Program Overview

Program Description

Electric sector companies today face an unprecedented array of uncertainties. Low natural gas prices—which may or may not persist—have turned conventional generation dispatch priorities upside down, dramatically increased the reliance of the electric system on natural gas, and fundamentally altered planning questions. Coal plants that have run intensely for decades have been cut back or idled, leaving large fuel inventories and changing the generation risk profile. Renewable portfolio mandates at the state level have forced significant and growing deployment of intermittent generation, which affects the value of existing generation and potential investments in existing and new capacity. More-stringent environmental regulations will require retrofit capital investments at virtually all coal plants in the next few years. Many plants are closing, creating a need for new capacity. New Clean Air Act regulations that limit CO2 emissions have been proposed, and standards for existing plants may be coming soon. In addition, load growth has slowed, and in some cases declined, as a result of slow economic growth and a transforming economy. In addition, the future cost, performance, and public acceptance of new generation, transmission, and distribution technologies are highly uncertain; and the emergence of advanced distributed generation, storage, and grid technologies may be changing some fundamental planning questions. Combined with increased public scrutiny and media coverage of electric sector decisions, these factors create new, high-stakes challenges for generation planners.

Program 178 helps companies address these issues by providing objective technical information, a variety of tools for exploring familiar and emerging planning issues, and a place for planners to meet to assess technical challenges, possible solutions, and emerging information and analytical needs. The program has a long track record of success in providing technology cost and performance data and in informing the planning process. More specifically, the program provides the following:

- Comprehensive, credible, and up-to-date data and analyses of technology costs and performance. The annual EPRI Technical Assessment Guide (TAG®) has long set the standard for this type of information for the industry. Combined with TAGWeb™, an Internet-based software package for creating customized technology cost estimates and rapid-response support from the EPRI team, this information provides a sound technology basis for understanding and comparing technology cost estimates and validating results of more-detailed, engineering studies.

- Clear assessments of fuel and electricity market trends. Natural gas prices drive electricity prices and fundamentally affect the economics of capital investments. At the same time, power industry demand for natural gas is an important agent of change in fuel prices and fuel market dynamics. EPRI research on industry trends and the near-term prospects for fuel markets provides insights and understanding to complement projections from other sources.

- Consistent analysis methodologies and tools:
  - TAGWeb™, for providing up-to-date technology costs and performance in asset planning
  - The Utility Fuel Inventory Model (UFIM), for managing traditional fuel risks as well as gaining insights into emerging fuel supply and storage questions
  - The Electric Generation Expansion Analysis System (EGEAS), for clarifying key issues, including the deployment of nondispatchable renewable and the recent dash to gas
  - The Energy Book System (EBS), for evaluating physical and financial portfolio strategies

- Custom analyses to explore emerging issues in planning. Market transaction analyses, hedging analyses, the value of a diverse generation portfolio, and exploratory analyses of other planning issues identified by members may be undertaken by the program.
For continuing funders, the basic structure of Program 178 remains the same as in 2013: two project sets, described in more detail below. A number of interest and user groups have been created as supplemental projects to allow companies with narrower interests to participate in elements of the program where their interests are focused. These interest groups provide a low-cost entry point and will provide a meeting place to discuss model applications, challenges, and solutions, and possibly to generate more-substantive research and model development agendas. Program 178A funds will provide support to the TAGWeb™ supplemental project, offering P178a funders a one-year license to TAGWeb™ and access to the supplemental project results. Program 178b will provide partial support for several user groups, including UFIM and EGEAS, which will offer P178B funders access to these discussions.

