08 Power Markets and Risk

Program Overview

Industry Needs and Issues Addressed

- Decision support methods that reflect market dynamics and rely on market-based valuation and risk management principles
- Ability to forecast market behavior (i.e., forward pricing, volatility, and correlations) in support of planning and risk management
- Means to optimize selection and deployment of a portfolio of assets, both physical and financial, including generation, transmission, storage, obligations to serve loads, emissions allowances, and a variety of derivative contracts.
- Ability to understand and respond effectively to changes in market conditions or structure, such as
  - CO_2 "cap and trade"
  - Transmission congestion pricing
  - Transmission load relief
  - Capacity markets
  - Increasing emphasis on demand response and energy efficiency

Key Accomplishments

- Over the past 10 years, this program has developed advanced methods for market forecasting, market-based valuation, and financial risk analysis, some of which have become industry standards.
- In addition to delivering numerous ground-breaking reports, popular seminars, and webcasts, this program offers a software suite of tools including
  - Energy Book System for valuation and risk management
  - FastFit for near-term forecasting
  - FastForward for medium- to long-term forecasting
- This program typically serves 30 participants annually, mostly in North America, but also in Europe, Asia, and Africa.

Value

- Optimize use of energy assets while fulfilling obligations, taking into account conditions of market uncertainty.
- Assess financial risk and assure that portfolio risk is within company policy.
- Enable tactical adjustments to asset base and operations in response to changes in market conditions or market regulation (e.g., CO_2 cap and trade).
- Assist functions such as trading, resource planning, risk management, forecasting, marketing, and financial offices.

Anticipated Deliverables

- New and updated methodologies for forecasting, valuation, and risk analysis that reflect advances in understanding of market movements, evolving market designs, and evolving needs of the industry.
- Tactical frameworks for addressing changes in market structures, such as CO_2 cap and trade, transmission congestion, capacity market mechanisms, and increased emphasis on demand response and energy efficiency.
- Delivery mechanisms include reports, seminars, webcasts, spreadsheets, and software.

Industry Involvement

- Estimated total 2008 budget: $1.4M
- Program financial leverage: $23:$1

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Summary of Projects

Project Number	Project Title	Value
P08.001	Forecasting Market Pricing and Uncertainty	Estimate future market behavior to enable planning, deployment, and risk management
P08.002	Valuation, Risk Management, and Portfolio Optimization	Manage portfolios of contracts and assets to optimize financial benefit within permitted risk tolerances
P08.003	Strategies under Changing Market Structures: CO_2, Transmission and Capacity	Respond appropriately to changes in market structures
P08.004	Assessment of Power Market Designs for Demand Response and Energy Efficiency	Understand implications and optimize use of demand response and energy efficiency programs

Project Descriptions

P08.001 Forecasting Market Pricing and Uncertainty (062068)

Issue

Market prices for wholesale power determine the cash flows that underlie the value of virtually all of the assets of an energy firm, including generation, transmission, power contracts, and obligations to serve retail customers. Price volatility in these markets is extremely high, undercutting the credibility of any specific price forecast but providing value to real options and flexible business strategies. These prices provide an opportunity for off-system sales and purchases, as well as a benchmark for assessing the cost-effectiveness of resource commitments. Moreover, the forward prices, volatilities, and correlations of power markets, along with those of related markets in fuel, capacity, transmission, emissions, and others, are critical inputs for asset management, asset valuation, resource planning, and financial risk management.

Description

This EPRI project provides the technology and understanding needed to estimate forward prices, volatilities, and correlations between markets—that is, the market descriptions needed to drive planning, risk management and asset valuation models. Cutting edge research delivered annually will ensure that forecasts are adapted to the current market environment. This project will deliver a mix of software and analytical studies that will enable members to produce best-practice estimates of forward prices, volatilities, and correlations, as well as better understand the uncertainty in energy markets.

In 2008, this project will continue to develop and enhance the following suite of forecasting products:

- The FastForward model adopts a *structural* approach to price/volatility/correlation forecasting. This approach captures the potential for structural change in markets, the effect of market-driven investment in new generating capacity on prices and volatility, and regional price differentials. It also provides rich insight into the key drivers of prices and volatility beyond the horizon of observable market prices.
- The FastFit model adopts a *statistical* approach to estimating price/volatility/correlations from current and past market data. While not suitable alone for long-term price forecasting, it fills in the seasonal and monthly shapes in lumpy annual forward contracts and estimates three-factor volatilities, mean reversion rates, and correlations that reflect the current market.
- The Static Equilibrium model adopts a long-term view of candidate technologies, to determine an appropriate long-term asset mix for the industry. This provides, in effect, a long-term target range for the other forecasting methods.

