

Final Draft

**Regional Economic Impacts  
Appendix to TVA Reservoir Operations Study  
Draft EIS**

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**TVA ROS**  
**Regional Economic Impacts Appendix**  
**Final EIS**  
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## **1 Regional Economic Impact Assessment**

### **1.1 Purpose of Economic Analysis**

TVA operating policy changes that affect business activity and employment in the Tennessee Valley are important to business, government and TVA decision makers. Sections 22 and 23 of the TVA Act of 1933 include language that directs the agency to key on economic development and the economic well-being of the people living in the Tennessee River basin. During 2002 and 2003 the Tennessee Valley Authority (TVA) undertook a Reservoir Operations Study (ROS) to determine if changes in TVA's reservoir system operating policies would produce greater overall public value. An operating policy without change, similar to operations in 2002, was evaluated along with a number of alternative operating policies. Seven of these alternatives survived other constraints to be evaluated in terms of their contribution to the overall regional economy.

The purpose of the economic impact assessment is to estimate the changes in business activity, income and employment related to alternative operating policies under review by TVA. The difference between two projections of the economic variables of interest (no change of operating policies compared to the alternative policy) is considered the economic impact of the alternative policy. Economic impacts are one of a number of evaluation criteria by which to assess and rank the policy alternatives in terms of overall value to the public.

## 1.2 Summary of Findings

Table 1.1 summarizes the results from a number of underlying studies of the direct and secondary economic effects of seven TVA operating policy changes from existing conditions. Results for 2010 are shown on the table because by then changes to the region's economy are assumed mostly to have rippled thru the region. The ultimate results from a series of economic studies are expressed as changes to the regional economy compared to the forecast economy with no change to the operating system. These changes could result from a host of economic drivers, for example, increased recreation activity at TVA reservoirs, lowered waterborne transportation costs, and/or reduced electric power rates. (Throughout this study, power rate changes are a convention of the modeling. TVA could assimilate cost changes by a number of policy options; rate changes assumed in this study are merely hypothetical.)

All but Alternative 6A, which would deepen the navigation channel, would reduce the regional economy as measured by Gross Regional Product (GRP), the value of goods and services created in the region; by Personal Income, the amount of money that owners and employees derive from work; and by Employment. Alternative 6A reduces both transportation costs and the cost of power supplied to the TVA region. Each of these effects reduces the cost of producing goods and services in the region and reduces the costs of living in the region. Hence, Alternative 6A is the most beneficial economic alternative.

By far, Alternative 8A has the largest adverse economic effect on the region's economy. Designed to mimic natural flows through the system, the alternative imposes large reductions in hydro peaking availability, which in turn must be replaced with high cost fossil generation or purchased power alternatives. This raises hypothetical power costs.

A Blended Alternative was developed after extensive input from the public reviews expressing strong preferences for recreation opportunities created by the TVA system. It combines the desirable features of the alternatives identified in the DEIS. Under the Blended Alternative, TVA would increase reservoir and tailwater recreation opportunities, while preserving the primary reservoir system operating objectives of flood control, navigation, and power generation. As a result, recreation spending and wealth-induced

spending increase under this alternative. Shipper savings also increase; but there are offsetting forces in the form of slightly higher water supply and power costs.

| <b>1.1 Regional Economic Impacts of Alternatives REMI Results: 2010</b> |                        |                        |                   |   |                       |                      |                   |                       |
|---|------------------------|------------------------|-------------------|---|-----------------------|----------------------|-------------------|-----------------------|
| <b>Alternative</b>  | <b>2A</b>              | <b>3C</b>              | <b>4D</b>         | <b>5A</b>                                 | <b>6A</b>             | <b>7C</b>            | <b>8A</b>         | <b>Blended</b>        |
| Description   | Reservoir Recreation A | Reservoir Recreation B | Summer Hydropower | <b>Equalized Summer/Winter Flood Risk</b> | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred Alternative |
| GRP (Mil 2002\$)  | -13.6                  | -32.5                  | -43.2             | -76.5                                     | 54.0                  | -30.8                | -160.8            | -6.0                  |
| Pers Inc (Mil 2002\$)   | -4.4                   | -11.5                  | -14.6             | -31.1                                     | 15.8                  | -10.9                | -63.7             | -1.9                  |
| Employment  | -43                    | -220                   | -413              | -745                                      | 408                   | -201                 | -1,522            | 2                     |
| Population  | -408                   | -769                   | -372              | -1,571                                    | 405                   | -745                 | -3,518            | -191                  |
| Source: EWE May 20, 2003; Blend 8, Oct. 21, 2003                        |                        |                        |                   |   |                       |                      |                   |                       |

Keep in mind that inputs to the economic model for some direct effects are measured in absolute values and others are measured as percentage changes. Hence, the results on Table 1.1 stated in constant 2002 dollars are the consistent economic values by which to compare among alternatives.

Even though Alternative 6A is clearly the most beneficial and Alternative 8A the most adverse measured by economic impacts, Table 1.2 emphasizes that the effects are quite small by comparison to the size of the underlying regional economy. The 2010 regional forecast is shown in the second column. The values in the other columns are the percentage changes of the values in Table ES1 benchmarked to the "without change" forecast. In all cases, the changes are less than one-hundredth of one percent. By far, the smallest reduction to TVA Baseline conditions occurs with the Blended Alternative. On balance, the economic analysis reveals that public gains by access to more recreation are balanced by slightly higher hypothetical power costs.

| <b>1.2 Regional Economic % Effects of Alternatives REMI Results: 2010</b>                  |                   |           |           |           |           |           |           |           |                |
|--|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| <b>Alternative</b>   | <b>TVA Region</b> | <b>2A</b> | <b>3C</b> | <b>4D</b> | <b>5A</b> | <b>6A</b> | <b>7C</b> | <b>8A</b> | <b>Blended</b> |
|  | <b>Baseline</b>   |           |           |           |           |           |           |           |                |
| GRP (Mil 2002 \$)  | 372,681           | -0.0037%  | -0.0087%  | -0.0116%  | -0.0205%  | 0.015%    | -0.0083%  | -0.043    | -0.002%        |
| Pers Inc (Mil 2002 \$)   | 303,334           | -0.0014%  | -0.0038%  | -0.0048%  | -0.0103%  | 0.005%    | -0.0036%  | -0.021    | -0.001%        |
| Employment   | 6,095,168         | -0.0007%  | -0.0036%  | -0.0068%  | -0.0122%  | 0.007%    | -0.0033%  | -0.025    | 0.000%         |
| Population   | 10,227,213        | -0.0040%  | -0.0075%  | -0.0036%  | -0.0154%  | 0.004%    | -0.0073%  | -0.034    | -0.002%        |
| Source: TVA Regional Forecast, December 2002<br>EWE, May 20, 2003; Blended, Oct. 21, 2003. |                   |           |           |           |           |           |           |           |                |

Other evaluation criteria may be more important to the ranking of these alternatives than the economic effects. The remainder of this appendix explains how the analysis was planned and executed using the REMI TVA model in sections 2 thru 5, and shows more detailed results in section 6.

## **2 Policy Alternatives Affect Regional Costs and Expenditures**

Management of water resources is fundamental to the Tennessee Valley regional economy. Low cost power and access to waterborne transportation have been central to both general and specific industrial development in the Valley. Navigable waterways reduce the cost of shipping bulky commodities such as grain, gravel, chemicals, coal, and petroleum products that aren't pipelined. Changes in the cost of delivering these commodities affect both the selling and purchasing industries in ways that will ripple across the region and to other regions. Flood control has been central to the growth of Chattanooga. Impoundments and flow releases coincident to TVA's mission have enhanced recreation opportunities in the region.

TVA's operations affect five pathways that directly link reservoir operations to the level of economic activity in the TVA region. These pathways are power supply, waterborne transportation, water supply, recreation, and property values. Changes to reservoir operations in the TVA region can generate economic effects two ways along these pathways that ripple across the TVA region.

1. Changes that affect recreation activity, property values, or electricity prices change levels of expenditures for local goods and services in the region.
2. Changes that affect transportation, water supply, or electricity prices cause cost increases or cost savings to the region's producers, which will make local producers more or less competitive with those outside the region.

The effects of changes in expenditures are estimated as changes in demand, while changes in costs are estimated as changes to the production costs of directly affected businesses. Both can lead to changes in regional economic activity. Direct effects that raise costs will change household disposable income and business/utility operating margins, which in turn will affect consumer spending and business sales volume. Changes in production costs can lead to changes in the region's output, employment and income in two ways. For example, higher power costs would raise the cost of doing business in the region and reduce regional consumer spendable income, thereby reducing the consumption of the region's goods and services due to both supply side and demand side effects. Reductions in production costs make indigenous industries more competitive, which enables them to increase market share and leads to firm expansions.

### **3 REMI Model to Estimate Regional Economic Effects of Reservoir Management Alternatives**

This project uses TVA's ten-area economic simulation and forecasting model purchased from *Regional Economic Models, Inc.* (REMI). (See *Appendix A for background on TVA's approach to forecasting and analysis the regional economy.*) REMI constructs models that reveal the economic and demographic effects, which policy initiatives or external events may impose on a local economy. A REMI model was built especially for the TVA region. This model is based on 31 years of historical data. REMI's model-building system uses hundreds of programs developed over the past two decades to build customized models using data from the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Department of Energy, the Census Bureau and other public sources.

