Chapter Five

Evaluation Criteria

Chapter Five: Evaluation Criteria

Sound judgments about energy resource options require a way to evaluate cost, benefits, and effects on the environment for each of these options.

Through Energy Vision 2020, TVA developed a comprehensive evaluation system that reflects TVA's goals and objectives, as well as the concerns and values of the public. TVA's evaluation criteria include:

- Long-Run Cost/Value
- TVA Short- and Mid-Term Rates
- Reliability
- Environment
- Economic Development
- Financial Requirements
- Risk Management
- Equity Among Rate Classes

These criteria and associated measures became the quantitative basis for ranking supply-side and customer service options. They were later used in the multi-attribute trade-off analysis to evaluate and improve TVA's strategies.

This Chapter Includes:

- Using the Evaluation Criteria
- Evaluation Criteria and Measurement Descriptions

Evaluation Criteria

TVA's evaluation criteria (listed in *Figure 5-1*) were developed to reflect the values of the public and TVA's goals and objectives. The public's concerns were collected through the public participation process described in Chapter 1. The method by which TVA translated the public concerns and TVA's goals and objectives into measurable criteria for Energy Vision 2020 is described in Chapter 2. These quantifiable measures of public concern and TVA's goals provide the primary guidance for developing the strategies.

Through Energy Vision 2020, TVA developed a comprehensive evaluation system that reflects TVA's goals and objectives, as well as the concerns and values of the public.

Using the Evaluation Criteria

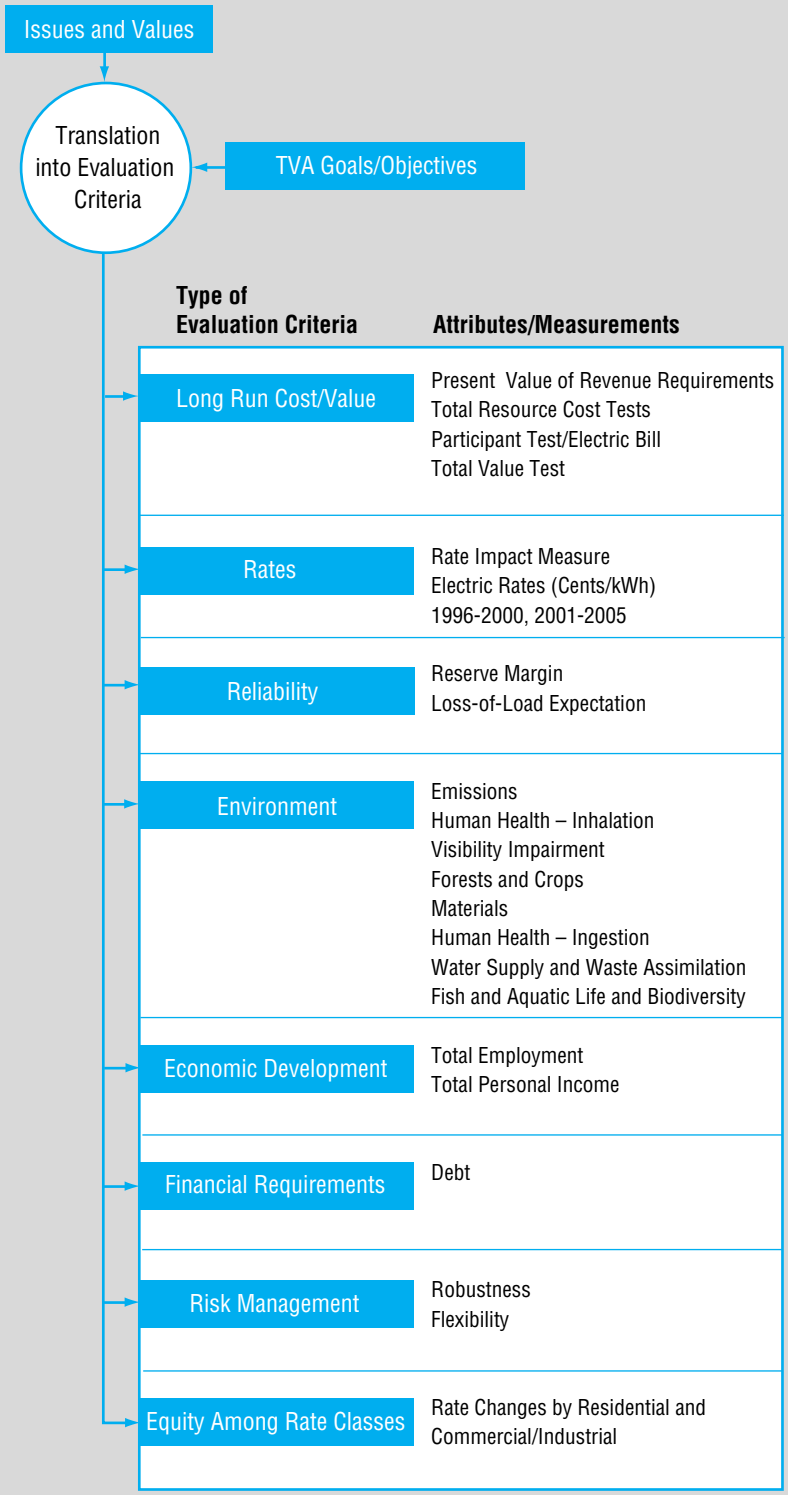
The evaluation criteria and their associated measurements are used at two different points in the integrated resource planning process. First, individual resource options are evaluated and ranked based on appropriate measurements. This ranking is used to prioritize and group individual resource options into possible resource strategies. The evaluation criteria measurements are then used in multi-attribute trade-off analysis to evaluate strategies (for example, short-term rates versus environmental quality measures). By looking at a series of key trade-off plots, the decision-maker is able to see the likely positive or negative consequences of using certain strategies. Additional information about the multi-attribute trade-off analysis used in Energy Vision 2020 is found in Chapter 9.

