040 | 14 | 32 | 0.0% | 14.7% | 85.3% |
| 2041 | 18 | 41 | 0.0% | 11.5% | 88.5% |
| 2042 | 10 | 22 | 0.0% | 21.9% | 78.1% |
| 2043 | 37 | 85 | 0.0% | 5.8% | 94.2% |
| 2044 | 37 | 86 | 0.0% | 5.8% | 94.2% |
| PV (5%) | 8,283 | 12,159 | | | |
| PV (7%) | 7,342 | 10,679 | | | |

### 6.2.2 Impacts and Benefits

There are five categories of ADHS impact that are covered in this study: A) business cost savings; B) household out-of-pocket savings; C) household value of time savings; D) business growth due to improved market access; and E) indirect and induced economic growth (multiplier effects). Traditionally, Categories A-C are considered to be measures of travel efficiency benefit and Categories D-E are considered to be measures of regional economic impact. However, since the ADHS is specifically intended to help address economic distress by improving access in a relatively isolated region, the impacts on economic growth in the ARC region also can be viewed as an indicator of societal benefit and economic return on investment.

The various impacts described in the preceding sections are estimated for the years 2020 and 2035. In order to estimate present values, these impacts are phased in based on: 1) growth rate of underlying traffic volumes from 2020 to 2035; 2) the planned project rollout schedule; 3) empirical research on the timing of market access impacts (see Section 2.5 and Appendix B); and 4) research on the timing of indirect and induced impacts. Tables 6.5 to 6.9 show the annual impacts for each growth scenario, as well as both discounted and undiscounted benefits.

The resulting present values for each impact category are shown in Tables 6.5 and 6.6 using different discount rates.

These tables reaffirm the results of the preceding sections, where within the ARC region, benefits result primarily from industry savings, market access impacts, and secondary economic effects. For the nation as a whole, the latter two impacts are greatly diminished, and benefits flow primarily from industry user savings (travel efficiency and lower costs). Meanwhile, lowering the discount rate to a real 5 percent significantly increases the present value of total benefits as future benefits retain more value.

## Table 6.5 Medium-Growth Scenario Benefits to ARC Region from ADHS by Year

*Undiscounted (2007 Million Dollars)*

| Year | Industry User Savings | HH Out-of-Pocket Savings | HH Value of Time Savings | Total Travel Efficiency Benefits | Market Access Growth |
|---|---|---|---|---|---|
| 2005 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 30 | 0 | 9 | 40 | 1 |
| 2009 | 61 | 1 | 19 | 81 | 2 |
| 2010 | 85 | 1 | 27 | 113 | 4 |
| 2011 | 110 | 1 | 35 | 146 | 6 |
| 2012 | 149 | 1 | 47 | 197 | 9 |
| 2013 | 188 | 2 | 60 | 250 | 12 |
| 2014 | 245 | 2 | 77 | 325 | 19 |
| 2015 | 303 | 3 | 96 | 402 | 27 |
| 2016 | 384 | 4 | 121 | 509 | 39 |
| 2017 | 467 | 4 | 148 | 619 | 55 |
| 2018 | 581 | 6 | 184 | 770 | 78 |
| 2019 | 699 | 7 | 221 | 927 | 113 |
| 2020 | 851 | 8 | 270 | 1,129 | 158 |
| 2021 | 1,009 | 10 | 319 | 1,338 | 226 |
| 2022 | 1,178 | 11 | 373 | 1,562 | 317 |
| 2023 | 1,354 | 13 | 429 | 1,795 | 431 |
| 2024 | 1,500 | 14 | 475 | 1,989 | 576 |
| 2025 | 1,652 | 16 | 523 | 2,191 | 753 |
| 2026 | 1,756 | 17 | 556 | 2,329 | 920 |
| 2027 | 1,864 | 18 | 591 | 2,473 | 1,114 |
| 2028 | 1,937 | 19 | 614 | 2,570 | 1,282 |
| 2029 | 2,013 | 19 | 637 | 2,669 | 1,433 |
| 2030 | 2,069 | 20 | 655 | 2,744 | 1,582 |
| 2031 | 2,127 | 20 | 674 | 2,821 | 1,683 |
| 2032 | 2,182 | 21 | 691 | 2,894 | 1,789 |
| 2033 | 2,238 | 21 | 709 | 2,968 | 1,866 |
| 2034 | 2,283 | 22 | 723 | 3,028 | 1,938 |
| 2035 | 2,328 | 22 | 737 | 3,088 | 2,060 |
| 2036 | 2,375 | 23 | 752 | 3,150 | 2,102 |
| 2037 | 2,422 | 23 | 767 | 3,213 | 2,144 |
| 2038 | 2,471 | 24 | 783 | 3,277 | 2,187 |
| 2039 | 2,520 | 24 | 798 | 3,343 | 2,230 |
| 2040 | 2,571 | 25 | 814 | 3,410 | 2,275 |
| 2041 | 2,622 | 25 | 830 | 3,478 | 2,320 |
| 2042 | 2,675 | 26 | 847 | 3,547 | 2,367 |
| 2043 | 2,728 | 26 | 864 | 3,618 | 2,414 |
| 2044 | 2,783 | 27 | 881 | 3,691 | 2,462 |
| 2045 | 2,838 | 27 | 899 | 3,764 | 2,512 |

## Table 6.6 Medium-Growth Scenario Benefits to ARC Region from ADHS by Year

*Discounted at Five Percent (2007 Million Dollars)*

| Year | Industry User Savings | HH Out-of-Pocket Savings | HH Value of Time Savings | Total Travel Efficiency Benefits | Market Access Growth |
|---|---|---|---|---|---|
| 2005 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 28 | 0 | 9 | 38 | 1 |
| 2009 | 55 | 1 | 18 | 73 | 2 |
| 2010 | 74 | 1 | 23 | 98 | 3 |
| 2011 | 91 | 1 | 29 | 120 | 5 |
| 2012 | 116 | 1 | 37 | 154 | 7 |
| 2013 | 141 | 1 | 45 | 186 | 9 |
| 2014 | 174 | 2 | 55 | 231 | 13 |
| 2015 | 205 | 2 | 65 | 272 | 18 |
| 2016 | 247 | 2 | 78 | 328 | 25 |
| 2017 | 287 | 3 | 91 | 380 | 34 |
| 2018 | 340 | 3 | 108 | 450 | 46 |
| 2019 | 389 | 4 | 123 | 516 | 63 |
| 2020 | 451 | 4 | 143 | 599 | 84 |
| 2021 | 509 | 5 | 161 | 676 | 114 |
| 2022 | 567 | 5 | 179 | 751 | 152 |
| 2023 | 620 | 6 | 196 | 822 | 198 |
| 2024 | 654 | 6 | 207 | 868 | 251 |
| 2025 | 686 | 7 | 217 | 910 | 313 |
| 2026 | 695 | 7 | 220 | 922 | 364 |
| 2027 | 703 | 7 | 223 | 932 | 420 |
| 2028 | 695 | 7 | 220 | 922 | 460 |
| 2029 | 688 | 7 | 218 | 912 | 490 |
| 2030 | 674 | 6 | 213 | 893 | 515 |
| 2031 | 659 | 6 | 209 | 875 | 522 |
| 2032 | 644 | 6 | 204 | 855 | 528 |
| 2033 | 629 | 6 | 199 | 835 | 525 |
| 2034 | 611 | 6 | 194 | 811 | 519 |
| 2035 | 594 | 6 | 188 | 788 | 526 |
| 2036 | 577 | 6 | 183 | 765 | 511 |
| 2037 | 561 | 5 | 178 | 743 | 496 |
| 2038 | 544 | 5 | 172 | 722 | 482 |
| 2039 | 529 | 5 | 168 | 702 | 468 |
| 2040 | 514 | 5 | 163 | 681 | 455 |
| 2041 | 499 | 5 | 158 | 662 | 442 |
| 2042 | 485 | 5 | 154 | 643 | 429 |
| 2043 | 471 | 5 | 149 | 625 | 417 |
| 2044 | 458 | 4 | 145 | 607 | 405 |
| 2045 | 444 | 4 | 141 | 590 | 393 |