Research Value

In a time of unprecedented uncertainty for the industry, good planning decisions can save hundreds of millions to billions of dollars for companies and their customers. EPRI’s Technology Assessment, Market Analysis, and Generation Planning program (Program 178) has a long track record of providing information and tools that have helped companies make more-informed planning decisions and communicate with their many interested and diverse stakeholders. By combining technology assessment and market analysis with an array of planning tools and analyses, Program 178 provides members with an integrated solution to support company planning:

- Comprehensive data, methodologies, and tools, resulting in a sound technical basis for technology planning, investments, and market strategies
- Insights into fuel market trends and uncertainties that drive electric sector economics and risks
- Tools and analyses that help to inform company strategy and capital investment choices
- A community with which to anticipate and explore emerging planning challenges

Approach

Program staff work closely with funders to identify and prioritize research topics, to review results, and to communicate key results and insights effectively. Members have a variety of ways to access results:

- Technical reports provide industrywide cost and market data, establish reference values, offer new and improved analysis methods, and provide insights into key fuel and electricity market trends.
- Algorithms development and software tools provide customizable and flexible application of accepted methodologies to analysis of technology costs, asset portfolio planning, market risk, and price/cost volatility. Flagship products include TAGWeb™ and EBS.
- Research meetings such as the annual EPRI-EEI conference on Power Technology, Fuel Supply, and Market Risk provide in-depth discussions of analyses and results. Webinars provide a stream of results in a timely fashion without requiring travel.
- User groups examine both broad planning interests and narrower, model-focused issues, providing a place to share ideas, identify emerging issues, and create focused plans for model support and enhancements.

Accomplishments

- EPRI’s Technical Assessment Guide (TAG®) is recognized as an authoritative source for up-to-date technology information. It is well accepted by regulators and is sought after as a critical resource by both U.S. and international agencies and researchers.
- EPRI’s fuel and industry markets research continues to expand understanding of the link between power plant project developments and domestic and global fuel markets, changing assessments of fuel supply and availability, and impacts of changes in infrastructures critical to the fuel supply chain.
- EPRI tools and methodologies, such as the UFIM, EGEAS, and the EBS, are well respected by companies and regulatory agencies and have helped companies make better-informed decisions, providing significant value to their shareholders and their customers.
Current Year Activities

The Technology Assessment, Market Analysis, and Generation Planning program in 2014 will focus on updating existing data and methodologies and continuing to explore an array of critical planning issues identified by members.

- The annual TAG® technology reports will examine an array of technology issues identified by members.
- The TAGWeb™ software will be updated to reflect new technology-cost and performance information as well as updates to costing methodologies.
- The annual EPRI-EEI Power & Fuel Supply Seminar will examine key fuel market and electricity industry trends in depth.
- User and interest groups will be continued or created to increase support and communication about existing EPRI planning tools.
- The program will inform members about the variety of commercially available planning tools and their core capabilities.
- New, emerging issues identified by members will be discussed and, if appropriate, initial analyses conducted. Candidate topics include:
  - Value of portfolio diversity. In a world of cheap natural gas, what is the value of maintaining other technology options such as nuclear and coal?
  - Fuel inventory analysis. With uncertain coal burns possibly persisting for years and increased reliance on natural gas for baseload generation, how can companies manage fuel procurement and inventories effectively?
  - Risk and hedging. How does the rush to gas affect company risk profiles and hedging strategies? Hedges, such as forward contracts for power or fuel, reduce future cash flow uncertainty but at the risk of locking in prices that may appear unfavorable with hindsight. Furthermore, application of even the most systematic procedures may be seen by regulators as speculation, leading to unfavorable rulings in rate cases. Related research addresses fundamental changes in price and heat rate volatility, peak/off-peak price spreads, and price correlations.
  - Ways to project future technology costs. Estimating today’s technology choices is a challenge. Nearly as important for many investment decisions today are future technology choices. Technology cost and performance are changing rapidly. What approaches may provide insights regarding their direction, and how can this uncertainty be integrated into planning decisions?
  - Modeling future policy uncertainty. The Clean Air Act provides a framework for continual tightening of regulations. Compliance today does not mean compliance tomorrow. In addition, the climate issue has not been resolved and will likely re-emerge at some point, with dramatic effects on coal and gas generation. What are options for including these fundamental uncertainties in planning?
  - Modeling the possible electric system of the future. The electric system will increasingly integrate distributed generation and storage with traditional generation technologies. Many modeling advances are needed to understand these changes, their implications, and where they might lead.