REMI Policy Insight, the newest version of REMI's software, combines years of economic experience with an easy-to-use software interface. A major feature of REMI is that it is a dynamic model, which forecasts how changes in the economy and adjustments to those changes will occur on a year-by-year basis. The model is sensitive to a very wide range of policy and project alternatives and to interactions between the regional and national economies.

The REMI model is a structural model, meaning that the REMI TVA ROS Model includes cause-and-effect relationships. Estimated changes to the five direct drivers are model inputs. The model builds on two key underlying assumptions that guide economic theory: *households maximize utility* and *producers maximize profits*. Interested lay people as well as trained economists can understand the model because these assumptions make sense.

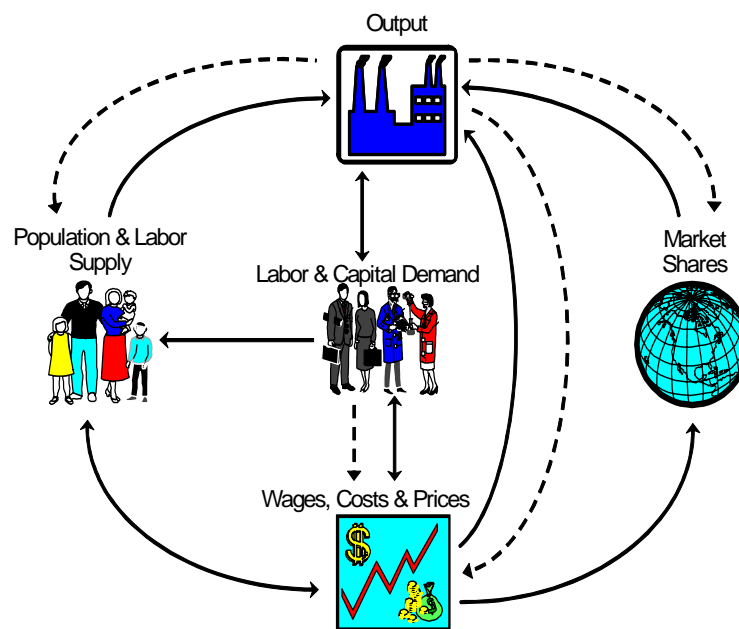
In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit of output depends on their relative costs; an increase in the price of any of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates, the likelihood of being employed, and the access to consumer goods increases in a region.

Supply and demand for labor in the model determines the wage rates. These wage rates, along with other prices and productivity, determine the cost of doing business for every industry in the model. An increase in the cost of doing business causes an increase in production costs and the prices of goods or service, which would decrease the share of the domestic and foreign markets supplied by local firms. This market share combined with the demand described above determines the amount of local output. The model has many other feedbacks. For example, changes in wages and employment affect income and consumption. Economic expansion changes investment and population growth. Figure 1 is a pictorial representation of the model. The Output block shows a factory that sells to all the sectors of final demand as well as to other

industries. The Labor and Capital Demand block shows how labor and capital requirements depend both on output and their relative costs. Population and Labor Supply are shown as contributing to demand and to wage determination in the product and labor markets. The feedback from the product market shows that economic migrants respond to labor market conditions.

Figure 1

## REMI (2002) Model Structure



Economic Geography Linkages (dashed lines)

Demand and supply interact in the Wage, Costs and Prices block. Once costs and prices are established, they determine market shares, which along with components of demand determine output.

Linkages indicated by the dashed arrows account for the effects of agglomeration in both the labor and product markets. These effects are crucial to understand why certain

areas that have a concentration of similar businesses can prosper despite high wages and real estate costs. The reason is that by having a choice of suppliers and workers each firm can obtain specialized labor and inputs that best fulfill their needs. This increases productivity and efficiency. Nashville's agglomeration of music artists, producers, recording studios, show case venues, songwriters, agents, entertainment lawyers, etc. is the perfect example of an agglomeration economy.

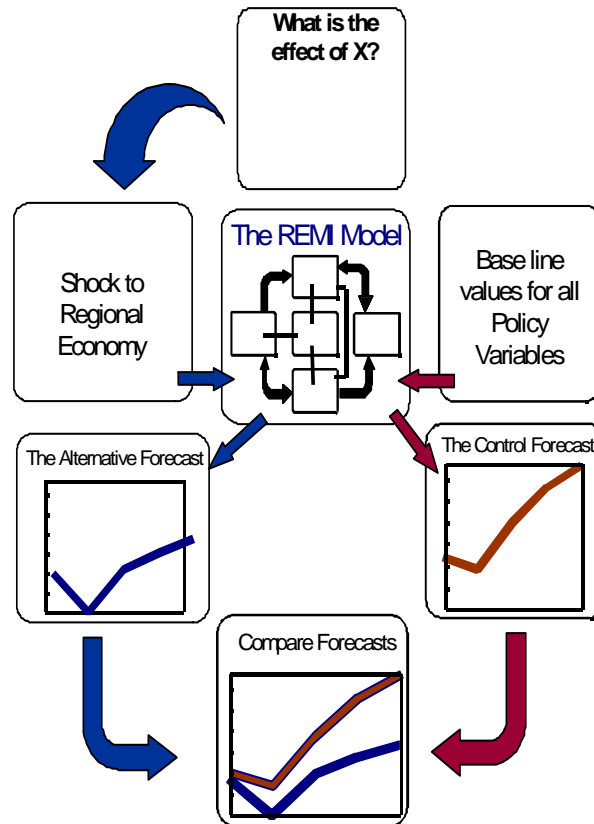
The dashed arrow from the output block to the cost block shows that more suppliers will increase the efficiency of inputs, which will then reduce production costs and competitiveness. The dashed arrow from the labor block shows that more labor will increase the productivity of labor, thus reducing labor costs and thereby making the area more competitive; i. e, more songwriters migrating to Nashville bring in better ideas. The arrow from output to the population block shows that the greater output provides more variety of choices and enhances consumer satisfaction, thus inducing inward migration. The arrow from the output to the shares block shows that the areas with concentration can offer more to purchasers, thus having an effect on market share in addition to the price advantages through the cost and price block.

The REMI model has strong dynamic properties, which means that it forecasts what will happen and when it will happen. The model brings together all of the above elements to determine the value of each of the variables in the model for each year in the baseline forecast. Inter-industry relationships contained in typical input-output models are captured in the REMI Output block; but REMI goes well beyond typical input-output models by including the relationships among all of the other blocks shown in Figure 1.

The REMI TVA ROS model is designed to examine the effects of policy changes or direct economic changes to the TVA regional economy arising from the five economic drivers. The baseline forecast uses the baseline assumptions about the national and regional economic variables. In the study, alternative forecasts have been generated using selected input variable values for the five drivers that reflect changes caused by alternative reservoir operations. Figure 2 shows how this process would work for a reservoir operating change called Alternative X.

Figure 2

# Policy Insight



The REMI model comes with default baseline economic forecasts for the U.S. and the TVA region, referred to as "Control Forecasts." Specified alternatives that will have some effects on the regional economy have been studied to understand and estimate the direct effects of these alternatives. The direct changes to industries affected by reservoir operations are introduced into the model, which is then run to produce a new forecast incorporating the impacts of the specified alternatives. Results are shown in terms of how the new forecast differs from the Control Forecast. For example, reservoir

operation changes that sustain tributary reservoir water levels longer into the fall will affect local recreation activity and associated spending. The REMI model tracks these changes as consumer spending in relation to specific recreation activities. This study reports incremental changes between the baseline and alternative as the results.

#### **4 What to Measure with REMI to Compare Operating Alternatives?**

Economic impacts refer to changes to the level of economic activity in the TVA region. Economic activity may be measured in terms of business output (gross sales volume), gross regional product, GRP, (the sum of value added across levels in the marketing chain), personal income (wages and salaries, primarily) or employment (jobs added or lost) and population. When measuring economic impacts, growth effects (a net benefit to the economy) must be distinguished from redistribution effects (where activity is shifted from one location to another). This study keys on the *net* economic effects on the TVA regional economy resulting from changes in reservoir operations. Net effects are distinguished from gross effects, which may be associated with either (1) transfers of resources within the TVA region with no net change in economic activity or (2) other activities that would otherwise make use of the resources.

Economic impacts are classified as direct, indirect and induced. Indirect impacts result from changes in sales of suppliers to the directly-affected businesses. Induced impacts result from changes in spending on consumer goods and services as a consequence of the changes in employment and payroll of directly and indirectly affected businesses. These may be referred to as direct and secondary effects. Secondary effects can be referred to as the multiplier effects or ripple effects. REMI calculates the secondary effects of direct changes, taking account of the ability of the TVA region to provide the goods and services and labor to affected industries. Direct effects are provided to the model and total effects are reported in this appendix and in Section 5.25 of the Draft EIS.