## Table 6.7 High-Growth Scenario Benefits to ARC Region from ADHS by Year

*Undiscounted (2007 Million Dollars)*

| Year | Industry User Savings | HH Out-of-Pocket Savings | HH Value of Time Savings | Total Travel Efficiency Benefits | Market Access Growth |
|---|---|---|---|---|---|
| 2005 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 36 | 1 | 13 | 50 | 1 |
| 2009 | 74 | 1 | 27 | 103 | 3 |
| 2010 | 103 | 2 | 38 | 143 | 4 |
| 2011 | 134 | 2 | 50 | 186 | 6 |
| 2012 | 180 | 3 | 67 | 250 | 9 |
| 2013 | 229 | 3 | 85 | 317 | 13 |
| 2014 | 297 | 4 | 110 | 412 | 21 |
| 2015 | 368 | 6 | 137 | 510 | 29 |
| 2016 | 466 | 7 | 173 | 646 | 43 |
| 2017 | 567 | 8 | 210 | 786 | 61 |
| 2018 | 705 | 11 | 262 | 978 | 86 |
| 2019 | 849 | 13 | 315 | 1,177 | 124 |
| 2020 | 1,034 | 15 | 384 | 1,433 | 174 |
| 2021 | 1,225 | 18 | 455 | 1,698 | 249 |
| 2022 | 1,431 | 21 | 531 | 1,983 | 349 |
| 2023 | 1,644 | 25 | 610 | 2,279 | 475 |
| 2024 | 1,822 | 27 | 676 | 2,525 | 635 |
| 2025 | 2,006 | 30 | 744 | 2,780 | 830 |
| 2026 | 2,133 | 32 | 792 | 2,957 | 1,014 |
| 2027 | 2,264 | 34 | 840 | 3,139 | 1,227 |
| 2028 | 2,353 | 35 | 873 | 3,262 | 1,413 |
| 2029 | 2,444 | 37 | 907 | 3,388 | 1,578 |
| 2030 | 2,513 | 38 | 933 | 3,483 | 1,743 |
| 2031 | 2,583 | 39 | 959 | 3,581 | 1,854 |
| 2032 | 2,650 | 40 | 983 | 3,673 | 1,971 |
| 2033 | 2,718 | 41 | 1,009 | 3,767 | 2,056 |
| 2034 | 2,772 | 41 | 1,029 | 3,843 | 2,135 |
| 2035 | 2,828 | 42 | 1,050 | 3,920 | 2,270 |
| 2036 | 2,884 | 43 | 1,071 | 3,998 | 2,315 |
| 2037 | 2,942 | 44 | 1,092 | 4,078 | 2,361 |
| 2038 | 3,001 | 45 | 1,114 | 4,160 | 2,409 |
| 2039 | 3,061 | 46 | 1,136 | 4,243 | 2,457 |
| 2040 | 3,122 | 47 | 1,159 | 4,328 | 2,506 |
| 2041 | 3,185 | 48 | 1,182 | 4,414 | 2,556 |
| 2042 | 3,248 | 49 | 1,206 | 4,502 | 2,607 |
| 2043 | 3,313 | 50 | 1,230 | 4,593 | 2,659 |
| 2044 | 3,380 | 51 | 1,254 | 4,684 | 2,712 |
| 2045 | 3,447 | 52 | 1,279 | 4,778 | 2,767 |

## Table 6.8 High-Growth Scenario Benefits to ARC Region from ADHS by Year

*Discounted at Five Percent (2007 Million Dollars)*

| Year | Industry User Savings | HH out-of-pocket Savings | HH Value of Time Savings | Total Travel Efficiency Benefits | Market Access Growth |
|---|---|---|---|---|---|
| 2005 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 35 | 1 | 13 | 48 | 1 |
| 2009 | 67 | 1 | 25 | 93 | 2 |
| 2010 | 89 | 1 | 33 | 124 | 4 |
| 2011 | 110 | 2 | 41 | 153 | 5 |
| 2012 | 141 | 2 | 52 | 196 | 7 |
| 2013 | 171 | 3 | 63 | 237 | 10 |
| 2014 | 211 | 3 | 78 | 293 | 15 |
| 2015 | 249 | 4 | 93 | 345 | 20 |
| 2016 | 300 | 4 | 111 | 416 | 27 |
| 2017 | 348 | 5 | 129 | 483 | 38 |
| 2018 | 412 | 6 | 153 | 572 | 50 |
| 2019 | 473 | 7 | 175 | 655 | 69 |
| 2020 | 548 | 8 | 203 | 760 | 92 |
| 2021 | 619 | 9 | 230 | 858 | 126 |
| 2022 | 688 | 10 | 255 | 954 | 168 |
| 2023 | 753 | 11 | 280 | 1,044 | 218 |
| 2024 | 795 | 12 | 295 | 1,102 | 277 |
| 2025 | 834 | 12 | 309 | 1,155 | 345 |
| 2026 | 844 | 13 | 313 | 1,170 | 401 |
| 2027 | 853 | 13 | 317 | 1,183 | 462 |
| 2028 | 845 | 13 | 313 | 1,171 | 507 |
| 2029 | 836 | 12 | 310 | 1,158 | 540 |
| 2030 | 818 | 12 | 304 | 1,134 | 568 |
| 2031 | 801 | 12 | 297 | 1,110 | 575 |
| 2032 | 782 | 12 | 290 | 1,085 | 582 |
| 2033 | 764 | 11 | 284 | 1,060 | 578 |
| 2034 | 743 | 11 | 276 | 1,029 | 572 |
| 2035 | 721 | 11 | 268 | 1,000 | 579 |
| 2036 | 701 | 10 | 260 | 971 | 562 |
| 2037 | 681 | 10 | 253 | 944 | 546 |
| 2038 | 661 | 10 | 245 | 917 | 531 |
| 2039 | 642 | 10 | 238 | 890 | 516 |
| 2040 | 624 | 9 | 232 | 865 | 501 |
| 2041 | 606 | 9 | 225 | 840 | 487 |
| 2042 | 589 | 9 | 219 | 816 | 473 |
| 2043 | 572 | 9 | 212 | 793 | 459 |
| 2044 | 556 | 8 | 206 | 770 | 446 |
| 2045 | 540 | 8 | 200 | 748 | 433 |

Table 6.9 Present Value of Impact Streams from ARC Highway Investments, Discounted at Seven Percent per Year
*All Figures Shown in Million 2007 Dollars*

| Impact Type | Medium Growth | | High Growth | |
|---|---|---|---|---|
| | ARC | National | ARC | National |
| A. Industry User Savings | 11,388 | 18,781 | 13,831 | 21,793 |
| B. HH Out-of-Pocket Savings | 109 | 113 | 207 | 215 |
| C. HH Value of Time Savings | 3,607 | 3,754 | 5,133 | 5,343 |
| D. Market Access Growth[a] | 6,514 | 1,261 | 7,176 | 1,390 |
| E. Indirect and Induced Growth[a] | 5,541 | N/A | 6,302 | N/A |
| Total Impacts | 27,159 | 23,909 | 32,649 | 28,741 |

[a] Value Added.

Table 6.10 Present Value of Impact Streams from ARC Highway Investments, Discounted at Five Percent per Year
*All Figures Shown in Million 2007 Dollars*

| Benefit Description | Medium Growth | | High Growth | |
|---|---|---|---|---|
| | ARC | National | ARC | National |
| A. Industry User Savings | 17,310 | 29,114 | 21,023 | 33,737 |
| B. HH Out-of-Pocket Savings | 165 | 173 | 314 | 328 |
| C. HH Value of Time Savings | 5,482 | 5,718 | 7,803 | 8,137 |
| D. Market Access Growth[a] | 10,684 | 2,069 | 11,769 | 2,280 |
| E. Indirect and Induced Growth[a] | 9,551 | N/A | 10,862 | N/A |
| Total Impacts | 43,192 | 37,074 | 51,771 | 44,482 |

[a] Value Added.

Although the magnitudes are somewhat higher for the Woods & Poole growth scenario, the patterns are very similar. Within the ARC region, direct travel savings account for roughly half of overall impacts (with industry receiving a disproportionate share), while market access impacts and secondary economic growth account for the other half. Moving to the National perspective, most of the market access impacts are lost (by accounting for "reshuffling" of the location of existing businesses and jobs), but direct travel savings are greatly increased by including benefits of "through" traffic.[20] These larger impacts arise because a

[20] "Secondary" indirect and induced impacts are not considered at the national level due to constraints on labor mobility into and out of the United States.

large number of firms utilize the improved infrastructure, but are located outside the ARC region.