In 2014, Program 178 again will consist of two project sets:

- Project Set 178A, Technology-Based Business Planning Information and Services (TAG), continues its focus on conventional and advanced technology cost and performance for new generation capacity screening, with supporting information on technology risks, cost escalation, and technology deep dives. Members suggest topics of interest and technologies where in-depth cost updates are needed. They are actively engaged in reviewing results.
- Project Set 178B, Fuel & Power Market Analysis, Generation Planning, and Risk Analysis, will provide insights regarding fuel markets, planning analyses, and tools to help planners deal with emerging challenges, and support for addressing a variety of risk management issues.

Together these project sets provide a consistent set of information, analyses, and planning tools to inform and communicate company investment decisions.
**Estimated 2014 Program Funding**

$2.0M

**Program Manager**

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**Summary of Projects**

**PS178A Technology-Based Business Planning Information and Services (TAG) (069229)**

**Project Set Description**

The electric industry faces declining demand for power, increasing environmental regulations, and an aging infrastructure. However, these challenges are part of a typical industry cycle, and an upward swing in power demand is anticipated in the next few years, which will require new generation facilities to make up for retirements and to meet new demand. The current planning process for new generation facilities requires credible technology information and data that can be customized to individual company needs to meet changing regulatory environments. The Electric Power Research Institute's (EPRI's) Technical Assessment Guide (TAG®) project set delivers time-critical, technology-based business planning information, tools, and services that help planners, technologists, engineers, marketers, and financiers optimize capital investments in generation, storage, and transmission and distribution infrastructure. Research priorities in 2014 will include

- production of the annual “Power Generation and Storage Technology Options” report, capturing the latest industry data on technologies and cost and performance;
- a report on generation capacity impact topics identified by funders. Recent topics have included technology risks, impacts of environmental regulations, life-cycle management, and cost escalation trends; and
- complementary research completed via supplemental projects, addressing customized technology evaluation using the TAGWeb™ software.

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<th>Project Number</th>
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<tr>
<td>P178.001</td>
<td>Technical Assessment Guide (TAG®)</td>
<td>TAG® focuses on power industry and fuel market developments and asset management questions, drawing on previous studies, premier analysts, databases, and market simulation techniques to provide critical planning information. In addition to the TAG technical report, project participants can obtain a one-year subscription, from 1/1/2014 to 12/31/2014, depending on the project participant funding year, for up to five users of the TAGWeb™ software package.</td>
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**P178.001 Technical Assessment Guide (TAG®) (065783)**

**Description**

Electricity generators are considering large retrofit investments in existing coal generation to keep the units operating. Many are choosing to retire capacity, and, with increases in the demand for power in the United States anticipated in the next few years, companies are actively considering what types of generation capacity to build. As the planning process for new capacity additions is fairly long and a diversified set of technologies has to be considered, energy companies need credible and consistent information on the performance and cost of both conventional and emerging power system technologies. Implementation of environmentally friendly and effective, capital-intensive, and long-asset-life technologies is more important than ever before. Developing and implementing strategic technology solutions require linking technology plans to business plans, which in turn requires critical information on the technologies. This information includes consistent, up-to-date data on the performance and cost of conventional and emerging electricity technologies and facilitates analysis of plant retrofits, retirements, major asset replacement/refurbishment, and new capacity additions.
PS178B Fuel & Power Market Analysis, Generation Planning, and Risk Analysis (072104)

Project Set Description

Given the recent and ongoing upheaval in fuel markets; potential changes in the business paradigm driven by the emergence of distributed generation, storage, and grid technologies; and an emerging need for better integration of operations and planning, the need for forward-looking planning research has never been higher. This project set provides an integrated set of information, analyses, and tools to help members address critical issues:

- **Markets.** Insights into the persistence of currently low natural gas prices are essential for planning. This project funds original analyses to create market insights and to provide input for other analyses.
- **Planning.** The project provides a community within which companies can discuss emerging planning needs, examine analytic tools that may provide insights, and, when appropriate, fund methodology and tool development. Potential topics for 2014 include fuel inventory strategies, integrated analysis of gas supply physical and contractual options and unit deployment, and methods to incorporate future policy and technology uncertainties.
- **Risk management.** This project will undertake special analytical efforts identified with members to clarify and communicate key risk-based messages, e.g., the value of portfolio diversity, transaction structure, fundamentals of risk, and hedging strategies.

