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# An Overview of Analysis Tools for Integrated Resource Planning

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# AN OVERVIEW OF ANALYSIS TOOLS FOR INTEGRATED RESOURCE PLANNING

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**ABSTRACT**

Least-cost utility planning confronts utilities with the difficult task of preparing resource plans that use conventional modeling tools in new ways, as in the calculation of avoided costs from production-cost models, and it introduces a new generation of planning tools specifically designed to deal with the complexities of demand-side resource quantification and demand-supply-side integration. In this study, we provide a road map that seeks to illustrate the broad range of capabilities available with current planning models and the major conceptual distinctions among them. We start from a sketch of the major steps in least-cost planning and highlight some of the complexities involved. We then discuss various approximations to this ideal that can be achieved with existing modeling tools. Moving from the most sophisticated approach, which involves the linking of a number of detailed, specialized models, we discuss successively simpler modeling approaches and the compromises they involve.

## INTRODUCTION

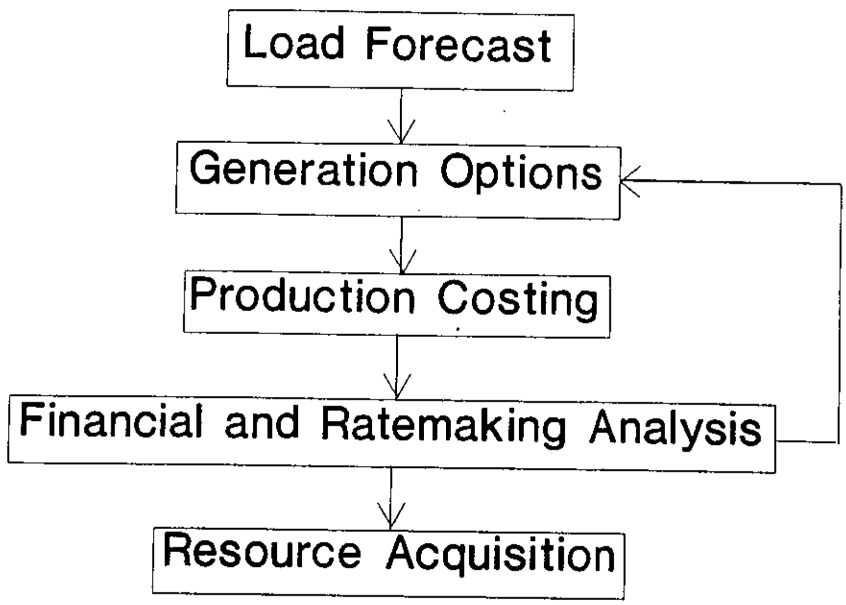
Well-documented failures in the markets for energy services have lead regulators to consider new planning approaches for utilities.[1,2] These planning approaches, broadly referred to as integrated resource and least-cost utility planning, called for expanded roles for utilities in the provision of energy services. Specifically, they call for increased utility reliance on resources on the demand- or customer-side of the meter. This new planning approach involves substantial modifications and expansions for traditional utility resource plans. From an analytical standpoint, these modifications include the use of conventional modeling tools in new ways, as in the calculation of avoided costs from production cost models, and typically the use of a new generation of planning tools specifically designed to deal with the complexities of demand-side resource quantification and demand-/supply-side integration.

Hirst provides an excellent example of these modeling complexities in his recent description of the Demand and Resource Evaluation (DARE) project of Puget Power and Light: "The DARE final report includes the key elements of an IRP. Alternative load forecasts were developed....Various demand and supply resources were assessed....Different combinations of demand and supply resource were then examined."[3] Models and other analytical tools have value for LCUP only to the extent that they facilitate planning by manipulating data in ways that are meaningful, understandable, and helpful to decision makers. That value stems largely from the conceptual structure provided by a modeling framework. Technically, the structure serves to define the range and manner in which issues can be addressed. Institutionally, the structure promotes the use of a common set of definitions and, as such, can be extremely effective in building consensus during the planning process and in identifying areas for conflict resolution. Use of common data sets also gives staff at many levels of utilities and PUCs a broader picture of the LCUP process.