### 6.2.3 Benefit/Cost Ratios

Total impact results are summarized in Table 6.11. They are shown both as: 1) *travel efficiency benefits* (reflecting industry savings, household out-of-pocket savings and household time savings); and as 2) *total economic benefits* (reflecting the combined impacts of direct travel-cost savings, market access improvements and indirect and induced growth). All values are expressed in terms of the present value of future benefit and cost streams over 30 years, expressed in constant 2007 dollars.

The comparison of benefits and costs are shown as *net present values* (representing benefits minus costs) and as *benefit/cost ratios* (representing benefits divided by costs). They are shown as ranges, reflecting varying assumptions about future construction cost increases and future baseline growth forecasts:

The lower bound of the ranges reflect the high-cost scenario (accelerated cost increases in the construction sector above the general rate of inflation), along with Global Insight's medium baseline growth scenario.

The upper bound of the ranges reflect the low-cost scenario (construction costs following the general rate of inflation), along with the higher baseline growth scenario from Woods and Poole.

Finally, all results are displayed using both a 7 percent real discount rate and a 5 percent real discount rate. While Office of Management and Budget (OMB) guidelines had in the past recommended a 7 percent discount rate for program evaluation, most economists today recognize a 5 percent real discount rate as a more reasonable measure of the opportunity cost of capital. (It represents the private sector cost of borrowing, over-and-above the rate of inflation. While government bonds have a lower cost of borrowing, they come at the cost of displacing private sector borrowing.)

Economic return on investment also was calculated from two perspectives: 1) the ARC region; and 2) the entire United States. While costs are assumed to be the same from either perspective, benefits vary in two important ways:

*Travel efficiency benefits* are significant for the ARC region but even higher from a national perspective. That is because a significant share of the affected trips are long-distance freight shipments that have a high value and extend to origins and destinations beyond the ARC region.

On the other hand, *total economic benefits* are high for the ARC region but lower from a national perspective. That is because benefits of increased market access, including induced economic growth and development, accrue largely to the ARC region via regional economic impacts, although there are also productivity and export gains for the rest of the United States in addition to direct travel efficiency benefits.

## Table 6.11 Net Present Value and Benefit/Cost Ratio Ranges for ARC Highway Investments

| | | Net Present Value (Million Dollars) | Benefit/Cost Ratio |
|---|---|---|---|
| *Using a Five Percent Discount Rate* | | | |
| Travel Efficiency Benefits[a] (A+B+C) | ARC | 10,797-20,857 | 1.9-3.5 |
| | National | 22,845-33,919 | 2.9-5.1 |
| Total Economic Benefits[a] (A through E) | ARC | 31,032-43,488 | 3.6-6.3 |
| | National | 24,914-36,199 | 3.1-5.4 |
| *Using a Seven Percent Discount Rate* | | | |
| Travel Efficiency Benefits[a] (A+B+C) | ARC | 4,425-11,829 | 1.4-2.6 |
| | National | 11,969-20,009 | 2.1-3.7 |
| Total Economic Benefits[a] (A through E) | ARC | 16,480-25,307 | 2.5-4.5 |
| | National | 13,230-21,399 | 2.2-3.9 |

Source: Economic Development Research Group and HDR Decision Economics.

[a] Lower-range value reflects high-cost and medium-growth (Global Insight) scenarios; upper-range value reflects low-cost and high-growth (Woods & Poole) scenarios.

As shown in Table 6.11, the key findings are as follows:

No matter the scenario, the perspective, the assumptions, or the inclusion of more narrow or expansive measures of economic benefit, completing and maintaining the remaining ADHS corridor segments is expected to generate benefits in excess of costs.

*Travel Efficiency (U.S.)* – The present value of travel efficiency benefits at the national level is estimated to be at least 2.9 times the cost (using a 5 percent discount rate). With alternative assumptions regarding the discount rate, construction costs and growth forecasts, that value may range from 2.1 to 5.1. This represents the traditional measure of travel efficiency and even the most conservative assumptions produce a national economic return of over $2 for every $1 of cost.

*Travel Efficiency (ARC Region)* – Regardless of the assumptions made, travel-cost savings accruing to people and businesses within the ARC region amount to approximately two-thirds of the national value and thus a benefit/ratio in excess of 1.0.

*Total Economic Benefits (ARC Region)* – The present value of total estimated economic benefits for the ARC region is at least 3.6 times the estimated cost (using a 5 percent discount rate). With alternative assumptions regarding the discount rate, construction costs and growth forecasts, that value may range from 2.5 to 6.3. This represents the increase in total economic effects,

including value added due to increased business activity, as well as travel-cost savings. Since a goal of the ADHS is to promote economic growth in the region by reducing isolation, these total economic impacts are indicative of how completing the ADHS can help achieve that goal.

*Total Economic Benefits (U.S.)* – At the U.S. level, the estimated total economic benefit impact is 3.1 times the estimated cost (using a 5 percent discount rate). With alternative assumptions regarding the discount rate, construction costs and growth forecasts, that value may range from 2.2 to 5.4. This impact represents the modest additional increase in value added due to productivity and export gains from travel-cost savings and access/connectivity improvements. The value is lower than the economic impact for the ARC region since business location shifts are assumed to cancel out at the national level. However, the value is higher than the national-level travel efficiency impact shown above, due to the inclusion of effects beyond pure travel-cost savings.

### 6.2.4 Conclusions

The analysis reported here indicates that completion of the ADHS will result in significant benefits in excess of costs, under all scenarios and assumptions regarding costs, growth, and discount rates. The benefit/cost ratios associated with ADHS completion are within the range usually found for individual highway projects that are funded, which tend to be between 1.2 and 3.5[21] and also within the range of coordinated transportation investment programs. The benefit/cost ratios of ADHS completion actually tend towards the upper end of the range for the ratios found for rural corridors in the United States. There are several reasons for this result:

The remaining ADHS highway projects complete important linkages in a long-distance network, rather than just serving connections between individual communities;

Many of these projects open up access for isolated, mountainous areas, rather than merely expanding system capacity;

Benefits of the remaining segments leverage benefits of already-completed parts of the system; and

These highway segments are projected to serve a mix of trips with a high portion of long-distance truck travel, which has a particularly high value of time savings.

The importance of these network-related factors is amplified by the growing national and global nature of industries and markets. These findings underscore the role that a completed ADHS can make to the future economic competitiveness of the ARC region and the United States.

[21] This range is based on results of highway benefit/cost studies conducted in Wisconsin, Indiana, Oregon, California, Montana, New York State, and Canada.

# A. Travel Demand Model

The purpose of the Appalachian Region Commission (ARC) travel demand model is to evaluate the future conditions upon completion of the Appalachian Development Highway System (ADHS). The proposed ADHS was evaluated using the ARC travel demand model to determine the impact on the travel performance. Highway projects such as adding capacity to a roadway, adding additional mileage of roadways, and relocation or removal of roadways were analyzed using the travel demand model.

Forecast travel demand models traditionally consist of four steps. During the first step, Trip Generation, the number of trips being produced and attracted to or by an area is estimated based on the land use of the area and generation rates which are usually derived from a survey. The second step, Trip Distribution, determines the number of trips from the Trip Generation step that are going between areas. The third step, Mode Split, predicts by which mode of transportation the trips will occur. The final step, Trip Assignment, assigns the trips to a network that represents the modeled area.

The travel demand model developed for the ARC travel demand model is not a four-step model. The ARC travel demand model uses an Origin-Destination Matrix Estimator (ODME) procedure to estimate the trip tables used in the model. The ODME procedure replaces the traditional trip generation and distribution steps of the four-step modeling procedure. ODME is an accepted practice that estimates trip tables based on traffic count data. Traffic count data is generally more readily available than the socioeconomic data that is required for trip generation, and since ODME does not need survey data to derive trip rates and lengths, the procedure is dramatically less costly to implement.

The mode split step in not included in the model. However, three different modes/purposes were used in the model. Trip tables were developed for automobiles and trucks, with the truck being further classified as commodity-carrying trucks and non-commodity-carrying trucks.