Evaluation Criteria and Measurement Descriptions

LONG RUN COST/VALUE

The long run cost/value criteria provide a measure of how various resource options and strategies will change TVA's overall cost of doing business and its requirements for revenues over the full 25-year planning period. This, in turn, provides a measure of whether certain options and strategies will add value for TVA's customers. TVA presently uses four different tests to measure long-run cost and benefits.

FIGURE 5-1. **Evaluation Criteria**



Multiple evaluation criteria are used in Energy Vision 2020.

- **Total Resource Cost (TRC) Test** – This test measures whether a resource option or strategy will be cost effective when the net costs and benefits for customers are included in the analysis. The costs include all utility and customer costs for implementing a resource option. The benefits result from the reduction in the cost of producing electricity by implementing the resource option instead of the next best alternative. Choosing options or strategies with the lowest total resource cost is a measure of the least economic cost or highest economic efficiency.
- **Participant Test** – This test is a benefit-cost measurement that evaluates demand-side management programs from the point of view of the customers participating in the programs. The benefits measured include reduction in the participants' utility bills, incentives paid by the utility, and any state, federal, or local tax benefits the participant may receive from participating in the programs. The costs include any additional customer out-of-pocket expenses incurred as a result of participating in the program.
- **Rate Impact Measure (RIM)** – This test measures what happens to electric rates due to changes in utility revenue and operating costs in the long term caused by resource options or strategies
- **Total Value Test** – This test measures not only the total cost of a resource option or strategy from the point of view of TVA and customers as a whole, but also the effects upon the benefits or "value" that participants and ratepayers receive. Value is measured by the

difference between what consumers are willing to pay for a service and what they actually pay. Traditional cost-effectiveness tests are insufficient to capture the full range of benefits that a customer might experience (such as productivity and quality improvements from selecting an option that results in increased electric consumption). The total resource cost test measures value only in terms of cost reductions in electric service. The value test measures value from cost reductions in electric service, other energy services such as natural gas, cost reductions in improvements to industrial processes, and quality improvements in the delivery of energy services. The value test provides an improved measure of economic efficiency.

TVA SHORT- AND MID-TERM RATES

The competitiveness of utilities will be largely based on their rates in the future marketplace. Therefore, all resource options and strategies are measured for their short- and mid-term effect on rates (as well as using the long-term rate impact measurement test described above). TVA has elected to show average short-term impacts for the years 1996-2000 and average mid-term impacts for the years 2001-2005. Electric rates are becoming an increasingly important criterion for resource planning as the industry becomes more competitive and the planning horizon is shortened.