Also in 2008, this project will investigate special topics pertinent to making price/volatility/correlation forecasting more accurate, less labor intensive, and more transparent to decision makers. Forecasting forward prices for electricity—and the volatility and correlation of those prices—is a complex undertaking, which involves issues such as statistical estimation, valuation analyses, stochastic process modeling, data management, and investment behavior. While specific topics will be identified in close coordination with members to reflect the latest market and analytical technology developments and member priorities, candidate topics include the following:

- Represent CO_2, capacity, and transmission markets, and their impact on investment behavior.
- Integrate the market projections of alternative forecasting methodologies.
- Estimate the forward curve and volatility term structure for CO_2 allowance prices.
- Use option price information in fuel markets to gain insights into forward-looking volatility estimates of power prices.
- Identify stochastic process models that can more faithfully represent the highly skewed distributions observed in locational market prices and financial transmission rights.

Value

The deliverables in this project will provide:

- Enhanced accuracy and confidence in projections of market behavior,
- Increased revenue, while smoothing the growth of surplus and/or profits,
- Improved efficiency of asset utilization, and
- Increased stakeholder confidence.

How to Apply Results

Energy firms increasingly tend to centralize the market-forecasting activity, and develop corporate specialists in this function. This is because the results influence the work of numerous other high-profile groups within the firm, such as risk management, trading, CFO's office, and resource planning for power, fuels, and emissions. Staff may gain capability by attending EPRI seminars and webcasts, studying EPRI reports, and implementing EPRI's software products. Once so equipped, staff may participate in research products designed to help them solve the tougher problems, ultimately providing forecasts based on the extra insight needed to support the critical decision-makers in their firm.

Members benefit from the synergistic relationship between the software and the special studies developed in this project. Studies performed in the special topics area will help ensure development of state-of-the-art tools, while tools development will serve as a test-bed for study implications, ensuring that the studies are applicable to real-world problems.

2008 Deliverables

Deliverable Title & Description	Planned Completion Date	Deliverable Type
Software for Forecasting: New and updated methodologies for forecasting energy markets, in light of new knowledge and changes in regulations. These will be delivered as updates and consolidations of the various existing models: FastFit (extrapolation and analysis of history), FastForward (structural model), and Static Equilibrium (long term candidate technology assessment). Early deliverables may be in spreadsheet form.	12/31/2008	Software
Reports, Training, and Webcasts on Forecasting Topics: Studies on special topics in forecasting will deliver reports, training, and webcasts to help client staff understand and modify their procedures to reflect the new insights.	12/31/2008	Technical Update

P08.002 Valuation, Risk Management, and Portfolio Optimization (062069)

Issue

Market risk includes exposure to fluctuations in power prices, fuel prices, transmission congestion pricing or load relief, uncertain loads, emissions allowances, capacity markets, credit exposures, unanticipated breakdowns, or potential changes in market regulation. Some of these exposures, such as power and fuel prices, may be remarkably volatile and move in tandem in a manner that exacerbates risk.

Market participants require the means to assess the net risk of their portfolio of energy assets, and adjust the portfolio to bring that risk within the comfort levels of management and within corporate policy. Assessing risk many months and years into the future is recommended, because many energy assets cannot be created and deployed quickly. Risk must be assessed within a *corporate perspective*—that is, one that facilitates netting out risks derived from different assets and exposures—in order to avoid duplicate risk avoidance and/or over-hedging that increases risk.

Market exposure affects management of the deployment, use, purchase, and sale of assets. Asset value is dependent on future expected revenue and expenses, and these in turn depend on future market behavior and likely response to that behavior. Asset value is particularly dependent on the flexibilities built into assets—such as the ability to support rapid changes in deployment—which can prove extremely advantageous in volatile markets. These needs and opportunities affect numerous job functions, including trading, risk reporting, risk management, resource planning, marketing, and financial management.

Description

This project will provide tools and methods that help market participants optimize their energy asset portfolios with respect to potential profit/surplus and exposure to risk. This comprehensive, market-based framework enables valuation over a wide variety of assets and assessment over a range of risks.

This project will conduct timely topic-specific research studies—attempts to bridge the gap between risk management theory and practice—such as the effects of poor market liquidity on valuation and risk modeling, providing the means to relate business objectives to risk limits, or integrating the tradeoffs among hedging different types of risk.