The assignment step from the four-step model is used in a similar manner in the ARC travel demand model. Commodity and non-commodity trucks are assigned to the network together with automobile trip table in a multiclass congested equilibrium assignment.

# A.1 BACKGROUND

The analysis for the completion of the ADHS requires forecasts of the traffic volumes on the all of the roadways in the ARC region that will vary in response to the ADHS improvement alternatives. While there is no travel demand model for the multistate Arc region, the basic functionality of such a model; i.e., trip tables and networks, were developed as part of this project. A highway network was being developed and trip tables were being estimated from observed traffic counts using an origin-destination matrix estimation (ODME) technique. The TransCAD travel demand modeling software used in this study has an ODME feature available as a standard option.

# A.2 MODEL DEVELOPMENT

## A.2.1 Highway Network

A TransCAD highway network for the United States was developed as part of FHWA's Freight Analysis Framework – Version 1 (FAF1)[22] project. It provides basic infrastructure and connectivity information for major highways in the United States. The FAF1 highway network of the United Sates uses counties as loading points.

This highway network includes sufficient detail to analyze the ADHS performance. It includes highway throughout the United States, far beyond the boundaries of the ARC region. The FAF1 highway network includes automobile and truck traffic counts on all links in the highway system. Those traffic counts are those reported by the state department of transportation, primarily through the FHWA's Highway Performance Monitoring System. The HPMS submittals also provide lane, speed, and capacity information that were included in the FAF1 network. Only major roads were included in the highway network model.

The boundaries chosen for the ARC travel demand model highway network, was selected to include not only the highways in the ARC region, but the major highway decision points, for example the interstate highways nearby the ARC region, where a traveler could chose to use or not use a route involving an improved ADHS road, based on the quality of service that was being provided. Therefore, rather than just the 417 counties (and incorporated cities in Virginia) as TAZs in the model, and a total of 697 counties are included as TAZs in the model, 280 of which are in a "halo" of TAZs/counties within the model boundary but outside the ARC region. The highway network includes not only 23,042 miles of intestates and other major highways within the ARC region but 76,634

[22] Battelle Memorial Institute, Freight Analysis Framework Highway Capacity Version 1: Methodology Report, Office of Freight Management and Operations, Federal Highway Administration, April 18, 2002.

miles outside of the ARC region for a total of 99, 676 miles of major highways in the entire model area.

At the edge of the model region, 125 external stations were coded to provide for travel between these external stations and the remainder of the United States. The inclusion of these stations allows the inclusion of automobile and truck trips that travel from the rest of the United States to the ARC model TAZs, to the rest of the United States from the ARC model TAZs, or from the western United Stets to the eastern United States passing through the highway in the Arc model region.

## A.2.2 Trip Tables

Absent a traditional "four-step" model covering the ARC region, including the "halo" of counties surrounding the Arc region, an alternative method had to be identified to develop base year trip tables. The Origin Destination Matrix Estimation technique implemented in TransCAD was used for this purpose. This technique builds the statistically most likely trip table that is consistent with the highway network and its observed traffic counts. This feature is included as a standard feature in TransCAD. The method is improved with the use of a "seed" trip table. An unvalidated "seed" table was created by applying standard national trip generation rates to the base year socioeconomic data in the model and then distributing those trips based on the average highway travel times between TAZs in the model using a standard gravity model trip distribution.

When assigned to the highway network, the base year trip table will produce average daily trips between counties and the external stations that match the average daily traffic counts. Separate counts were provided for trucks and autos. This information was used to estimate separate automobile and truck trip tables.

The truck trip table is based on observed truck volumes, which include both freight and non-freight trucks. The 2002 FAF2 commodity freight truck table was allocated from FAF2 regions to the ARC model counties using the county percentages by commodity from a 1998 commodity flow freight database developed for ARC by Marshall University. This table includes additional detail about the contents of those freight trucks. These commodity tables were subtracted from the original ODME truck table. This will result in an automobile trip table, a non-freight truck trip table, and additional freight truck trip tables by commodity.

## A.2.3 Assignment

The trip tables can be assigned to the highway network in a conventional manner using the congestion on the highway links to determine the shortest paths. Changes in the physical attributes of the highway system can be coded and used to test how traffic volumes will change in response to highway improvements. A terrain code was added to all roads in the Arc highway network which characterizes the highway section as "flat," "rolling," or "mountainous." That terrain

code was based on average terrain in the county. Before calculating congested speeds a Passenger Car Equivalent of 1.5, 2.5, or 4.5, for flat, rolling and mountainous terrain respectively was applied to the assigned volume of trucks prior to comparing the total volume on the highway to the capacity of highways when the congested speed is computed. The congested speeds are used in an equilibrium assignment that ensures that each vehicle traveling between two zones ahs the same congested travel time, regardless of which route is chosen.

### A.2.4 Forecast Trip Tables

The estimated trip tables are prepared independently of trip generation and distribution steps so these steps cannot be used to produce forecasts. Forecast trip tables are produced by factoring the estimated trip table based on changes in county-level employment and population. Standard trip generation rates were applied to the Global Insight (medium- growth scenario) 2020 and 2035 population and employment and for the Woods and Poole (high-growth scenario) 2020 and 2035 population and employment forecasts. Those rates were applied to the base automobile and non-commodity freight truck trip tables using the ratio of the base and future control totals by county using an Iterative Proportional Fitting technique (i.e., Fratar). The future freight truck table was developed by allocating the FAF2 2020 and 2035 trip tables in exactly the same manner that the base year commodity trip table was created.

### A.2.5 Future Assignments

The development of future year trip tables together with the existing and future highway networks provided the ability to forecast future highway volumes for those future networks. The No-Build highway network was created by updating the base year network with ARC "Cost to Complete" GIS database. That database was used to identify ADHS improvement that have been completed or will be completed by others, in addition to ADHS projects where construction is committed by ARC. Those projects define the No-Build highway network. Those ADHS project for which funding has not yet been secured are part of the Build scenario. The ARC "Cost to Complete" GIS database was used to determine the proposed number of lanes and the proposed design speed for widen section of ADHS highway, and the design and location of new roads.

# B. Market Access and Economic Development Impacts Modeling

Section 2.5 summarized the methodology for estimating economic development benefits, using the Transportation Economic Development Impact System (TREDIS). This appendix presents additional information regarding that methodology. It is organized into three parts: 1) process for analysis of market access changes and business attraction impacts, 2) description of market access changes, and 3) analysis of economic impact timing and magnitude.

## B.1 MARKET ACCESS IMPACT METHODOLOGY

### B.1.1 Process for Estimating Market Access Benefit

This section expands upon the description of the market access impact analysis process that was provided in Section 2.5.2 of the main report. In summary, this process estimates the extent of new economic activity created by changes in transportation connectivity and access – effects that are beyond the traditional "travel efficiency benefit" measures of travel time, cost, and safety changes. It covers two types of transportation changes created by completion of the ADHS:

(A) Impacts from expanded *market reach*, facilitating agglomeration economies (i.e., operational efficiencies associated with working in larger markets); and

(B) Impacts from enhanced *intermodal connectivity*, resulting from either enhanced service levels or enhanced connectivity to those services.

For each county within Appalachia, market reach change is measured in terms of size of the labor market (measured as population accessible within 60 minutes of the county population center), and size of the same-day truck delivery market (measured in terms of employment within three hours one-way truck delivery time from the county populations center). Intermodal connectivity is measured in terms of the change in travel times from each county to the nearest commercial airport, marine port, intermodal rail facility and international freight gateway.

The methodology for estimating market access impacts in TREDIS is drawn from the Local Economic Assessment Package (LEAP) economic development analysis process. Impacts are estimated at the county level based on the access change variables, shown above. The steps are as follows.