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<td>P178.002</td>
<td>Natural Gas, Coal, and Power Market Analysis</td>
<td>This project will analyze energy market developments to provide in-depth understanding of the recent, fundamental changes in natural gas and coal markets, implications of these changes for forecasting and market modeling, and the impacts of a changing fuel and generation infrastructure.</td>
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<td>P178.003</td>
<td>Fleet Migration and Advances in Generation Planning</td>
<td>This is a hands-on project, where members are provided the opportunity to identify issues, help choose approaches to address the issues, and participate in the analyses.</td>
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<tr>
<td>P178.004</td>
<td>Emerging Issues in Corporate Risk Management</td>
<td>The rapid changes in the electric sector along with changes in markets and regulation continue to create new issues in risk management. The move to much greater reliance on natural gas further exposes the electric sector and the public to the volatility of natural gas markets. With fundamental change, companies can rely less on historic precedents. This project performs a mix of market studies, case studies, and algorithm development. Delivery will be via reports, webcasts, advisory presentations, applications of program software.</td>
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P178.002 Natural Gas, Coal, and Power Market Analysis (072101)

Description

The unanticipated impact of vast, potentially low-cost shale gas in the United States and elsewhere has fundamentally changed electric sector economics over the past few years. Currently in oversupply and selling at prices below cost, and with coal plants subject to increasingly stringent Clean Air Act regulations, gas is an amazingly attractive fuel. Yet utility and industrial demands for gas are starting to rise rapidly in response, and prices must increase at some point. The United States could even become an exporter of gas, although the extent is debatable. At the same time, coal exports have helped link domestic and international prices, a linkage that could extend to the Powder River Basin. What is driving these trends, how long might they last, and what factors could change the current picture? Better understanding of fuel markets and gas demand is essential for effective generation planning.
P178.003 Fleet Migration and Advances in Generation Planning (073460)

Description

Electric sector companies today face an unprecedented array of uncertainties such as, low natural gas prices—which may or may not persist—frequently idled coal plants with large fuel inventories; widespread deployment of nondispatchable renewable generation; new capital investment requirements for existing coal to continue operation and many plant retirements; slow load growth and a faltering economy; new distributed generation, storage, and grid technologies suggesting new business paradigms; deep uncertainty about the form and timing of future climate and other environmental policies; and increased public scrutiny. All are helping to create new, high-stakes challenges for planners. Planning challenges include the following:

- **Closer integration of planning and operations.** A number of changes in the electric system suggest a need for further integration of operational considerations in planning tools:
  - **Valuing flexible generation asset additions to the system.** Rapid deployment of nondispatchable renewables in some regions of the world has led to an increased need for flexible generation that can rapidly ramp up or down. Clarifying the value of flexibility in making capacity investment choices is an emerging field of study.
  - **Expanded environmental dispatch.** Near-term compliance with environmental regulations such as the U.S. Environmental Protection Agency's (EPA’s) Cross-State Air Pollution Rule (CSAPR) and other new Clean Air Act requirements may require operational changes in addition to capital investments in plants in order to achieve near-term compliance.
  - **Plant-level integration of gas supply contracts and delivery uncertainties with unit commitment.** Low natural gas prices have created a dramatic shift from coal to gas. EPA Clean Air Act regulations may lead to additional, significant refueling of coal plants to natural gas. In many locations, one of the key challenges to doing this is creating a strategy for secure supply of gas (e.g., contractually, by building pipelines, or by developing storage) and linking gas supply uncertainty with dispatch models.
  - **Better representations of future policy uncertainties.** Just a few years ago, the electric sector faced a significant likelihood of being driven by a market-based climate policy that used a carbon price to substantially decarbonize the electric system over a 40-year period. The timing, stringency, and form of a future climate policy are now uncertain. What are effective ways to include this critical uncertainty in planning?
  - **New business paradigms.** Advances in distributed generation, storage, and grid technologies create an increasing need to integrate supply, transmission, distribution, and end-use choices in planning. Both long-term investment and operations activities could be significantly impacted.
  - **Power infrastructure changes and implications.** The extent and timing of “retire/retrofit/replace” alter the mix along with renewables/transmission. What different trajectories may occur and how do they alter regional energy and capacity values?