##### **4.1 Employment**

Employment changes created by each scenario alternative are provided by the model output. Jobs alone, however, don't reveal whether the quality of employment opportunities has changed. Relying on jobs alone would overlook the implications of

creation of low paying boat slip operator jobs at the expense of industrial workers. The policy issues at stake specifically may affect recreation-driven employment at the risk of other employment in the TVA region. Jobs are reported.

#### **4.2 Personal Income**

Personal income will change as elements of the employed labor force change. The REMI model provides this output. Personal income measures wages and salaries of the employed labor force and will change as the mix of employment shifts in relation to the policy issues. Personal income, however, excludes net business income (profit) and therefore is an underestimate of the true income impact to the region. Personal income is reported.

#### **4.3 Gross Regional Product**

Value added, equivalent to Gross Regional Product (GRP), is a broad measure of the full income effect caused by a policy alternative. GRP measures the sum of wages, income and business profit. This may overestimate the net effect to the TVA region in that business profit may leak to corporate owners elsewhere. Changes to personal income represent a conservative measure and changes to GRP represent an upper bound. GRP is reported.

#### **4.4 Regional Output**

Regional business output (gross sales revenues) generates the largest numbers. Regional output may confound the policy effect by not distinguishing between high value added activity, which generates substantial area profit and income, and low value added activity, which generates relatively little local profit or income for the same level of sales. Regional output is not reported.

#### **4.5 Population**

Population change induced by economic stimuli is another measure of interest and sometimes useful to evaluate in relation to the local area's ability to provide community

services. As this project examines the entire TVA region, the social impacts of sudden large population shifts are not examined. Nonetheless, population changes are reported.

## **5 Modeling Alternative Effects within REMI**

Research findings from the underlying five direct study areas measure cost changes for those whose production costs are influenced by system operations and expenditure changes for those whose demands are influenced by reservoir operations. Changes in power costs affect both the cost of production within the region and the disposable income of consumers, who will either pay more or less for power. The direct economic effects stemming from waterborne transportation, hydropower, and water supply are estimated within the TVA ROS and modeled in REMI with production cost changes to identifiable sectors. Cost changes, along with input elasticities within REMI, determine the new prices consistent with cost changes. The changes in the relative prices of inputs and outputs then alter the technical and trade relationships within the model, which results in a new equilibration of the output levels produced by the industrial sectors. These changes in the equilibrium output levels yield the changes in the direct and secondary input requirements of the regional economy induced by the cost change.

The economic impacts of residential electricity price increases, added recreation expenditures or wealth-induced expenditure changes are estimated as changes in spending. The changes in expenditures associated with recreation or wealth effects of property value changes are converted into changes in final demands by distributing expenditures into appropriate final demand categories. The resulting ripple effects, distributed by the model across the region, yield the direct and secondary output changes to the region caused by changes in final demands.

The following subsections discuss the details of the modeling conventions.

### **5.1 Power**

Electricity price levels in a region affect (1) the cost of doing business in the region and (2) the cost of living for residents. TVA electricity supply costs are tied to hydropower generation. Operating scenarios that alter the amount or timing of hydropower

generation could affect the cost of replacement power, either through increased fuel and non-fuel operating costs or through direct power purchases off-system, or both. Additions to generating capacity may be needed as well. Changes in electricity prices may affect regional economic activity through their impact on the cost of doing business for commercial and industrial customers, and through their impact on household spending. This analysis assumes as a modeling approach that increased or decreased power supply costs will be passed along to consumers. In truth, TVA's decision process involves other considerations, notably, debt management, and changes in power supply costs may not be passed along to consumers. Throughout this report, usage of terminology about rate changes refers in all cases to hypothetical changes.

Higher electric rates could cause an increase in the cost of doing business that could, in turn, lead to (1) a decline in competitiveness in the products made by industries within the TVA region and (2) the substitution by customers of products made outside the region for locally produced items. In the extreme case, rate increases could create an incentive for some businesses to move out of the region, discourage plant expansion, or discourage the siting of new plants.

Direct effects of changes in electric rates occur as businesses and households change production and spending behavior, respectively. Secondary effects occur as industries supplying those directly affected adjust their production and spending.

To the extent that electricity price increases reduce the family budget available for other goods and services, the proportion of the total expenditures for other goods and services will be reduced. Increases in the household electricity bill will result in reduced demand for locally produced goods and services and substitution towards goods and services produced outside of the area, whose prices have not gone up due to increased electricity cost.

Changes in electricity rates will affect regions differently depending on economic structure of the region. The composition of electricity sales across TVA -- the mix of residential, commercial and industrial -- influences the size of the effects of changes in hydropower operations. The size of the direct and secondary impacts related to changes in the electricity prices depends on the importance of electricity as a factor input to the

regional industries. The size of impacts will vary according to the electricity intensity of the industries and the competitive sensitivity of industries to cost changes. If electricity is a large percentage of the cost structure, say ~ 5 percent, and profit margins are small, a change in electricity cost may make a noticeable change in profitability. Across the board changes in electricity costs would have different impacts on various industries. Paper, chemicals, primary metals and textiles tend to be more electricity intensive than, say, assembly plants. Rate increases have been distributed evenly across the region for this analysis.

Changes in the cost of doing business will have short term and long term effects. In the short term, the model will follow standard microeconomic theory and predict, for example, that increased electricity costs will result in output reductions in most industries, depending on the electricity intensity of the industry. In the long term, industries in each subregion will change their production technologies in favor of less electricity intensive capital equipment and substitute labor for capital equipment.

## **5.2 Waterborne Transportation**

Waterborne transportation infrastructure affects the cost structure of certain industries in TVA's region that directly depend on access to low cost bulk transport. Seven industries are directly affected by the ability to move commodities efficiently on Tennessee River.

1. Coal and Coke
2. Petroleum Fuel Products
3. Aggregates
4. Grains and Processed Food Products
5. Chemicals
6. Ores and Minerals
7. Iron & Steel Products

Access to waterborne transportation lowers the cost of delivery of bulky materials to these industries. This, in turn, lowers the cost of producing products with these bulky inputs, such as roads, which rely on both aggregates and asphalt products. If, in turn,

the produced output is also bulky and relies on the waterborne transport system to get to market, this creates a double cost impact.

Reductions in channel depths caused by holding water in upstream reservoirs during low flow late summer months may reduce effective delivery loads (light loads) and raise costs per tonnage delivered. Subsequent increased flows caused by rapid drawdown of reservoirs after the "recreation period" may impair traffic due to increased flow velocity, increased delivery times and increased risk of operations.

The total regional economic impact of changes to manufacturing costs for the selected industries that rely on waterborne transport stems from the product of three factors:

1. The extent of the change in cost of waterborne transport for the selected industries -- whether direct river shippers, or other shippers who benefit from water compelled rates;<sup>1</sup>
2. The proportion of total business operating cost affected by the change to waterborne transport cost;
3. The size of each of the selected industries in the regional economy.

Cost savings or cost increases may have different effects on different industries depending on demand elasticities. For instance, if the markets for their product would allow them to pass-thru cost increases or retain cost savings as added profits, this would cause a different response as compared to a firm operating in a competitive industry. The REMI model makes this determination based on built in demand elasticities.

The Navigation study determined the magnitude of Tennessee River shipper savings accruing to the presently maintained 11 foot navigation channel (baseline) and estimated the decreases or increases in shipper savings that would be expected if channel depth were lowered or raised. Shipper savings are treated as changes to operating costs for affected industries originating or receiving waterborne freight in the TVA region.

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<sup>1</sup> Where commercial barge transportation is available, observed railroad rates in the area tend to be lower reflecting the competition from barge carriers. The water compelled rate effect is the difference in the rail rates proximate to the river and rates for customers distant from the river.

### **5.3 Water Supply**

The alternative operating policies result in different flow regimes in the river system and different reservoir pool level elevations on reservoirs. If minimum reservoir elevations fall below existing water supply intake elevations, added capital expenditure is required to alter intakes. Capital recovery factors are estimated and imposed on customers as an added annual cost, which serves to reduce profitability of producing the same level of output.

### **5.4 Recreation**

Changes to operations of TVA reservoirs can affect recreation activity by changing the length of the recreation season in local areas surrounding specific reservoirs. Changes to length of season would alter expenditures in the area of the reservoirs. Economic impact analysis is concerned only with the effects of “new” or external money brought into the region, not with the redistribution of money from one part of the Tennessee Valley to another caused by changes in reservoir operations. The recreation study plan focused on new expenditures created by the operating alternatives. Changes in expenditures related to operating scenarios are estimated separately for visitors who live outside of the TVA region and for residents who alter their mix of recreation within the region. Visitation and spending patterns for out of region lake property owners also are separately estimated for the various scenarios.