First, the groups of ARC counties are compared to non-ARC counties in the same states to determine whether the extent to which they exhibit "gaps" in economic

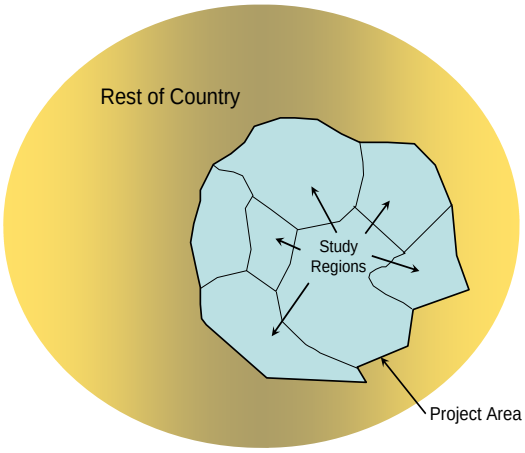
mix or growth performance. This gap analysis is performed at the industry level. Second, the relative strengths and weaknesses of transport and non-transport factors are assessed. This step identifies whether any economic development potential in the study area can be achieved by improving access factors (as, say, improving the quality of the labor force). After the potential benefit from improving transport access is identified, the market access module utilizes the inputs shown above to determine the extent of the access improvements. This leads to the final step of estimating the magnitude of economic development impact.

The magnitude of the impact is determined by cross-referencing three "pools" of data. These are: 1) the mix of industry observed in the study area; 2) each industry's utilization of and sensitivity to different modes in select markets; and 3) the extent of improvement of these modal accessibilities. The markets considered in the present study include the labor market, final demand consumer markets, supply-chain delivery markets, and markets for international imports and exports.

## B.1.2 Multiregion Applications: Net and Gross Impacts

The Market Access module is based on the theory that locational advantage strengthens an area's potential for conducting business. In practice, given a change in access to markets, subsequent growth may reflect either local productivity gains or relocation of productive activity from other areas (or some combination thereof). Activity shifts may reflect actual firm migration or local industrial expansion coupled with contraction elsewhere. This can include shifts from outside areas to the Appalachian region, or shifts within the Appalachian region. Clearly, there is a need to adjust for the latter case to avoid double-counting of economic impacts.

In a multistate regional analysis as applied in this study, TREDIS accounts for potential offsets within the broader study area with a spatial adjustment module. This module distinguishes the extent to which business attraction and relocation occurs within the Appalachian region or from outside to the Appalachian region. This makes it possible to estimate the *net* economic development impact for the overall Appalachian region.



### B.1.3 Sources of Growth

The spatial adjustment module is sensitive to several types of growth following an access-improving transportation investment. These fall into three categories: increased productivity, increased export activity, and relocation of productive factors.

First, an access improvement may raise the productivity of the directly affected region. In this category, we use the term "productivity" to mean the ratio of output per worker (as opposed to "expansion of output"). This productivity gain stems from the benefits of increased agglomeration. These positive externalities have been well-established in the literature,[23] and reflect the mechanisms of better labor matching, better selection of intermediate inputs, and knowledge spillovers. The ensuing productivity gains are realized as increased output and value added relative to employment. In other words, access (and resulting agglomeration) allows firms to make better use of existing labor and capital inputs without necessarily increasing local employment. As such, any local benefits from market access improvements do not necessarily come at the expense of other parts of the study area. In fact, research indicates that productivity gains from agglomeration are more likely to have positive spatial externalities – that is, local gains may improve the economic performance of neighboring areas.

The second possible effect is a gain in industrial output (sales) through increased exports. Results are based on research relating exports (sales) to accessibility to different types of international gateways. As such, improvements in access may increase industrial output in the host region such that: 1) technology does not necessarily change – that is, the ratio of output and income to employment may remain constant; and 2) economic benefits to one region do not necessarily come at the expense of others, because the increased outputs helps satisfy international demand (which is assumed to be highly inelastic).

Finally, accessibility improvements may change the geography of profitability for spatially competitive firms. Access changes have the potential to increase revenue potential or decrease costs at a particular location relative to other locations. The increased revenue potential may come from increased accessibility to consumers of a particular type; decreased costs may come from industrial or logistical reorganization capitalizing on access changes (these are distinct from travel-time and travel-cost savings). In either case, an access improvement may induce migration of productive factors to take advantage of the new economic landscape. The key point here is that the migration is due to *relative cost changes between regions in spatial competition*. In practice, this "migration" occurs over relatively long-time scales (5 to 10 years), and may be observed as either physical

[23] For a review of the theory and empirics of agglomeration-productivity relationships, see reviews by Rosenthal and Strange (2003), Puga (2003), Fujita and Thisse (2002), or Eberts and McMillen (1999).

relocation of a single business, through firm birth/death that benefits one region at the expense of another, or it could reflect the opening of branch offices in one location at the expense of another. In any of these cases, local economic growth comes at the expense of other competing jurisdictions, and, therefore, must be accounted for when considering the net impact to each in a multi-region project.

### B.1.4 Adjusting for Spatial Relocation

The Market Access module estimates the impacts due to each of the three effects described above separately. Because the first two effects are assumed to have no relocation impacts on neighboring areas, only the third impact type is used to determine net impacts to a group of distinct study regions. More specifically, the spatial accounting module estimates the spatial relocation of *employment* resulting from market access improvements that affect relative cost or revenue factors.

The module begins by considering the estimated economic development gains in employment to a "destination" area within the larger study region. These gross impact numbers reflect potential benefits to an area *as though it were the only one impacted by a project*. The destination area is then compared, in a pair-wise fashion, to all the other areas within the broader study region. For each pair, employment relocation is estimated from the "source" area to the "destination" area based on several factors (discussed below). After all interproject area pairs have been cycled through, the module moves to another "destination" area, and all pair-wise comparisons are performed again. This sequence is repeated for as many times as there are areas within the broader study region.

Each pair-wise comparison is made on an industry-specific basis. In other words, the module asks: "if the destination area is forecast to gain X jobs in a specific sector, then how many of those jobs may be drawn from the 'origin' area?" The result is based on several factors, including sector properties, the distance between the two areas, and the industry trends of the origin area.

**Sector Properties –** For any area-to-area pair within the broader region, the magnitude of relocation depends on the specific industry under consideration. This accounts for different levels of mobility among different types of production. For example, service sector firms are more mobile than manufacturing firms because the latter are more capital intensive and, therefore, moving costs are higher. Furthermore, revenues for service firms are typically more spatially dependent than manufacturing firms. Finally, industries that are nationally or globally serving may be less sensitive to cost differences between two areas. Other things equal, locally serving sectors are modeled as more mobile, and more likely to be drawn from nearby areas, whereas more nationally serving industries are modeled as less mobile, and as more likely to be drawn from anywhere in the area (rather than *only* nearby areas).

**Inter-county Travel Times –** For those sectors that are more locally serving, the amount of industrial relocation is modeled as declining with distance between origin and destination area. The reason for this distance decay is that mobile, locally serving industries are more likely to move in response to *observed* access improvements, and the likelihood of observing these improvements declines with distance. The net impact to nationally serving firms also diminishes with distance, but the effect is much less pronounced. Travel times are estimated using Oak Ridge county-to-county "impedances," which reflect travel times with an "average" amount of highway congestion. Other things equal, distance diminishes the amount of inter-county industrial mobility predicted in the model (the effect varies based on sector, as discussed in the previous bullet).

**Industry Trends –** Finally, the mobility of industrial activity between two firms is modeled as being a function of industry trends in the "source" area. This accounts for the fact that growing economies are less likely to lose industrial growth than declining ones. TREDIS measures this by trend analysis. If, in recent history, the "origin" area has seen growth in employment higher than the United States average, then that area is less likely to contribute to the destination area's growth impact. It is important to note that growth is measured relative to United States trends, so an area with declining employment may still be considered "healthy" if employment is declining at a slower rate than the United States (for that sector).

To estimate the net economic impact to each study area, the above factors are accounted in such a way to normalize the effect for the size of the larger project region *relative to the rest of the country*. This may be explained conceptually by noting how the model behaves for project areas of increasing size. Consider a region with only two counties as study areas. These counties may net very little employment from each other, but may net a large number of jobs from the rest of the country. As the project area expands, a greater amount of inter-region mobility cancels itself out, because a greater amount of employment is drawn from *within* the project region as compared to the rest of the United States. Taken to its limit, for an analysis where the project area is defined as the entire United States, all employment migration will net to zero – that is, the model will estimate the net impact to each county in such a way that this impact sums to zero across all counties. It is important to note that TREDIS may still predict a net *productivity* or *export* impact at the United States level, but no new employment will be forecast as a result of inter-region mobility.

# B.2 MARKET ACCESS INPUTS

These tables provide summaries of the changes in market access from no-build to build. The amount in each cell is the number counties that fall into the corresponding category for each variable.