RELIABILITY

To maintain its competitiveness, TVA must not only supply electricity at the lowest possible cost, it must also provide a reliable supply of electricity. For the purposes of Energy Vision 2020, reliability means TVA's ability to provide a continuous supply of electricity to meet its customers' peak demand (expressed in megawatts) and energy requirements (kilowatt-hours). TVA relies on all resources considered in Energy Vision 2020 to meet its reserve requirements, including purchases of power and options to purchase.

The reliability of the TVA power system depends on the performance of TVA's generation and transmission systems. An important consideration in analyzing system reliability is reserve margin and loss-of-load probability. The trigger for adding new generating capacity is generally based on an analysis of loss-of-load probability. Loss-of-load probability can be described as the expected number of hours over a one-year period where TVA's hourly loads are expected to exceed its available supply of power. This is then converted into a reserve margin, or the amount (percentage) of "extra" generation TVA should have in addition to the projected peak load forecast to provide coverage for unexpected outages, scheduled maintenance, etc.

As discussed in Chapter 6, Load Forecast and Need for Power, TVA uses a reserve margin of 15 percent for the years 1996 and 1997 and 13 percent for the years 1998-2010. Since these reliability requirements must be met by all strategies considered in Energy Vision 2020, system reliability is treated as a constraint on each strategy. Therefore, all strategies considered during this process had adequate and comparable levels of reliability.

ENVIRONMENT

Certain environmental costs can be readily identified and included in the total costs of a particular resource option. A good example is the cost for pollution control equipment to reduce sulfur dioxide emissions. It is not always possible, however, to quantify or value all environmental impacts associated with supply-side or electric power generation resources. Nevertheless, these impacts are real and need to be measured and accounted for in the decision-making process to the extent possible. Whenever possible, TVA has analyzed the environmental impacts on the same basis as other evaluation criteria by using the multi-attribute analysis process.

Most of the resource options and strategies being considered in Energy Vision 2020 are generic in nature, rather than being associated with specific projects or sites. For example, integrated coal gasification combined cycle plants are considered in various strategies, but no site is proposed. Without specific sites, TVA is unable to fully evaluate those impacts that are dependent on local conditions. However, TVA does identify differences in strategies, either quantitatively or qualitatively, that reflect air and water pollutant emissions and other indicators such as land use for existing and new resources and their potential for impact on the environment.

TVA's environmental analysis focused primarily on regional or broad-scale environmental impacts and the generic impacts associated with categories of energy options. Site-specific or local impacts of an individual energy resource project will be addressed in detail in future environmental reviews as specific energy projects are developed.

As discussed in Chapter 3, Affected Environment, measurements of individual pollutant emissions or other indicators of potential environmental impacts were combined to form the indices of impacts listed in *Figure 5-2*. More detailed rationales for the various weightings for the measures are in Volume 2, Technical Document 1, Comprehensive Affected Environment.

ECONOMIC DEVELOPMENT

Economic development is a primary mission of TVA and a recognized public concern in the TVA service area. Historically, the residents of the Tennessee Valley have had low levels of per capita personal income compared to national averages. For this reason, all of the states in the Valley place a high value on opportunities to broaden and enhance their economic base.

Alternative strategies for meeting future needs for electricity have different economic impacts. This criterion, like the others, does not override other considerations. Nevertheless, it is necessary and appropriate to evaluate the economic consequences of each proposed resource option and strategy.

Energy Vision 2020 uses two measurements of economic development: (1) total employment created by various resource strategies in the Valley and (2) the effect of these strategies on total personal income for Valley residents.

FIGURE 5-2. Environmental Indices and Weightings

Environmental indices have been developed by weighting environmental emissions. The environmental indices have been developed for air and water impacts. In addition, greenhouse gases are measured in terms of equivalent tons of carbon dioxide.