Recreation use and expenditures during the months of August, September, and October were estimated for individuals who live outside of the region but recreate at reservoirs and select non-riverine tailwaters within the TVA subregions. This estimate provided a baseline scenario of recreation use by "Public Access Site Visitors" under no change in operations management at TVA reservoirs. Changes in visitation and spending are benchmarked to this baseline for each of the proposed operating scenarios. Visitor spending is tabulated within five broad categories as shown:

1. Lodging
2. Food and Beverages
3. Transportation
4. Activities
5. Miscellaneous

Economic impacts that arise from residents are due to changes in household expenditures associated with changes in days spent living at a TVA reservoir or non-riverine tailwater residence rather than traveling or living elsewhere. Essentially, the estimates reflect the analytic question: "How many days will property owners live at their TVA region residence vs. living elsewhere or traveling outside of the TVA region under reservoir operating alternatives?" Incremental resident spending is tabulated in 11 categories as shown.

1. Gasoline and Oil
2. Automobile Repair and  
Maintenance
3. Food and Beverages
4. Housing Repair and  
Maintenance
5. General Utilities
6. Household Operation
7. Furniture, Computers, Other  
Miscellaneous Household  
Durables
8. Clothing and Shoes
9. Medical Care
10. Other Nondurables
11. General Recreation and  
Amusements

The REMI analysis used the expenditure changes of the visitor and resident groups as model inputs. Annual estimates of expenditure changes for the above categories were

direct input into the REMI model for each scenario. The changes in expenditure by categories were projected to 2030.

## 5.5 Property Values

The property values component of the analysis evaluates the effect on consumer spending related to changes in values of waterfront properties on TVA reservoirs due to current and alternative operating scenarios. In other words, what effect do seasonal variations in pool level have on the value of adjacent properties? And, more relevant to this part of the analysis, how would this wealth effect be transformed into expenditure changes? Expenditure changes are the direct effects of alternative water management strategies measured as inputs to the REMI model.

The logic underlying a direct wealth effect is modeled according to an article by Dean M. Maki and Michael G. Palumbo<sup>2</sup>: An increase in property values increases a household's net worth and, thus, allows an increase in its consumption, holding the level of income constant. Their research indicates that consumer spending rises to between three and five cents for every extra dollar of wealth that is recognized by households and sustained over a period of time. An analysis by a national macroeconomic consulting service, Global Insight, concluded that the average American spends slightly less than \$30 for each \$1,000 increase in household wealth; i. e., the marginal propensity to consume from wealth is just under three percent. TVA uses Global Insight for its national economic forecast.

Increased expenditures are modeled as spending for household structural improvements and luxury purchases: expenditures for new furniture, electrical equipment and durable goods, new vehicles, and new boats. These "high end" expenditures differ from general residential consumer expenditures for an array of largely nondurable consumables related to day-to-day life. Arguably, some of the increased wealth could be spent on travel out of the region. Some of it could be used to finance children's college education. To maximize the effect of the increased wealth on spending within the TVA region, travel outside the region and children's college education both were excluded from the model. This makes the results conservative.

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<sup>2</sup> "Disentangling The Wealth Effect: A Cohort Analysis Of Household Savings in The 1990S," Fed

## 6 Regional Economic Impacts - Results of Analysis

[Tables 6.2, 6.3 and 6.4 excluded]

Underlying studies of the direct effects have estimated the magnitude of changes related to each alternative. The effects on the economic drivers do not occur in isolation. Changes to the economic drivers described above occur simultaneously due to system wide perturbations to TVA operations. For instance, a decision to hold water in upstream reservoirs to Labor Day to enhance recreation in those reservoirs could reduce water releases for hydro generation and channel depths for navigation. Of 24 preliminary alternatives considered, seven survived for detailed REMI analysis of their regionwide economic impacts. The objectives of the seven alternatives that survived preliminary investigation are described succinctly below and expanded following:

|           |   |
|-----------|---|
| Base Case | Continue current operating policies   |
| 2A        | Extend recreation season on tributary reservoirs                              |
| 3C        | Extend recreation season on tributary <u>and</u> mainstem reservoirs          |
| 4D        | Enhance summer hydro production with unrestricted drawdown                    |
| 5A        | Enhance summer/winter flood risk  |
| 6A        | Enhance navigation  |
| 7C        | Enhance reservoir recreation, increase opportunities for tailwater recreation |
| 8A        | Enhance biodiversity, restrict turbine peaking                                |
| Blend 8   | Enhance reservoir recreation, preserve primary purposes of operations         |

The Blended Alternative, developed to enhance the most desirable features of the alternatives identified in the DEIS, after extensive public review of the DEIS and additional analyses that ruled out seven blended alternatives, responds to the values and objectives expressed by the public during the EIS review process. This alternative was designed to re-balance operating system priorities to achieve TVA's goal of increasing the overall public value of the reservoir system consistent with, but not limited to, the operating priorities established by the TVA Act.

Under the Blended Alternative, TVA would preserve the primary reservoir system operating objectives of flood control, navigation, and power generation, yet increase reservoir and tailwater recreation opportunities. This alternative would not increase annual average flood damages at any critical location within the Tennessee Valley,

including Chattanooga. Adoption of the Blended Alternative would increase the minimum depth of the Tennessee River navigation channel at two locations and would maintain power system reliability while lessening impacts to delivered cost of power compared to other alternatives. This alternative also would maintain tailwater minimum flows and dissolved oxygen targets while minimizing impacts on reservoir water quality, and would provide for more balanced tributary reservoir levels across the system.

**Alternatives Matrix (1)**

| Alt. | Major Issues or Operating Objectives  | Operational Changes to Address Issues and Objectives   | Impacts Based on Results to Date  |
|------|---|--|---|
| BC   | <ul style="list-style-type: none"> <li>Continue Current Operation Policies</li> </ul>   | <ul style="list-style-type: none"> <li><u>Summer pool</u> – Fill TB by June 1; restrict drawdown June and July; begin TB drawdown August 1; fill and draw MR by target dates.</li> <li><u>Winter pool</u> –Continue to meet January 1 target elevations on TB and MR.</li> <li><u>Min. flows</u> –Continue established min. flows June 1 to August 1; continue Chickamauga releases at 13,000 cfs.</li> </ul>  | <ul style="list-style-type: none"> <li>Establishes baseline environmental, social and economic conditions.</li> </ul>   |
| 2A   | <ul style="list-style-type: none"> <li>Reservoir Recreation A</li> </ul>  | <ul style="list-style-type: none"> <li><u>Summer pool</u> - Extend TB and MR to Labor Day, where applicable; draw MR one-foot between August 1 and Labor Day.</li> <li><u>Winter pool</u> – Raise TB flood guide to current March 15; raise MR flood guide by 2 feet.</li> <li><u>Min. flows</u> – Release only min. flows June 1 to August 1; limit Chickamauga releases to 25,000 cfs. August 1 and Labor Day.</li> </ul>  | <ul style="list-style-type: none"> <li>Increases reservoir recreation.</li> <li>Reduces navigation cost.</li> <li>Increases flood risk.</li> <li>Reduces power system reliability in June and July; avoids additional derates during August.</li> <li>Impacts water quality.</li> </ul>   |
| 3C   | <ul style="list-style-type: none"> <li>Reservoir Recreation B</li> </ul>  | <ul style="list-style-type: none"> <li><u>Summer pool</u> - Extend TB and MR to Labor Day.</li> <li><u>Winter pool</u> – Raise TB flood guide to store 7-day, 500-year storm inflow; raise MR flood guide by 2 feet.</li> <li><u>Min. flows</u> – Release only min. flows June 1 to Labor Day.</li> </ul>  | <ul style="list-style-type: none"> <li>Increases reservoir recreation.</li> <li>Reduces navigation cost.</li> <li>Increases flood risk.</li> <li>Major adverse impacts on power system reliability.</li> <li>Impacts water quality.</li> </ul>  |
| 4D   | <ul style="list-style-type: none"> <li>Enhance Summer Hydro Power Production</li> </ul>   | <ul style="list-style-type: none"> <li><u>Summer pool</u> – Begin restricted drawdown on June 1; no guaranteed reservoir pool levels.</li> <li><u>Winter pool</u> – Raise TB flood guide to store 7-day, 500-year storm inflow.</li> <li><u>Min. flows</u> - Limit Chickamauga releases to 35,000 cfs. June 1 through mid-September. [Chickamauga releases of 35,000 reflect tradeoff between maintaining available water through end of summer.]</li> </ul>                       | <ul style="list-style-type: none"> <li>Maximizes summer hydro production.</li> <li>Impacts reservoir and tailwater water quality.</li> <li>Increases navigation cost.</li> <li>Increases flood risk.</li> <li>Adverse impacts on reservoir and tailwater recreation.</li> </ul>   |
| 5A   | <ul style="list-style-type: none"> <li>Equalize Summer/Winter Flood Risk</li> </ul>   | <ul style="list-style-type: none"> <li><u>Summer and winter pool</u> – Establish year round flood guide based on critical period, 500 year inflow; generally lower summer pools; higher winter pools.</li> <li><u>Min. flows</u> – Release only min. flows June 1 to August 1; limit Chickamauga releases to 25,000 cfs. between August 1 and Labor Day.</li> </ul>  | <ul style="list-style-type: none"> <li>Equalizes summer/winter flood risk.</li> <li>Reduces power system reliability.</li> <li>Decreases reservoir and tailwater recreation.</li> <li>Maintains water quality.</li> </ul>   |
| 6A   | <ul style="list-style-type: none"> <li>Enhance Navigation</li> </ul>  | <ul style="list-style-type: none"> <li><u>Winter pool</u> –Raise MR flood guide by 2 feet to 13 foot channel, where applicable; with one foot operating range.</li> <li><u>Min. flows</u> – Increase min. flows at selected projects, including Kentucky, Pickwick, and Wilson; limit max. flow at Barkley.</li> </ul>   | <ul style="list-style-type: none"> <li>Reduces navigation costs.</li> <li>Increases flood risk.</li> <li>Minimal adverse impacts on hydro production.</li> <li>Minimal impacts on reservoir recreation.</li> </ul>  |
| 7C   | <ul style="list-style-type: none"> <li>Enhance Reservoir Recreation</li> <li>Increase Opportunities for Tailwater Recreation</li> </ul> | <ul style="list-style-type: none"> <li><u>Summer pool</u> – Extend TB and MR to Labor Day</li> <li><u>Winter pool</u> - Raise TB to store 7-day, 500-year storm inflow; raise MR by 2 feet</li> <li><u>Min. flows</u> – Release only min. flows and recreation flows June 1 to Labor Day</li> <li><u>Recreational flows</u> – Adjust flows to provide additional recreation opportunities for selected tailwaters [Norris, Watauga, Appalachia and South Holston].</li> </ul>      | <ul style="list-style-type: none"> <li>Increases opportunities for tailwater recreation.</li> <li>Increases reservoir recreation.</li> <li>Reduces navigation cost.</li> <li>Major adverse impacts on power system reliability.</li> <li>Increases flood risk.</li> <li>Impacts water quality.</li> </ul>                                     |
| 8A   | <ul style="list-style-type: none"> <li>Enhance Tailwater Habitat</li> <li>Restrict Turbine Peaking</li> </ul>                           | <ul style="list-style-type: none"> <li><u>Summer pool</u> –No min. operating guide for TB or MR; retain 75 % of inflow.</li> <li><u>Winter pool</u> – No min. operating guide curve; raise TB flood guide to current March 15; raise MR flood guide by 2 feet; retain 75 % of inflow.</li> <li><u>Min. flows</u> – Release current min. flow or 25 % of inflow, whichever is greater; restrict turbine peaking to flows below min. amount required to operate one unit.</li> </ul> | <ul style="list-style-type: none"> <li>Variable impacts on tailwater water quality; mimics natural flows.</li> <li>Variable impacts on tailwater recreation.</li> <li>Increases reservoir recreation.</li> <li>Reduces navigation cost.</li> <li>Increases flood risk.</li> <li>Major adverse impacts on power system reliability.</li> </ul> |