Table B.1 provides the change in the accessible markets by 2035 for ARC due to the improved highway access for the medium scenario.

Table B.1 Changes in Accessible Population (Number of Counties) by 2035
*Medium Scenario (Global Insight)*

| Percentage Change | Consumer/Labor Market (60 Minutes) | Delivery Market (180 Minutes) |
|---|---|---|
| 0% | 335 | 97 |
| <5% | 11 | 215 |
| 5%-10% | 14 | 34 |
| 10%-20% | 18 | 25 |
| 20%-30% | 7 | 18 |
| >30% | 25 | 21 |

Table B.2 provides the improvement in access time to all modes of transportation for counties in Appalachia for the medium scenario. The last column shows the number of counties that had the largest impact in terms of minutes for any given mode (for example: 37 counties received no improvement for access to any mode).

Table B.2 Changes in Mode Access (Number of Counties) by 2035
*Medium Scenario (Global Insight)*

| Change in Access Time (Minutes) | International Gateway | Rail | Air | Water | Largest Mode Change |
|---|---|---|---|---|---|
| 0 | 94 | 117 | 152 | 137 | *37* |
| < 5 Minutes | 217 | 243 | 215 | 199 | *240* |
| 5 to 10 Minutes | 34 | 13 | 14 | 14 | *20* |
| 10 to 20 Minutes | 29 | 15 | 21 | 47 | *59* |
| 20 to 30 Minutes | 25 | 7 | 6 | 10 | *30* |
| >30 Minutes | 11 | 15 | 2 | 3 | *24* |

Table B.3 shows the modes that had the largest impact – shown by the number of counties. This explains that while a majority of counties received a small impact on mode access; however, 119 counties had a mode access improvement greater than 10 minutes.

Table B.3 Largest Mode Access Change (Number of Counties) by 2035
*Medium Scenario (Global Insight)*

| Change in Access Time (Minutes) | International Gateway | Rail | Air | Water | Total |
|---|---|---|---|---|---|
| < 5 Minutes | 95 | 71 | 36 | 52 | 254 |
| 5 to 10 Minutes | 12 | 6 | 2 | 1 | 21 |
| 10 to 20 Minutes | 15 | 5 | 12 | 33 | 65 |
| 20 to 30 Minutes | 19 | 4 | 2 | 5 | 30 |
| >30 Minutes | 9 | 13 | 0 | 2 | 24 |

Tables B4 through B6 are provided for the high scenario; they correspond to the preceding tables shown for the medium scenario.

Table B.4 Changes in Accessible Population (Percent of Counties) by 2035
*High Scenario (W&P)*

| Percentage Change | Consumer/Labor Market (60 Minutes) | Delivery Market (180 Minutes) |
|---|---|---|
| 0% | 333 | 85 |
| <5% | 16 | 231 |
| 5%-10% | 14 | 35 |
| 10%-20% | 12 | 27 |
| 20%-30% | 8 | 13 |
| >30% | 27 | 19 |

Table B.5 Changes in Mode Access (Number of Counties) by 2035
*High Scenario (W&P)*

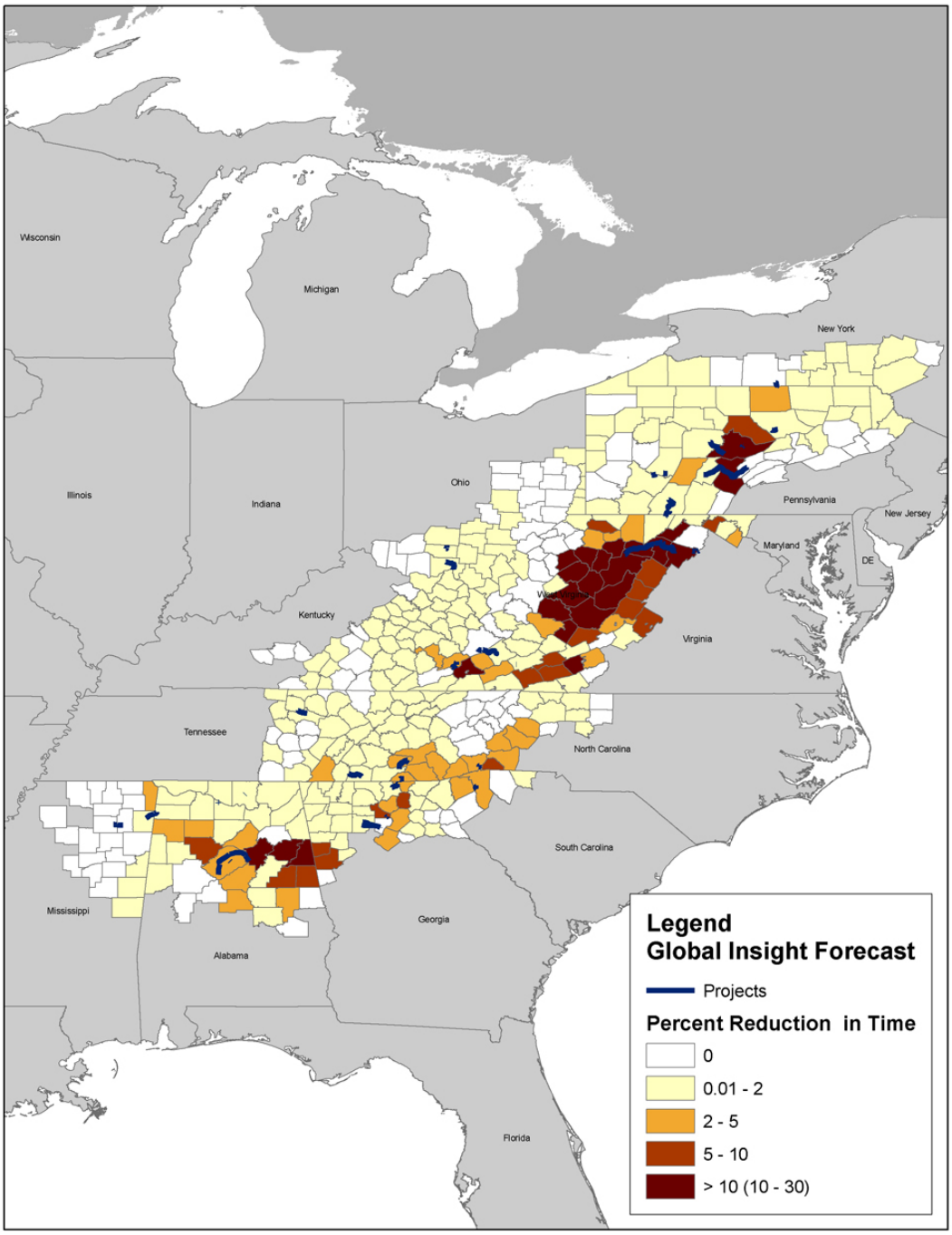
| Change in Access Time (Minutes) | International Gateway | Rail | Air | Water | *Largest Mode Change* |
|---|---|---|---|---|---|
| 0 | 102 | 104 | 175 | 165 | *29* |
| < 5 Minutes | 235 | 268 | 198 | 176 | *259* |
| 5 to 10 Minutes | 15 | 6 | 10 | 12 | *19* |
| 10 to 20 Minutes | 44 | 16 | 22 | 53 | *72* |
| 20 to 30 Minutes | 12 | 4 | 4 | 3 | *18* |
| >30 Minutes | 2 | 12 | 1 | 1 | *13* |

Table B.6 Largest Mode Access Change (Number of Counties) by 2035
*High Scenario (W&P)*