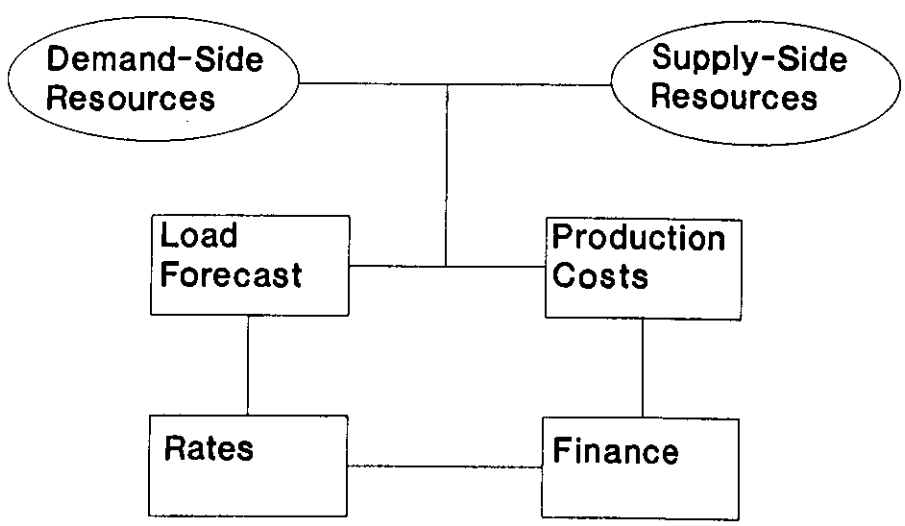
In the following discussion of models used in least-cost planning, we provide a road map that seeks to illustrate the broad range of capabilities available in current planning models and the major conceptual distinctions among them. Procedurally, we start from a sketch of the major steps in LCUP and highlight some of the complexities involved. We then discuss various approximations to this ideal that can be achieved with existing modeling tools. Moving from the most sophisticated approach, the linking of a number of detailed, specialized models, we discuss successively simpler modeling approaches and the compromises they involve. In all our discussions, emphasis is on the issues raised for LCUP by these compromises and on the sensitive areas they pinpoint.

Our review of LCUP analysis tools is not exhaustive, nor is it to be construed as an endorsement of one vendor's product over another. Accordingly, while these discussions are accurate portrayals of the models, given available reference materials, they cannot account for

# Figure 1
## Traditional Utility Resource Planning




# Figure 2
## Elements of Integrated Resource Planning



evaluation of important uncertainties. With integrated-planning models, major linkages are embedded in the simulation and made transparent to the user. The most important of these linkages is between the specification of the demand-side loads and the subsequent effects on production costs. Consequently, many scenarios or sensitivities can be evaluated very quickly compared to the model linkage approach.

Examples of commercially available integrated planning models include Lotus Consulting Group's UPLAN,[16] Energy Management Associate's PROSCREEN,[17] Decision Focus and Electric Power Software's LMSTM,[18] EPRI's MIDAS,[19] A. Ford's CPAM,[20] and Systematic Solutions' ENERGY 2020.[21]

We use two criteria to distinguish integrated planning models from screening tools (which are described in the following section). First, integrated planning models usually permit the user to specify the end-use structure of demand in great detail. The models typically accept hourly load shapes that can be combined individually from the bottom up or subtracted directly from a system total load shape. Second, they also usually feature dynamic simulation of the production cost impacts based on these load shapes. These features make integrated-planning models an attractive middle ground between time-consuming linking of independent detailed models, and the great sacrifices in detail required by simpler screening tools.

The benefits of integration, however, can be compromised by the technical and institutional costs of a modeling approach that falls between these two extremes. Technically, integration results in some loss of detail at each step in the analysis. Despite substantial data requirements, simplifications are often unavoidable, and model results will always be evaluated relative to those produced by the more detailed models. Thus, the models often need extensive benchmarking and calibration. In a recent study of thermal energy storage in the Pacific Gas and Electric (PG&E) Company service territory, LBL researchers devoted significant project resources to calibration of EPRI's LMSTM model to production cost results from PG&E's in-house model.[22] Institutionally, these calibration efforts are essential to give model results credibility.