\*Alt – Alternative; BC – Base Case; TB – Tributary Reservoir; MR -Main River Reservoirs; cfs. - cubic feet per second; min. flow – minimum flows.

Source: TVA

**Blended Alternative Matrix**

| Policy Alternative  | Changes to Reservoir Operating Guidelines (Guide Curves)  | Changes to Water Release Guidelines  |
|---------------------|---|--|
| Blended Alternative | <p>Subject to each project meeting its minimum flow requirements and a proportionate share of the system minimum flow requirements, maintain tributary reservoir elevations as close as possible to the flood guides during the summer (June 1 through Labor Day)</p> <p>Begin unrestricted tributary reservoir drawdown after Labor Day</p> <p>Maintain Base Case summer operating zone through Labor Day for Chickamauga, Guntersville, Pickwick, and Wheeler</p> <p>Raise winter flood guide to elevations based on flood risk analysis for 10 tributary reservoir projects</p> <p>Great Falls—Fill reservoir to summer pool by Memorial Day</p> <p>Raise minimum winter pool elevation by 0.5 foot at Wheeler</p> <p>Follow the Base Case fill schedule during the first week in April for Fort Loudoun, Watts Bar, and Chickamauga. Then, delay the fill to reach summer operating zone by mid-May</p> | <ul style="list-style-type: none"> <li>• If above system MOG curve, increase weekly average minimum flow from Chickamauga each week during June and July (beginning with 14,000 cfs the 1<sup>st</sup> week in June increasing to 25,000 the last week in July)</li> <li>• If below system MOG curve, release 13,000 cfs weekly average minimum flow from Chickamauga during June and July</li> <li>• Release 29,000 cfs weekly average minimum flow from Chickamauga from August 1 through Labor Day if above system MOG or 25,000 cfs if below system MOG curve</li> <li>• Provide continuous minimum flows up to 25,000 cfs at Kentucky, as needed, to maintain minimum tailwater elevation of 301</li> <li>• Maintain Base Case minimum flow commitments with additional scheduled tailwater recreation releases</li> <li>• Provide 25 cfs in Apalachia bypass reach from June 1 through November 1</li> </ul> |

The economic analysis of the effects of alternatives on the TVA region tabulates all changes to the economic drivers associated with each alternative as aggregate inputs to the REMI TVA model. Within each alternative, the input direct effects may reinforce or mitigate the commingled positive or negative impacts on the regional economy. Table 6.1 shows the direction of the direct effects that serve as inputs to the model.

| Alternative    | Recreation          | Property Value      | Navigation Costs    | Power Costs         |
|----------------|---------------------|---------------------|---------------------|---------------------|
| 2A             | Slightly Beneficial | Slightly Beneficial | No change           | Slightly Adverse    |
| 3C             | Slightly Beneficial | Slightly Beneficial | No change           | Slightly Adverse    |
| 4D             | Slightly Adverse    | Slightly Adverse    | Slightly Adverse    | Slightly Beneficial |
| 5A             | Slightly Beneficial | Slightly Adverse    | Slightly Adverse    | Slightly Adverse    |
| 6A             | Slightly Adverse    | Slightly Beneficial | Slightly Beneficial | Slightly Beneficial |
| 7C             | Slightly Beneficial | Slightly Beneficial | No change           | Slightly Adverse    |
| 8A             | Slightly Beneficial | Slightly Beneficial | No change           | Adverse             |
| <b>Blended</b> | Slightly Beneficial | Slightly Beneficial | Slightly Beneficial | Slightly Adverse    |

Source: EWE, June 10, 2003; Blended, October 21, 2003.

In aggregate, the inputs to each alternative can be viewed as follows:

- Alternative 2A Consumer spending up related to reservoirs; power costs up. Offsetting forces are net negative.
- Alternative 3C Same
- Alternative 4D Consumer spending down; production costs up due to increased freight costs; Power costs down. Offsetting forces are net negative.
- Alternative 5A Consumer spending down because the property decline overshadows the recreation gain; Production costs up; power costs up. Net negative forces on the economy.
- Alternative 6A Consumer spending slightly positive due to positive effects arising from property overshadowing recreation at the reservoirs; production costs down due to reduced freight costs; power costs down. Net positive forces on the economy.
- Alternative 7C Consumer spending up; power costs up. Offsetting forces are net negative.
- Alternative 8A Consumer spending up; power costs up substantially. Offsetting forces are net negative.
- Blended Alternative Consumer spending up and shipper savings up. Increased power costs just offset economic gains.

In all cases the direct effects of water supply cost changes related to specific alternatives may be locally observable, but are too small to matter to the regional economic effects.

Table 6.2 shows the results of the REMI TVA modeling analysis. Inputs to the model for some direct effects are measured in absolute values and others are measured as percentage changes. Hence, these results stated in constant 2002 dollars are the economic values by which to compare among alternatives in consistent economic values.

The results show that Alternative 6A is the only alternative that produces positive economic effects on the TVA regional economy. Changes to the system that lower

waterborne freight costs and lower the cost of electricity ripple across the entire economy creating both more consumer disposable income and lower production costs for goods and services. The economy expands.

Alternative 8A, which is designed to mimic nature, has the effect of reducing TVA's peaking hydro power availability, which causes TVA to replace the low-cost hydro with higher cost purchased and generated power. Increased consumer spending driven by enhancements to TVA's reservoir recreation activities is greatly offset by the effects of higher electricity costs across the entire TVA region. Alternative 8A represents the most adverse economic outcome. Alternative 5A, designed to enhance flood protection, raises power costs and selected waterborne freight costs, and reduces reservoir recreation activity. This alternative is the second most adverse outcome.

The other alternatives all entail tradeoffs. Alternative 4D, selected for analysis to maximize hydropower availability, has the effect of reducing consumer spending and increasing production costs related to waterborne commerce deliveries. These negative impacts on the region overshadow the positive effects of lower power costs. Alternatives 2A and 3C are designed to enhance recreation activities at the reservoirs. The effects on power costs offset the gains to the economy arising from the local areas of the reservoirs. The Final Blended Alternative enhances recreation and recreator spending at reservoirs and tailwaters, but entails a slight hypothetical rate increase that just offsets positive recreation economic effects regionwide. By far, the smallest reduction to TVA Baseline conditions occurs with the Blended Alternative. On balance, the economic analysis reveals that public gains by access to more recreation are balanced by slightly higher hypothetical power costs.