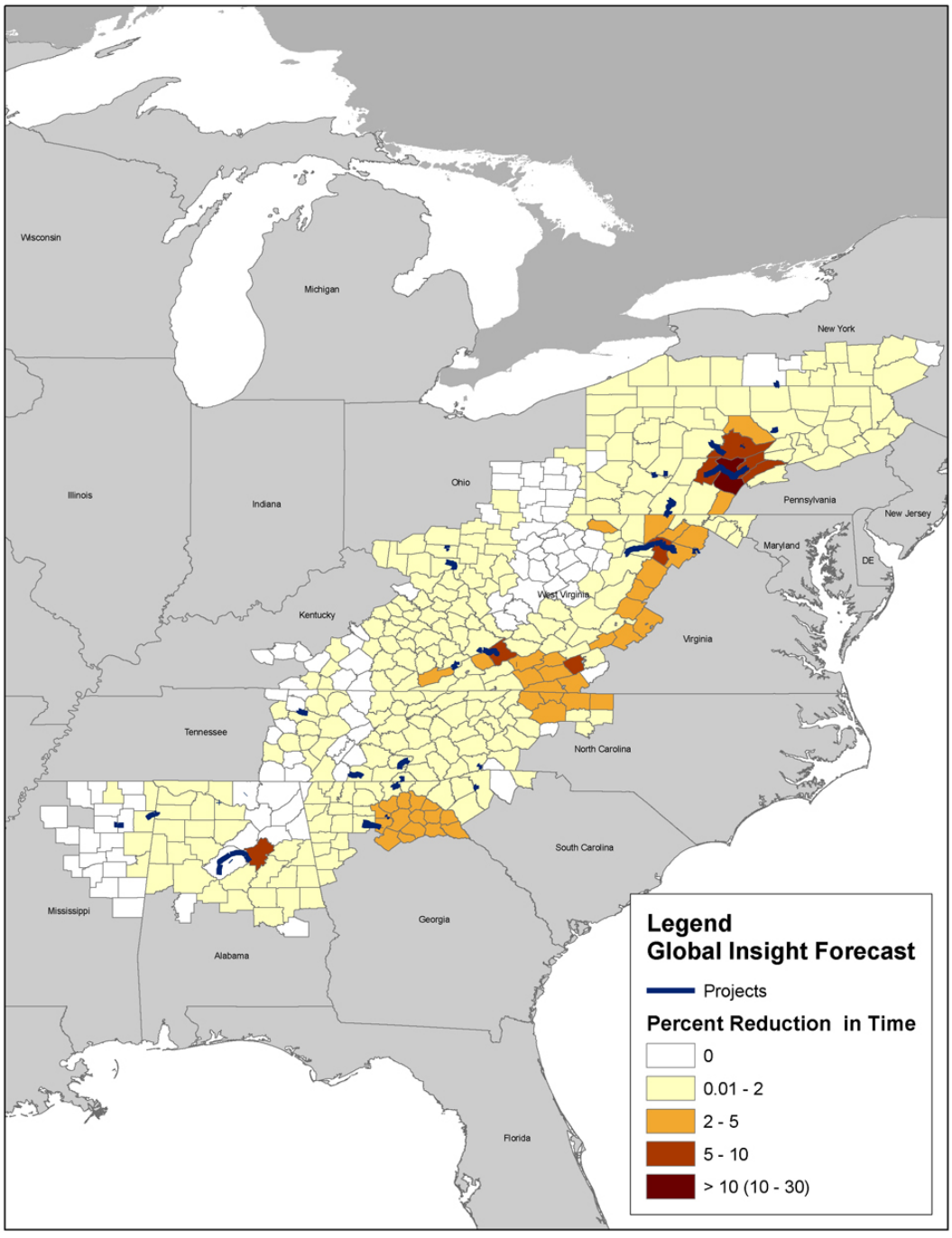
| Change in Access Time (Minutes) | International Gateway | Rail | Air | Water | Total |
|---|---|---|---|---|---|
| < 5 Minutes | 105 | 90 | 34 | 39 | 268 |
| 5 to 10 Minutes | 13 | 3 | 1 | 2 | 19 |
| 10 to 20 Minutes | 25 | 4 | 12 | 36 | 77 |
| 20 to 30 Minutes | 11 | 4 | 2 | 1 | 18 |
| >30 Minutes | 1 | 11 | 0 | 1 | 13 |

Figures B1 through B4 show the changes in accessibility for the Medium (Global Insight) Forecast. The darker shadings indicate larger improvements in access for that county. The blue markings show the locations of the AHDS projects.

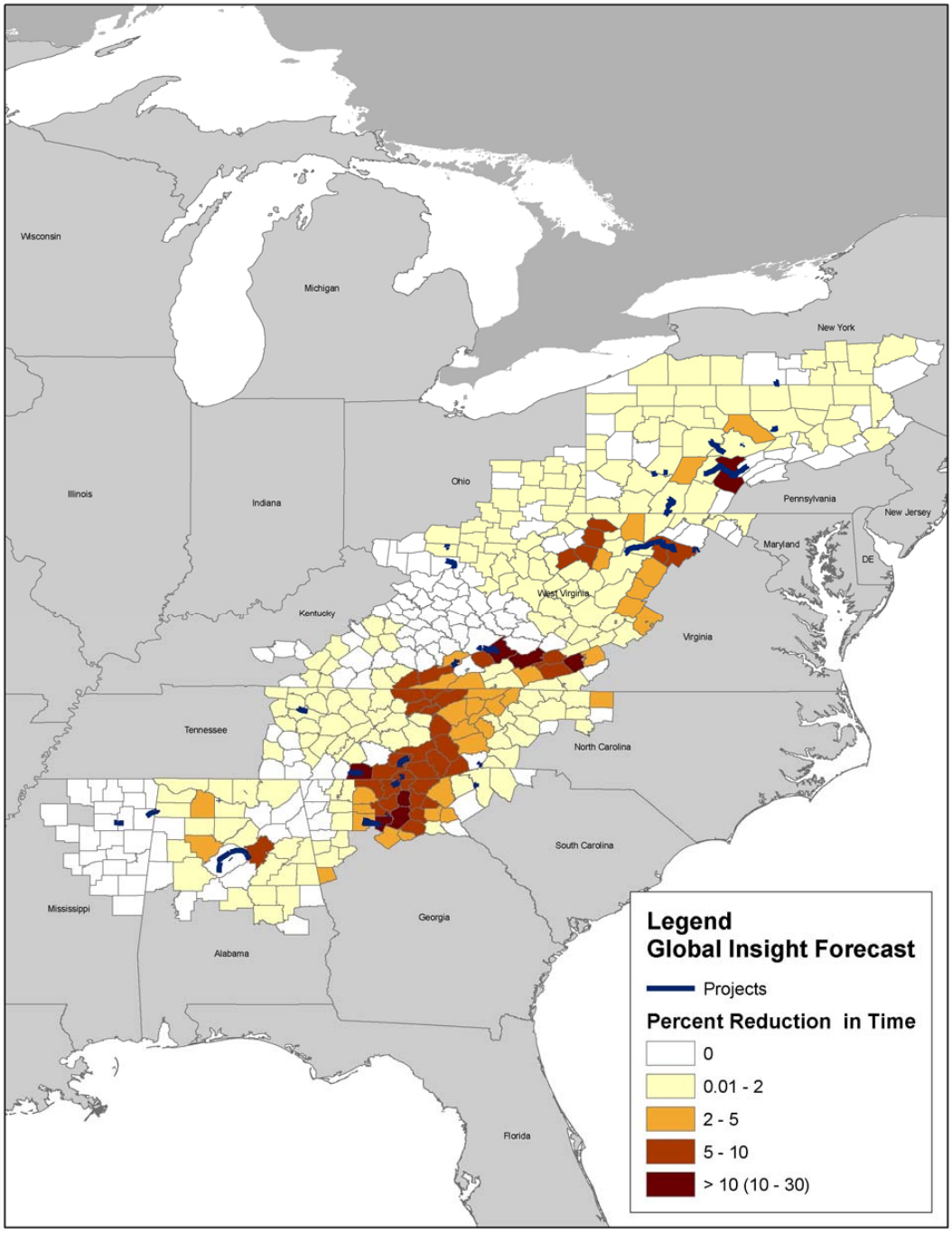
Figure B.1 Percentage Reduction in Travel Time to Nearest Intermodal Rail Terminal in 2035