The project provides a meeting place for member companies to discuss new planning challenges, identify possible approaches for gaining new insights, test existing tools to see how they address key issues, and, where appropriate, develop new analytical capabilities.
P178.004 Emerging Issues in Corporate Risk Management (073461)

Description

The rapid changes in the electric sector along with changes in markets and regulation continue to create new issues in risk management. The move to much greater reliance on natural gas further exposes the electric sector and the public to the volatility of natural gas markets. From 2008 to 2012, coal’s share will drop from 50% to below 40% and natural gas’ will increase from 20% to 30%. Several questions identified by members in 2012 include:

- **Estimates of the value of portfolio diversity.** Low natural gas prices are generating a new dash to gas squeezing out other forms of generation (unless mandated like renewables). However natural gas prices historically have been quite volatile. Given price uncertainty and questions about future limits on CO₂ emissions, what is the portfolio value of investing in other generation technologies such as coal or nuclear?

- **Hedging strategies.** The dash to gas can also affect companies’ risk profiles. What are appropriate changes to hedging strategies? How can these strategies be effectively communicated to regulators, shareholders and other interested parties? Hedges, such as forward contracts for power or fuel, reduce future cash flow uncertainty but at the risk of locking prices that may appear unfavorable with hindsight. Furthermore, application of even the most carefully considered opinions on hedging decisions may be seen by regulators as speculation entailing unfavorable rulings in rate cases. This research will examine actual hedging practices and contrast with views and rulings by regulators.

- **Updates in price modeling.** Shale gas may have fundamentally changed natural gas price dynamics, including local “basis”. What are ways to estimate this potential shift and what are possible implications? Can heat-rate approaches provide new insights? Coal retirements, new gas capacity, transmission, etc. are all altering price behavior from prior norms.

- **New fuel inventory issues.** With low natural gas prices and higher coal prices, the utilization of coal units has become uncertain, leading in the short term to large coal inventories and storage challenges. How can inventory strategies and contracts best be altered to address this new uncertainty? And how do retirements and coal and gas outlooks alter burn expectations?
Supplemental Projects

TAGWeb Technology Integration & Analysis (072453)

Background, Objectives, and New Learning
The TAGWeb™ (Technical Assessment Guide Web) software is an integrated, web-based software that provides current cost and performance data and technology trends for:

- Fossil technologies: pulverized coal, coal gasification/combined cycle, fluidized-bed combustion, and combustion turbine/combined cycle
- Nuclear technologies
- Renewable energy in the form of wind, solar thermal, photovoltaic, geothermal, and biomass technologies
- Small-scale generation such as fuel cell, internal combustion engines (diesel), small combustion turbines less than 25 MW, and microturbines
- Storage technologies represented by compressed air energy, batteries, pumped hydro, flywheels, and superconducting magnetic energy technologies

TAGWeb™ serves as a source for credible technology information and data that can be customized to individual company needs for input into simulation models for integrated resource plans, leading to selection of least-cost technology and fuel choice for the benefit of the public. Rate payers will benefit from more informed decisions by utilities and by their PUCs with regard to increased capacity planning and implementation. EPRI’s Energy and Environmental Analysis group benefits from TAGWeb derived data for public-domain technical analyses and assessments of energy technologies, energy-economic analyses, and potential for emissions reductions, including CO2.

Project Approach and Summary
Several new capabilities have been added based on 2013 research. Database updates were based on the research in the following areas:

- Techniques for analyzing the effect of integrating large-scale intermittent renewable resources into the grid
- Continuing impact of recession on prices of bulk materials (piping, structural steel, and electrical cables), labor, and equipment used in power plant construction
- Continuing impact of global warming concerns, particularly CO2 emissions, on continued operation of existing and planning for new fossil-fuel-based power plants
- New trends in technology designs that enhance performance
- Database and analysis to support environmental retrofit decisions

In addition to the annual technology cost and performance evaluations, the TAGWeb database is updated on a frequent basis to reflect current market conditions and technology trends in the cost and performance of Pulverized Coal with CO2 capture and storage, large Combustion Turbine/Combined Cycle (CT/CC), Nuclear, Solar Thermal, Photovoltaic (PV), Biomass, Wind, and Storage technologies.