The policy-relevant conclusions to be drawn from the analysis of these alternatives are the following:

- No alternatives significantly improve TVA's power generation optimization. Alternative 4D adds virtually no improvement to power costs, but increases to transportation costs and reduction of recreation spending at the tributary reservoirs have negative effects on the economy.

- Alternatives that set restrictive flow targets, Alternatives 5A and 8A, impose significant increases on TVA's power generation costs and have the most adverse effects on the regional economy.
- Enhancing waterborne transportation (6A) creates the largest economic stimulus to the region; spending is enhanced and power costs lowered.
- Increased consumer spending arising from either added recreation or enhanced property values (2A, 3C or 7C) is offset in all cases by the effects of increased power costs to the region. Localized recreation spending effects are more than offset by changes elsewhere in the TVA region.
- The Blended Alternative creates more localized spending in the vicinity of reservoirs, which is just offset by system-wide marginal power cost increases. Observable economic impacts are the smallest of all alternatives.

Table 6.3 shows the TVA forecast with no change to operating systems. Comparison of the results in Table 6.2 to Table 6.3 emphasizes that the regional economic impacts of all alternatives are quite small. The percentage changes of the results for 2010 in Table 6.2 benchmarked to the "without change" forecast, previously discussed in Table ES2, shows that the changes are less than one-tenth of one percent. Other evaluation criteria may be more important to the ranking of these alternatives than the economic effects.

Table 6.4 shows how changes in consumer spending, transportation costs, and power costs differentially ripple across the TVA regional economy. The analysis examined how a \$100 million change input as 1996 dollars affects the value of Gross Regional Product (GRP), Income to owners and wage earners, and Employment. The table reports all values in \$2002; so the \$100 million (1996 dollars) is inflated to \$115 million. The analysis reflected by the values on Table 6.4 distributes the \$100 million across the TVA subregions in proportion to where the activity arises and to the sectors differentially affected. For instance, increased recreation activity would occur mostly in the tributary reservoirs and would affect mostly nondurable consumer spending. Increased spending by property owners would occur mostly on the main stem and is allocated to durable goods. Hypothetical electricity rate changes affect all TVA power service area equally. Transportation cost changes mostly affects activity in the Nashville and Alabama

subareas, with the balance spread across other subareas, excluding Tri-Cities, not served by a navigable stream.

REMI is a unique dynamic model, which means that it traces the cumulative effects thru time of the region becoming more economically attractive if transportation or power costs are decreased; or consumer spending related to increased recreation or reservoir property values increase thru time. The table shows the relationship of the economic variables reported in this analysis (GRP, Income and Jobs) to a constant \$100 million change after the regional economy achieves equilibrium.

The policy-relevant conclusions for the PEIS to be drawn from the analysis are the following:

- TVA actions that would affect manufacturing costs via transportation or power costs have greater effects on the level of economic activity measured by GRP and local output than actions aimed at increasing consumer spending.
- TVA actions that would reduce power and transportation costs would create higher paying jobs than actions that increase consumer spending.
- TVA actions that would enhance recreation at the reservoirs would create more but lower paying jobs than would actions that would reduce power costs or transportation costs.
- TVA actions that would enhance property values of homes on main stem reservoirs would create the fewest new jobs as money spent by property owners leaks from the region.
- TVA can operate reservoirs to increase both reservoir and tailwater recreational opportunities.

The traditional output multiplier for transportation and power enhancements is approximately 60 percent larger than that associated with recreator or property owner consumer spending (~1.9 vs. ~1.2). This means that a dollar of reduced power or

transportation costs adds ~\$1.90 to local output of goods and services compared to ~\$1.20 for consumer spending.

| <b>Table 6.2 TVA REMI Final Results</b>                |       |       |        |        |        |        |        |        |  |
|--|-------|-------|--------|--------|--------|--------|--------|--------|--|
|  | 2004  | 2005  | 2006   | 2007   | 2008   | 2009   | 2010   | 2030   |  |
| <b>Alt 2A - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -7.3  | 1.1   | -9.1   | -10.3  | -14.4  | -14.6  | -13.6  | -3.7   |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -2.1  | 0.8   | -2.8   | -3.1   | -4.7   | -4.7   | -4.4   | 2.1    |  |
| Employment   | -73   | 67    | -49    | -47    | -81    | -66    | -43    | 123    |  |
| Population   | -139  | -180  | -251   | -314   | -365   | -392   | -408   | -200   |  |
| <b>Alt 3c - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -15.8 | -8.4  | -21.8  | -22.0  | -29.3  | -28.7  | -32.5  | -32.2  |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -5.1  | -2.7  | -7.6   | -7.7   | -10.4  | -10.2  | -11.5  | -5.3   |  |
| Employment   | -179  | -39   | -190   | -164   | -229   | -193   | -220   | 12     |  |
| Population   | -206  | -296  | -424   | -525   | -627   | -690   | -769   | -821   |  |
| <b>Alt 4D - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -21.3 | -24.3 | -36.2  | -34.7  | -45.3  | -42.6  | -43.2  | -69.8  |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -4.8  | -4.3  | -10.6  | -10.4  | -14.7  | -14.1  | -14.6  | -23.7  |  |
| Employment   | -186  | -171  | -376   | -346   | -460   | -417   | -413   | -496   |  |
| Population   | -4    | -34   | -111   | -178   | -251   | -307   | -372   | -922   |  |
| <b>Alt 5A - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -40.7 | -46.5 | -59.8  | -64.9  | -73.1  | -80.9  | -76.5  | -127.6 |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -14.9 | -17.8 | -23.3  | -25.7  | -29.1  | -32.5  | -31.1  | -39.8  |  |
| Employment   | -574  | -594  | -728   | -733   | -791   | -835   | -745   | -664   |  |
| Population   | -317  | -550  | -816   | -1,024 | -1,231 | -1,409 | -1,571 | -2,755 |  |
| <b>Alt 6A - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | 22.3  | 37.7  | 36.3   | 42.1   | 47.0   | 49.2   | 54.0   | 87.4   |  |
| Pers Inc (Mil Fixed 2002 \$)                           | 3.2   | 9.4   | 8.8    | 11.2   | 13.0   | 14.0   | 15.8   | 24.0   |  |
| Employment   | 111   | 320   | 263    | 320    | 361    | 369    | 408    | 466    |  |
| Population   | 23    | 112   | 161    | 220    | 285    | 344    | 405    | 974    |  |
| <b>Alt 7C - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -14.5 | -7.2  | -20.5  | -20.7  | -27.9  | -27.1  | -30.8  | -29.7  |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -4.6  | -2.2  | -7.0   | -7.1   | -9.7   | -9.5   | -10.9  | -4.4   |  |
| Employment   | -162  | -23   | -173   | -147   | -211   | -174   | -201   | 30     |  |
| Population   | -200  | -287  | -410   | -510   | -608   | -671   | -745   | -784   |  |
| <b>Alt 8A - TVA Region</b>                             |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -46.3 | -78.2 | -100.3 | -115.8 | -123.8 | -141.3 | -160.8 | -335.2 |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -17.2 | -30.2 | -39.4  | -45.8  | -49.4  | -56.2  | -63.7  | -105.3 |  |
| Employment   | -700  | -1027 | -1196  | -1291  | -1277  | -1390  | -1522  | -1699  |  |
| Population   | -592  | -1168 | -1704  | -2224  | -2659  | -3086  | -3518  | -7273  |  |
| <b>Final Blended Alternative 10/21/03 - TVA Region</b> |       |       |        |        |        |        |        |        |  |
| GRP (Mil Fixed 2002\$)                                 | -2.2  | -5.8  | -5.6   | -8.3   | -9.0   | -7.3   | -6.0   | -4.5   |  |
| Pers Inc (Mil Fixed 2002 \$)                           | -0.4  | -1.8  | -1.8   | -2.7   | -3.0   | -2.3   | -1.9   | 0.5    |  |
| Employment   | 2     | -27   | -16    | -44    | -43    | -16    | 2      | 61     |  |
| Population   | -63   | -101  | -130   | -163   | -184   | -189   | -191   | -116   |  |
| Source: EWE, May & Oct, 2003                           |       |       |        |        |        |        |        |        |  |

|                           | 2004    | 2005    | 2006    | 2007    | 2008     | 2009     | 2010     | 2020     | 2030     |
|---------------------------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| GRP<br>(Mil 2002 \$)      | 301,338 | 311,985 | 322,357 | 333,267 | 345,346  | 358,598  | 372,681  | 519,861  | 694,733  |
| Pers Inc<br>(Mil 2002 \$) | 253,806 | 260,528 | 268,255 | 276,115 | 285,081  | 294,394  | 303,334  | 410,298  | 529,835  |
| Employment<br>(1000)      | 5,553.8 | 5,648.3 | 5,727.8 | 5,811.8 | 5,909.4  | 6,000.4  | 6,095.2  | 6,859.7  | 7,482.9  |
| Population<br>(1000)      | 9,595.4 | 9,701.5 | 9,806.4 | 9,911.0 | 10,015.4 | 10,121.4 | 10,227.2 | 11,340.1 | 12,476.3 |