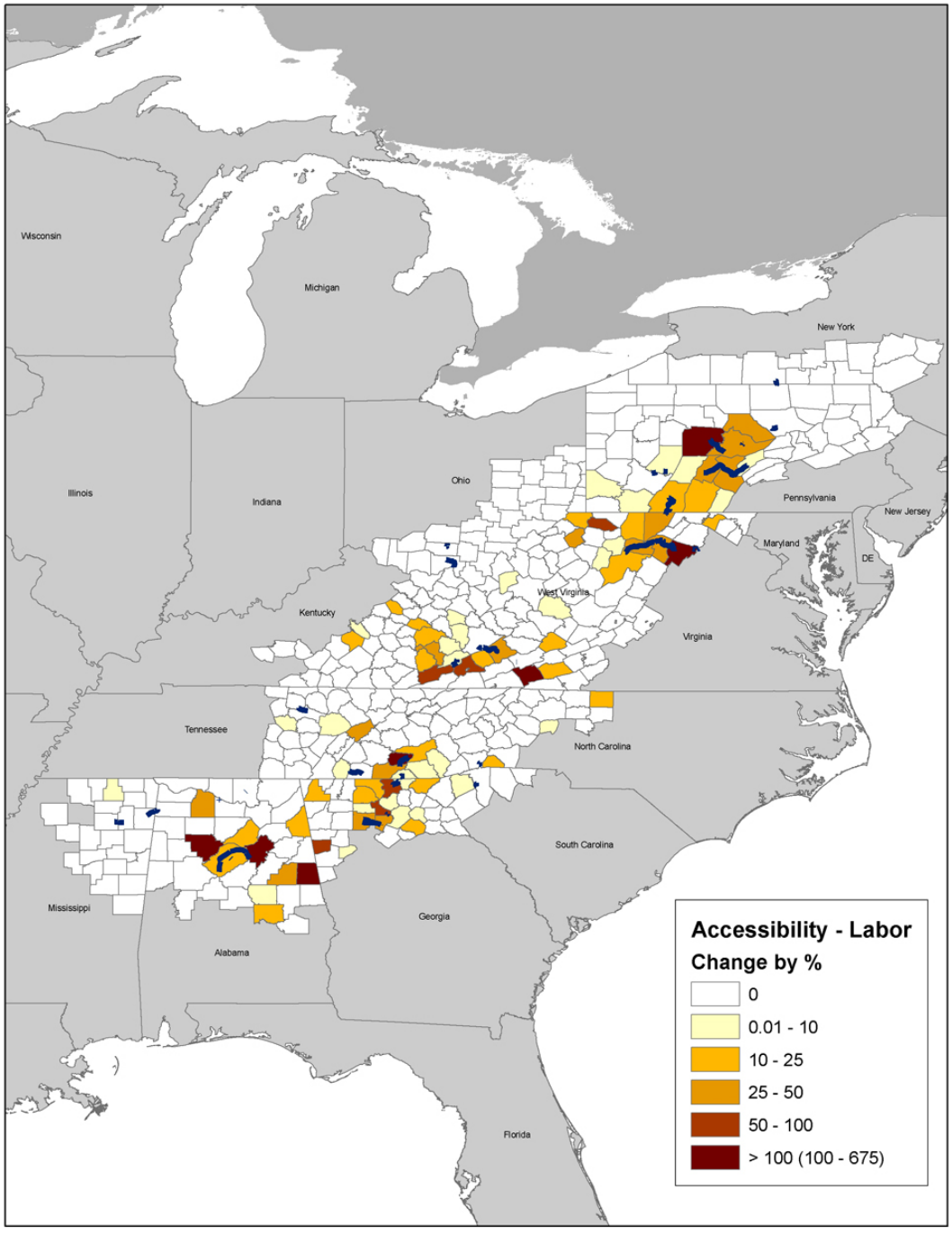
## Figure B.2 Percentage Reduction in Travel Time to Nearest International Gateway in 2035



## Figure B.3 Percentage Reduction in Travel Time to Nearest Marine Port in 2035



## Figure B.4 Percentage Change in Employment Accessible within a Three-Hour Drive Time (Buyer and Supplier Markets) in 2035



# B.3 ESTIMATING THE TIMING AND MAGNITUDE OF ADHS PROJECT IMPACTS

An analysis was conducted of the relationship between the timing of highway improvements and the magnitude and timing of subsequent economic growth impacts. This work updates the Twin County Study conducted by EDR Group in 2007.[24] The previous study compared growth rates of earnings and income from 391 counties in the ARC to "twin" counties of similar characteristics that were located elsewhere. It tested the impact of the Appalachian Development Highway System on economic growth in the counties of the ARC. For this research, a panel data set was used with each observation consisting of both a county and year – for the purpose of capturing the lagged effect of new lanes on economic growth. While the previous study measured the cumulative effect on growth through 1991 and 2000, this new study estimated the length of time that the opening of a highway (or added lanes) took to affect growth in ARC counties. To capture this impact the variable annual income growth was regressed on new lines miles per area on the current year and up to 10 years before. The hypothesis being that a county's level of distress or metropolitan status could affect the length of time that highway takes to impact growth.

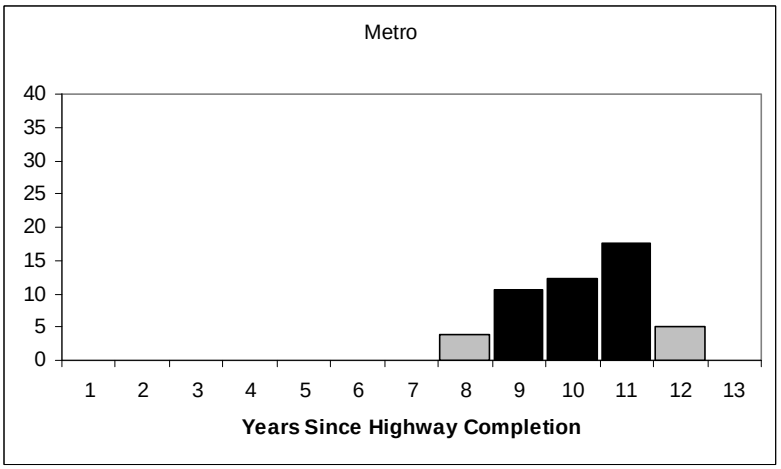
The counties were broken into three groups: metro, non-metro – distressed, and non-metro – non-distressed.[25] These categories were created based on whether the county was part of a metropolitan area and its classification of distress level by the ARC. The regression results are illustrated in Figure B.5. They show that distressed counties – after taking longer to react – actually had a larger economic growth impact from non highway development than non-distressed counties.

[24] This section is drawn from a working paper by Glen Weisbrod and Tyler Comings, *Economic Development Time Lag from Highway Improvements in Appalachia*, using a "twin county" dataset constructed by Theresa Lynch, *The Impact of Highway Investments on Economic Growth in the Appalachian Region, 1969-2000: Update and Extension of the Twin County Study*, Sources of Regional Growth in Nonmetro Appalachia –Volume 3 Statistical Studies of Spatial Economic Relationships, Economic Development Research Group, MIT Department of Urban Studies and Planning, 2007.

[25] The metro group was not broken into two groups because there was no significant difference between distressed and nondistressed counties in metropolitan areas.

## Figure B.5 Regression of Annual Income Growth on New Lane Miles
*Timing of Statistically Significant Impacts Are Shown*






Note: Black bars: years with statistically significant values (greater than 90 percent confidence).
Grey bars: fringe years with consistent impact but statistical confidence less than 90 percent.

The estimated impact clearly differs among the different settings. The non-metro – distressed group shows highly significant impact occurring six years after the project. The non-metro – non-distressed has highly significant impact three, four, and five years after project completion. This result is believable and promising as distressed areas should have more potential to grow than other areas. When comparing metro and non-metro categories, it was apparent that nonmetro counties exhibited more of an impact. This result was expected since the ADHS program targets rural areas that lack highway connectivity. Also, highways are concentrated in metro areas; therefore, it seems reasonable that rural areas would be more quickly affected from construction of a new highway. However, it is still a curious result that metro counties are positively affected eight or nine years after project completion.

This analysis, when breaking the counties into groups, provided outcomes that were close to expectations. One implication was that treatment of counties in metropolitan areas should not depend on level of distress. However, it is interesting to note that the estimated effect was similar for metropolitan areas to distressed counties not in metropolitan areas, though the latter group received a much larger impact. Treating the nonmetro counties based on their distress level was important. The implication here was that nondistressed counties in rural areas were the fastest to respond to added lanes or new highway construction. Distressed counties that were not in metropolitan areas took longer to respond to the stimulus but had a more intense reaction.

This analysis gave the powerful conclusion that the presence of new highways acted as a catalyst in disadvantaged areas; creating a much needed surge, albeit a delayed one, in economic growth. Therefore, transportation and economic development planners should not anticipate a rapid recovery for these counties when accessibility is improved.