		IMPACT AREAS							
		Air				Water			
		Environmental Evaluation Criteria							
Environmental Measure	**Units**	**Health-Inhalation**	**Visibility Impairment**	**Forests and Crops**	**Materials**	**Health-Ingestion**	**Water Supply and Waste Assimilation**	**Fish and Aquatic Life and Biodiversity**	**Greenhouse Gases Total Equivalent Carbon Dioxide (Millions of Tons)**
Sulfur Dioxide (SO_2) Emissions	Annual Average Tons	0.40	0.70	0.25	0.60				
Nitrogen Oxides (NO_X) Emissions	Annual Average Tons	0.50	0.25	0.75	0.40				
Total Suspended Particulates (TSP) Emissions	Annual Average Tons	0.05	0.05						
Carbon Dioxide (CO_2)Emissions	Annual Average Thousands of Tons								1
Mercury (Hg) Emissions	Annual Average Tons	0.05							
Coalbed Methane Recovered	Annual Average Tons								-21
Natural Gas Methane Emissions	Annual Average Tons								21
Landfill Methane Recovered	Annual Average Tons								-21
Wood Waste Methane Avoided	Annual Average Tons								-21
Wood Waste Carbon Dioxide Avoided	Annual Average Thousands of Tons								-1
Short Rotation Woody Crops Carbon Dioxide Avoided	Annual Average Thousands of Tons								-1
Heat Release to Surface Water	Annual Average Quadrillion BTUs						0.10	0.05	
Water Consumption	Annual Average Trillions of Gallons						0.10		
Water Use	Annual Average Trillions of Gallons							0.03	
Coal Burned	Annual Average Millions of Tons							0.20	
Nuclear Power Production	MWh					0.05		0.02	
Coal Power Production	MWh					0.60		0.05	
Hydro Electric Peaking Production	MWh					0.35	0.80	0.60	
New Power Plants Constructed	Number							0.05	

FINANCIAL REQUIREMENTS

The TVA power program is self-supporting, and its customers ultimately bear all of the costs incurred by the program. The power program receives no federal tax dollars. The TVA Act prescribes certain financial requirements for TVA. For example, TVA is to provide electric power at rates that are as low as possible. Other financial requirements are contained in the covenants of lending documents executed when TVA borrows money for capital improvements.

To address the general public concern over TVA's existing debt, all resource options and strategies were evaluated in terms of impact on TVA's debt. The TVA Act sets a limit on the amount of debt TVA may have outstanding at any one time. An Act of Congress is required to change this limit, which is currently $30 billion. TVA's debt is currently some $3 billion below this debt ceiling. The TVA Board has announced that TVA will limit its debt to an amount about $2 to $3 billion below the Congressionally set limit.

RISK MANAGEMENT

Uncertainties in load growth, fuel prices, capital costs, and regulatory standards have long challenged utility planners. Added to this list of traditional uncertainties is the likelihood of increasing competition, which will make sound resource decisions even more difficult.

Risk management is now considered an essential part of the planning process at TVA. Planners are shifting from simply making resource investments, based on a fixed set of assumptions about the future, to a different mode of planning that accounts for certain levels of uncertainty in future events. Plans must be both robust and flexible to successfully deal with an uncertain future.

A robust strategy is one that performs well relative to the evaluation criteria across a variety of possible futures. A flexible strategy is one that is conducive to being modified as events unfold and near-term futures become more clearly known. More flexible options are likely to be based on smaller units or program sizes. Flexible options would also have short lead times to construct or start, lower capital costs, and low walk-away costs.

Energy Vision 2020 introduces new techniques for analyzing flexibility. These techniques are based on financial options valuation models and extensions of decision analysis models. Financial options valuation models, such as the Black Scholes model, have been adapted by TVA to look at the value of flexibility in the utility industry. Decision analysis models have been extended to incorporate multiple decision points with many possible uncertainties to analyze the value of flexibility.

EQUITY AMONG RATE CLASSES

As in most businesses, utilities establish different classes of customers to tailor their products and services to meet the particular needs of those customers and to assign appropriate costs. The rate structures used by TVA and the distributors of TVA power provide a primary distinction between residential and commercial and industrial customers. Issues of equity among different class-

es of customers arise when a utility offers services to a particular class of customers for its benefit or to achieve social objectives (e.g., energy conservation). Likewise, issues of equity within a rate class can exist between those who participate in a program and those who do not (non-participants).

Typically, customers who participate in special programs or services (e.g., demand-side management) receive most, if not all the benefits. These programs, however, can increase non-participants' electric rates without providing them with corresponding benefits (i.e., reduced electric bills).

Energy Vision 2020 addresses the issues of equity by looking at the rate impacts of each customer service option on the residential and the commercial and industrial rate classes. In addition, equity is evaluated through the Rate Impact Measure (RIM) test. Programs that pass the RIM test benefit all customers through lower power bills for participants and lower rates for non-participants. If a program does not pass the RIM test, implementing the program would cause non-participants' rates to increase—creating a subsidy for participants.