Source: TVA Forecast, December 2002

|                        |                     | Increased<br>Recreator<br>Spending | Increased<br>Property Owners<br>Spending | Reduced<br>Transportation<br>Costs | Reduced<br>Power<br>Rates |
|------------------------|---------------------|------------------------------------|--|------------------------------------|---------------------------|
| <b>TVA ROS Change</b>  |                     |                                    |  |                                    |                           |
| GRP (Mil 2002 \$)      |                     | 78.8                               | 77.2                                     | 119.6                              | 118.8                     |
| Pers Inc (Mil 2002 \$) |                     | 46.5                               | 32.5                                     | 46.1                               | 49.0                      |
| Employment             |                     | 1,493                              | 920                                      | 1,167                              | 1,249                     |
| <b>MULTIPLIERS</b>     |                     |                                    |  |                                    |                           |
| GRP Multiplier         | \$ per \$ spending  | 0.69                               | 0.67                                     | 1.04                               | 1.04                      |
| Output Multiplier      | \$ per \$ spending  | 1.16                               | 1.18                                     | 1.89                               | 1.86                      |
| Income Multiplier      | \$ per \$ spending  | 0.41                               | 0.28                                     | 0.40                               | 0.43                      |
| Employment Multiplier  | jobs per \$ Million | 13.02                              | 8.02                                     | 10.17                              | 10.89                     |
| Annual Income per Job  | 2002 \$             | \$31,142                           | \$35,326                                 | \$39,542                           | \$39,271                  |

Source: EWE May 15, 2003

## Appendix A

### TVA Background Forecast of Regional Economic Activity

TVA produces its own forecasts of regional economic activity. These forecasts are based on forecasts of the national economy developed by an internationally recognized forecasting service, *Global Insight*. TVA uses its regional economic forecasts for budget planning, the planning of locks and other navigation facilities, and economic development activities. These forecasts are publicly distributed throughout the Tennessee Valley. The regional economic forecasts are the major "key assumption" to TVA's load forecasts.

These forecasts are based on five elements necessary for state-of-the-art forecasting: accuracy, use of best information, use of best methods, explicit treatment of uncertainty, and continuous improvement.

#### **Accuracy**

Table 1 below summarizes the accuracy of TVA five-year forecasts for total gross product (the dollar value of all goods and services produced in a geographic area) for the region and the nation. (*Global Insight* and its predecessors *DRI* and *WEFA* have been used for the national economic forecasts.) These forecasts have been produced and documented annually since 1980. For example, a regional and a national forecast for 1985 (the target year in Table 1) were done at the start of 1981, with 1980 as the latest historical year (the year of forecast in Table 1). Likewise, forecasts for 1995 were done at the beginning of 1991, with 1990 as the latest historical year. Table 1 shows the percent of error between the forecasted value and actual data (expressed as a positive--forecast was too high--or negative--forecast was too low--value) for both the regional and national forecasts.

Table 1 indicates that the performance of TVA regional economic forecasts has improved considerably since its early years and that it has overall been favorable compared to that of the national economic forecasts. For the last three target years for which actual data are available for both the region and the nation (1998 through 2000), the average error in the regional forecasts for total gross product was small, within plus

or minus two percent. An appendix table to this paper further describes the “track record” of the economic forecasts by exhibiting the average absolute percentage error for additional economic variables and forecasted target years.

Table 1

TVA Economic Forecast Five-Year Forecast Error  
Gross Product in Billions of Dollars<sup>3</sup>

| <u>Year of Forecast</u>                    | <u>Target Year</u> | <u>-----Regional-----</u> |               |                       | <u>-----National-----</u> |               |                       |
|--|--------------------|---------------------------|---------------|-----------------------|---------------------------|---------------|-----------------------|
|  |                    | <u>Forecast</u>           | <u>Actual</u> | <u>Forecast Error</u> | <u>Forecast</u>           | <u>Actual</u> | <u>Forecast Error</u> |
| 1980                                       | 1985               | \$115.6                   | \$99.9        | 15.7%                 | \$4,840                   | \$4,213       | 14.9%                 |
| 1981                                       | 1986               | \$125.6                   | \$103.1       | 21.9%                 | \$5,278                   | \$4,453       | 18.5%                 |
| 1982                                       | 1987               | \$122.2                   | \$113.4       | 7.8%                  | \$5,278                   | \$4,742       | 11.3%                 |
| 1983                                       | 1988               | \$130.7                   | \$122.1       | 7.0%                  | \$5,348                   | \$5,108       | 4.7%                  |
| 1984                                       | 1989               | \$135.3                   | \$128.6       | 5.2%                  | \$5,709                   | \$5,489       | 4.0%                  |
| 1985                                       | 1990               | \$139.3                   | \$133.6       | 4.3%                  | \$5,896                   | \$5,803       | 1.6%                  |
| 1986                                       | 1991               | \$150.0                   | \$142.8       | 5.0%                  | \$6,367                   | \$5,986       | 6.4%                  |
| 1987                                       | 1992               | \$155.1                   | \$156.4       | -0.8%                 | \$6,439                   | \$6,319       | 1.9%                  |
| 1988                                       | 1993               | \$172.2                   | \$166.0       | 3.7%                  | \$7,142                   | \$6,642       | 7.5%                  |
| 1989                                       | 1994               | \$181.7                   | \$178.9       | 1.6%                  | \$7,518                   | \$7,054       | 6.6%                  |
| 1990                                       | 1995               | \$181.1                   | \$188.8       | -4.0%                 | \$7,553                   | \$7,401       | 2.1%                  |
| 1991                                       | 1996               | \$195.7                   | \$197.4       | -0.9%                 | \$7,919                   | \$7,813       | 1.4%                  |
| 1992                                       | 1997               | \$211.4                   | \$210.7       | 0.4%                  | \$8,199                   | \$8,318       | -1.4%                 |
| 1993                                       | 1998               | \$223.6                   | \$222.1       | 0.7%                  | \$8,566                   | \$8,782       | -2.4%                 |
| 1994                                       | 1999               | \$238.2                   | \$233.0       | 2.2%                  | \$9,013                   | \$9,269       | -2.8%                 |
| 1995                                       | 2000               | \$248.6                   | \$245.5       | 1.2%                  | \$9,347                   | \$9,873       | -5.3%                 |
| <b>Average Absolute Error (1998-2000):</b> |                    |                           |               | <b>1.4%</b>           |                           |               |                       |
| <b>Average Absolute Error (1996-2000):</b> |                    |                           |               | <b>1.1%</b>           |                           |               |                       |
| <b>Average Absolute Error (1985-2000):</b> |                    |                           |               | <b>5.2%</b>           |                           |               |                       |

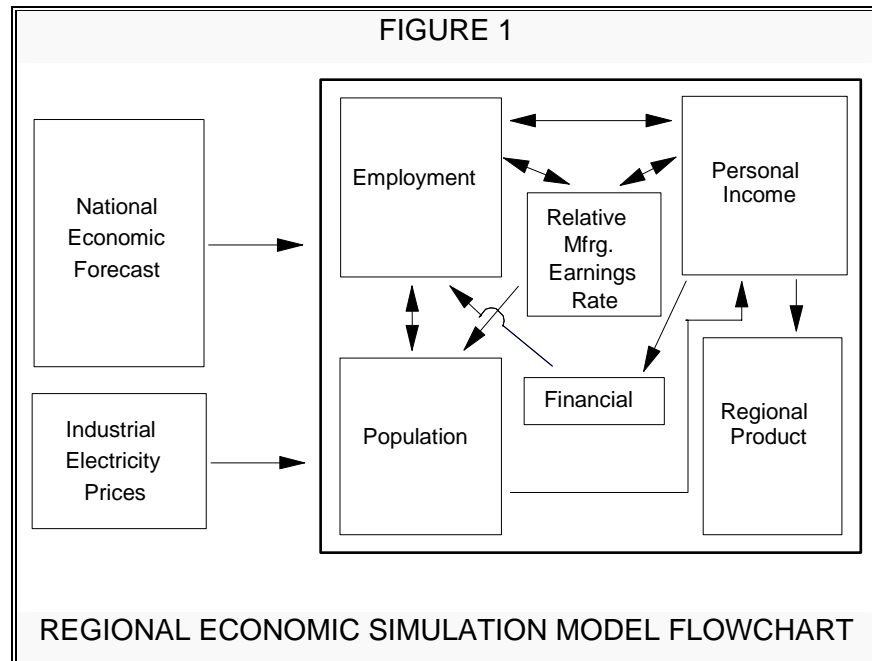
The regional economic forecast performance improvement can be attributed, in part, to the better performance of the national forecasts and to improvements in the TVA economic forecasting process, including validation procedures. TVA does reviews of forecasting performance (as per the example above) as well as annual reviews of new economic data. Economic "forecasts" over the historical period are done annually to test TVA's economic model performance versus actual data.