The following topics have also been addressed and included in the 2013 TAGWeb database: CT/CC demand and market impact, cycling duty impact on PC and CTCC plants, environmental emissions and control, impact of worldwide construction activity, and analysis of cost escalation impacts on future power plants.

The TAGWeb software was also enhanced with modeling capability for evaluation of renewable/storage technologies, analysis of data, and improved user friendliness. The TAGWeb software platform has also been upgraded to the .NET environment to enhance its graphical user interface (GUI), and upgrades to the analytical and reporting functions have been added to evaluate options for current industry uncertainties.
Benefits
An overview of the TAGWeb™ software and its benefits are provided below:

- “One-Stop” information source and analytical tool for capital investment planning
- Consistent, credible, current information
- Extensive research on specific technologies and competing options
- Cost and performance information on conventional and advanced generation, storage, and environmental control technologies
- Analyze key uncertainties, such as:
  - What if natural gas prices increase by 20% in one year? In five years?
  - What if combustion turbine heat rates increase by 10% after two years in operation?
  - What if initial market price for electricity is only 1¢/kWh? How does it affect return on investment (ROI)?
  - How do I analyze market uncertainties with respect to technical parameters?
  - Which electricity technologies should be considered?
  - How do renewable and storage technologies fit in to future planning?

Utility Fuel Inventory Model (UFIM) Software Users Group (105109)

Background, Objectives, and New Learning
The Utility Fuel Inventory Model (UFIM) is a powerful Windows software tool that can be used by electric companies to: (1) to identify least-cost coal, oil and natural gas fuel inventory strategies; and, (2) to manage financial and non-financial risks associated with uncertainties in fuel supplies, requirements and supply chain operations.

The model is an essential tool for electric companies performing fuel inventory analysis and developing robust fuel inventory and procurement policies. The UFIM helps electric power companies develop money-saving inventory management practices. The UFIM platform takes into account company-specific fuel delivery, market uncertainties, burn requirements, and operating constraints. As a result, users can easily derive reliable solutions to many of the fuel market risk issues that face companies every day. This EPRI tool is particularly useful for evaluating how uncertainty in natural gas and coal prices may impact the optimal fuel inventory policies of companies operating fossil fuel fired generation.

Recently, many electric companies started to re-evaluate fuel inventory policies in light of the changing economics of coal and natural gas. Fuel markets recently have been characterized by historically very low natural gas prices, and relatively higher but stable coal prices. In many parts of the Eastern and Southern United States, the real-time switching of natural gas for coal in the generation dispatch is a reality. As a consequence of these changing fuel market dynamics, many companies experienced unforeseen changes in the operations of fossil fuel generation plants.

EPRI’s UFIM software can help companies facing all these operational challenges develop more robust fuel inventory management policies. By optimizing fuel inventory policies, electric companies can reduce fuel management costs and better manage financial and operational risks.

Project Approach and Summary
This project provides two formal meetings annually (in-person or webcast) for funders to learn about UFIM applications, discuss model features and propose model modifications and enhancements. Participants also will receive basic online UFIM software training, UFIM version 5 software modifications, enhancements and “bug” fixes, and high-level, basic support for model applications.
**Benefits**

The primary benefits of this project are improved communication, and the creation of a launching point for new UFIM model development and long-term software support. This project builds on many years of EPRI R&D activity related to managing fossil fuel inventories.

The benefits of joining the UFIM Users Group Include:

- Regular meeting place for UFIM software users to share knowledge;
- Opportunity to examine model strengths and limitations, and to identify possible future software enhancements;
- Infrastructure to catalyze model enhancement efforts;
- Basic UFIM v.5.01 software end-user support; and,
- Limited training provided via webcast on using UFIM v5.01 to conduct inventory policy assessments.

The benefits of using UFIM to develop fuel inventory management policies are well documented in the peer-review literature and by current users. UFIM users reported that the tool has helped companies reduce fuel budgets by as much as 3-5 percent per year. More importantly, users can use UFIM to develop risk mitigation plans that reduce exposure to disruptions associated with such things as extreme weather events and swings in fuel and energy markets.