Several methodological issues must be evaluated in judging any integrated planning effort. We introduce several of them in this section because they are often suppressed in uncritical use of integrated models. Nevertheless, these issues are no less significant for the simpler screening tools to be described in the following section.

The first issue deals with consistent and meaningful treatment of demand-side programs in developing system-wide load shape impacts. Often, demand-side programs are represented as reductions in load from a system load shape. This technique can double-count load savings from successive, yet highly interactive demand-side measures. A chief advantage of stand-alone, end-use forecasting models is their ability—in principle—to treat demand-side measures consistently.

available to specify system loads, do not provide for sophisticated treatment of the factors that influence these loads (such as time-differentiated prices for electricity, income, demographic change, etc.). Typically, these influences must be captured in a detailed energy forecasting model and translated into load shapes for the integrated planning models.

Of course model capabilities do not guarantee utilization in a planning process. For example, in a recent study for a gas pipeline for the Northeast a system dynamics program for integrated resource planning was used. The model incorporates detailed interaction between supply- and demand-side activities, including the feedback between prices and subsequent demands. However, the project did not rely on a full implementation of the electric and gas utility supply sectors of the model. Instead, externally supplied electric and gas prices were used. In other words, the detailed interaction capabilities of the model were by-passed and replaced by a static model in which future demand-side and supply-side activities could not have any impact on future rates.

## DSM SCREENING TOOLS

DSM screening tools address the problem of the multitude of options available on the demand-side. Detailed analyses of every conceivable option or combination of options would require substantial effort (using the model linkage approach or an integrated planning model). The marginal benefit of these efforts may be limited because typically only a small number of options will make it into the final least-cost optimum.[†,26]

Hence, the goal of these models is to provide a "first-cut" ranking of DSM options in order to identify the most clearly beneficial measures. The logic is that, by simplifying many of the assumptions and by suppressing many of the details required by a more in-depth analysis, one can rapidly identify the most promising options. A related reason for using these models is that it is usually quite easy to perform sensitivity analyses of key assumptions. In general, the outcome of analysis using screening tools identifies the programs that are worth further study in greater detail. Examples of well-known DSM screening models include Synergic Resources Corporation's COMPASS,[27] EPRI's DS Manager,[28] Barakat, Howard and Chamberlin's DSM Planner,[29] and the American Public Power Association/EPRI's RDSM.[30]

Screening tools, by our definition, rarely include simulation capabilities. The characteristics of options (e.g., performance, cost, market penetration), and generalized yardsticks for use in valuation (e.g., marginal energy costs) are specified exogenously by the user. Typically, these

† See Hirst[26] for a review of the complexities inherent in creating viable utility conservation/load management programs.

More importantly, these problems are overshadowed by the even larger uncertainties in the input data required by the models. The data required by most models are more detailed than most currently available data, which often leads to use of default values or, essentially, judgment calls by the model user. The cumulative impact of these values is difficult to evaluate.

A related problem is the need in sophisticated least-cost planning efforts to link a number of models with each other. Extensive calibrations may be needed to make models compatible with each other, both in terms of data detail and formats. Utilities that have invested in a particular production cost model or other expensive planning tool may find themselves confronted with the need to make large additional investments in staff training, data generation, and calibration. The appropriate linking of models and their associated data sets to arrive at least cost integration is another area where good judgment is required and the impacts of methodological choices is not sufficiently understood.

Utilities must contend with these uncertainties while making high-stake planning decisions. There was no world of perfect information in the past, and it is unlikely that there will ever be one. It is our hope that this limited overview of integrated modeling tools will contribute to an informed dialogue between utilities and their PUCs that will ensure the constant improvement of least-cost planning procedures. Improvement may not just mean a move to ever greater detail and comprehensiveness, but also the development of acceptable approximations; the effects of which are understood by all parties and which keep filing requirements tractable.

## ACKNOWLEDGMENTS

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