<sup>3</sup> Nominal dollars incorporating U.S. Bureau of Economic Analysis, Department of Commerce, comprehensive revisions of the State and National Income and Product Accounts as of May 2002. Because

### Use of Best Methods

TVA uses its regional economic simulation model (RESM) as its primary model to produce its base regional economic forecasts within an integrated system of models and analysis. The RESM model uses state-of-the-art statistical methods, comparable to those of the major economic forecasters in the country. TVA has been a leader in the utility industry in the use of econometric forecasting models which have now become the industry standard. Several professional papers have been presented on TVA's model and articles published on the subject and the resultant TVA forecast analyses; the analyses have been quoted in *The Wall Street Journal* and *USA Today* as well as the regional media.

As seen in Figure 1, the two major inputs to RESM are *Global Insight* national economic forecasts and TVA industrial electricity prices. RESM does not just allocate national trends but captures the differences inherent in the regional economic



structure which affect regional performance. RESM is updated on an annual basis and has a high degree of industry detail. (For example, chemicals, apparel, etc., in manufacturing; food stores, health services, etc., in the commercial sector.) This allows for interindustry linkages; for instance, wholesale trade is linked to retail trade. (See Gonzalez, Juan E., "The TVA Regional Economic Simulation Model," Proceedings: Eighth Electric Utility Forecasting Symposium, (EPRI TR-100396), Electric Power Research Institute, Palo Alto, California, April 1992, pp. 39-1 to 39-11, for a more detailed discussion of RESM.)

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of revisions to the nominal dollar values, the levels quoted here may differ from those appearing in

TVA uses other models in an integrated fashion with the RESM model to further enhance the accuracy and detail of its economic forecasts and analyses. TVA maintains a monthly econometric model that uses current U.S. Bureau of Labor Statistics monthly state employment data to allocate the annual TVA region economic forecast over the year. Even though this model lacks the detail of the annual model, it allows for continuous tracking and updating of the forecast on a monthly basis.

TVA has a multi-area economic simulation and forecasting model purchased from *Regional Economic Models, Inc. (REMI)*. The REMI model is used along with the TVA econometric models to produce economic forecasts of TVA economic subregions and simulations of economic impacts for studies of economic development, transportation infrastructure, and electricity prices proposals.

The REMI model provides a much more comprehensive set of economic relations than the more aggregate econometric models including detailed inter-industry relationships within an input-output-type model and interlinkage of geographic subregions through simulation of inter-regional trade. While the econometric-based RESM has strong dynamic properties for producing accurate base trend economic forecasts, the REMI model enhances the forecast process through more extensive policy simulations of alternative scenarios and through allocation of TVA's regional economic forecasts to the economic subregions of the Valley.

As part of process improvement, TVA began a program with universities around the Valley to share economic information and review economic forecasts in 1985. Currently, there are 11 universities participating: The University of Alabama in Huntsville, Georgia State University, Eastern Kentucky University, Western Kentucky University, Mississippi State University, Austin Peay State University, East Tennessee State University, Middle Tennessee State University, The University of Memphis, The University of Tennessee at Knoxville, and The University of Tennessee at Martin. Besides providing current information on economic events in their specific subregions, the universities review both the regional economic forecast and the forecasts for the economic subregions of the

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previous versions of this report.

Valley on an annual basis. Feedback is incorporated into the economic forecasting process and used to validate and revise the regional economic forecasts.

Besides regular review by these universities, TVA regional economic forecasts have been occasionally audited by other outside parties including by the U.S. GAO as part of the Energy Vision 2020 study.

### **Use of Best Information**

TVA strives to use the best information available for its economic forecasting. As mentioned, the national economic forecasts are purchased from *Global Insight*. *Global Insight* forecasts are well recognized and widely used. Among *Global Insight* clients are a great number of utilities, federal and state agencies, universities, and Fortune 500 companies. *Global Insight* forecasts are quoted by the Wall Street Journal and other major business publications and used in Congressional hearings and legal cases. In addition, TVA monitors national economic forecasts, such as the survey done monthly by *Consensus Forecasts – USA*, as a “check” on the *Global Insight* national economic forecast.

The source historical economic data for the regional forecasts come from the federal government: the Bureau of Economic Analysis and the Bureau of the Census, U.S. Department of Commerce, and the Bureau of Labor Statistics, U.S. Department of Labor. The federal government has improved these data over the years. Further, TVA has improved its use of these data to get a better and more current picture of the regional economy. For example, by using the monthly state employment data from the Bureau of Labor Statistics, TVA can estimate regional employment in a more timely manner than by using estimates from other sources.

TVA has improved its information by supplementing the data discussed above with information from other sources, including detailed employment and payroll data from state employment agencies, announcements of plant openings and closings, information on industry trends from trade journals and government reports, and information from regional universities (discussed above) and TVA Customer Service and Economic Development staff about the status of local industries. TVA also monitors Tennessee

Valley state economic forecasts, such as the annual forecast article done by the Federal Reserve Bank of Atlanta, as a “check” on the TVA regional economic forecast.

### **Explicit Treatment of Uncertainty**

Forecasting is inherently uncertain. First, uncertainty exists within the major inputs to the regional forecast. Many events, especially those that are not economic in nature such as the break up of the Soviet Union or the September 11, 2001 terrorist attack, may derail the national economy from its expected growth path. Likewise, TVA electricity price forecasts are uncertain. In addition, how the regional economic structure will change over time is uncertain.

To deal with uncertainty, TVA supplements its modeling with industry analyses and studies of specific major issues such as the effects of changes in the value of the dollar or interest rates on the Valley economy. This is an effort to continually improve TVA's understanding of the Valley economy and its ability to produce accurate economic forecasts.

Further, TVA deals with uncertainty by producing alternative regional economic forecasts such as the high and low forecasts that define a range of possible future economic outcomes with a 90 percent confidence that the true outcome will fall within this range. The high and low forecasts are derived by using *Global Insight* national high and low economic forecasts and TVA low and high electricity price forecasts, respectively. Explicit assumptions are made as to possible events that are not considered most likely but are feasible developments from emerging historical events. Thus, for instance, in the current high economic forecast, the assumption is made that the region will develop a commercial sector that more closely matches that of the nation, including more “high-tech” business services. Likewise in the low forecast, the assumption is made that several of the Valley's manufacturing industries, not just apparel, experience large negative effects due to foreign competition.

# Appendix 1

## Average Absolute Percentage Error Forecast versus Actual Values

|                          | Last Five Target Years** |                   |                    |                   | All Target Years** |                   |                    |                   |
|--------------------------|--------------------------|-------------------|--------------------|-------------------|--------------------|-------------------|--------------------|-------------------|
|                          | One-Year Forecast        | Two-Year Forecast | Five-Year Forecast | Ten-Year Forecast | One-Year Forecast  | Two-Year Forecast | Five-Year Forecast | Ten-Year Forecast |
| Gross Product*           |                          |                   |                    |                   |                    |                   |                    |                   |
| <b>Region</b>            | 1.0%                     | 1.3%              | 2.2%               | 9.6%              | 1.1%               | 2.3%              | 4.1%               | 17.2%             |
| <b>US</b>                | 1.0%                     | 1.9%              | 1.3%               | 17.8%             | 1.0%               | 2.6%              | 6.1%               | 23.4%             |
| Manufacturing Product*   |                          |                   |                    |                   |                    |                   |                    |                   |
| <b>Region</b>            | 2.6%                     | 3.5%              | 8.3%               | 11.6%             | 2.0%               | 3.1%              | 7.2%               | 15.0%             |
| <b>US</b>                | 1.2%                     | 2.3%              | 1.7%               | 15.9%             | 1.4%               | 3.2%              | 6.4%               | 21.3%             |
| Total Employment         |                          |                   |                    |                   |                    |                   |                    |                   |
| <b>Region</b>            | 0.2%                     | 0.6%              | 2.7%               | 6.4%              | 0.6%               | 1.4%              | 2.9%               | 5.7%              |
| <b>US</b>                | 0.6%                     | 1.5%              | 1.2%               | 4.8%              | 0.5%               | 1.3%              | 1.6%               | 4.0%              |
| Manufacturing Employment |                          |                   |                    |                   |                    |                   |                    |                   |
| <b>Region</b>            | 1.3%                     | 2.5%              | 6.2%               | 3.8%              | 1.4%               | 2.8%              | 3.5%               | 3.5%              |
| <b>US</b>                | 1.1%                     | 2.9%              | 2.4%               | 3.4%              | 1.4%               | 3.4%              | 3.9%               | 6.5%              |
| Per Capita Income*       |                          |                   |                    |                   |                    |                   |                    |                   |
| <b>Region</b>            | 0.4%                     | 1.9%              | 2.8%               | 15.6%             | 1.1%               | 2.1%              | 3.5%               | 16.8%             |
| <b>US</b>                | 0.7%                     | 2.0%              | 4.6%               | 18.9%             | 1.1%               | 2.1%              | 5.4%               | 20.9%             |

\*\*\*"Last Five Target Years" represents the average absolute percentage error for forecasts of the years 1995-1999, the last five years for which actual data is available; "All Target Years" represents the average absolute percentage error for all years forecasted: one-year—1981-1999 target years, two-year—1982-1999, five-year—1985-1999, and ten-year—1990-1999.