This project offers research for stakeholders already sophisticated in market-based valuation and risk management, as well as training and business assessments for less experienced stakeholders.

New methods have been developed in recent years to enable measurement and management of the value and risk of energy assets and portfolios of energy assets in volatile markets. In particular, a “real options” approach to physical asset valuation accounts for the value of an assets capability as well as its operational flexibility. Such flexibility can be particularly valuable for responding in real time to market volatility.

Ongoing research and development are enhancing these methods with state-of-the-art representations of price behavior and representations of additional assets, such as congestion contracts, emissions allowances, and ancillary services. Improved functionality will also provide more effective consideration of long-term hedging techniques. This project will further develop the portfolio optimization approach to facilitate optimal decisionmaking, maximizing profit/surplus within appropriate constraints on risk capital.

Deliverables will provide fundamental capabilities and research in the following essential business functions:

- Risk management
- Derivative contract valuation
- Portfolio optimization
- Physical asset valuation
- Capital budget allocation
- Pricing and structuring retail products

Timely topics chosen for special study and reports will depend on funding and direction of members, but may include the following:

- Market circumstances, as in lack of liquidity, boom/bust behavior, and development of market dynamics, that do not fit existing models.
- New opportunities not addressed adequately in the existing framework, such as transmission congestion, CO_2, or capacity.
- Newly available procedures, such as measures of portfolio risk or means of portfolio optimization.
- Studies of best practices in the industry.
- New algorithms for valuation of assets.
- Optimization of business strategies, such as bidding around assets, operating in a partially competitive environment, or operating in a situation where actions affect the market.

Value

The deliverables in this project will provide members with:

- Enhanced accuracy and confidence in projections of portfolio behavior under a variety of potential market conditions.
- Improved efficiency of asset utilization.
- Increased stakeholder confidence.
- Increased revenue, while smoothing the growth of surplus and/or profits.

How to Apply Results

Energy firms form teams to perform the functions of risk management, resource planning, trading, and centralized financial analysis and reporting. The staff on these teams can develop their ability to incorporate market uncertainty into their work by attending EPRI seminars and webcasts, as well as reading the associated reports and implementing the EPRI software. Further, such staff can help direct the EPRI research, thereby assuring that EPRI is addressing their most pressing needs.

Members benefit from the synergistic relationship between the software and the special studies developed in this project. Studies performed in the special topics area will help ensure development of state-of-the-art tools, while tools development will serve as a testbed for ideas developed in the studies.

2008 Deliverables

Deliverable Title & Description	Planned Completion Date	Deliverable Type
Software Updates: Update on software for valuation and risk management	12/31/2008	Software
Seminars: Seminar on principles of market-based asset valuation, risk management, and market forecasting	12/31/2008	Workshop, Training, or Conference
Reports: Report on new approaches to valuation and risk management	12/31/2008	Technical Update

P08.003 Strategies under Changing Market Structures: CO_2, Transmission and Capacity (049085)

Issue

Energy firms face uneven, changing, and unpredictable regulatory environments. Uncertainties include the implications of possible CO_2 legislation, transmission congestion price risk, potential for transmission loading relief (TLR) calls, and changing designs of capacity markets. To help navigate these environments, competitive energy companies need information and decision-support tools to help them maximize value and manage risk under distinctly new business environments.

Description

This project provides analytic methodologies to help participants maximize value and manage risk in the face of evolving regulatory environments. Advisors will convene at the start of the research calendar year to determine research funding allocation. At the time of this writing, three industry issues stand out as most likely candidates to be addressed by this project:

- Implications of possible CO_2 legislation: This project will outline the most likely regulatory scenarios, based on current knowledge in the United States and experiences overseas. Methods will be developed to determine the impact of these changes, implications for long-term portfolio composition and deployment, and consequent near-term actions. The goal is to enable members to minimize risk and maximize value from pending changes, taking into account the variety of uncertainties.
- Transmission congestion price risk and TLR risk: This project seeks to model price movements in congestion, assess value and risk in this context, as well as identify means to incorporate risk of TLRs. The project has been initiated and delivered initial analyses and case studies in late 2006 and in 2007. Work will continue until methodologies for handing these types of risks are routinely incorporated into portfolio analysis along with other types of commodity risk.
- Capacity markets: This topic delivered a report in 2007 that outlined the issues of resource adequacy, and surveyed the variety of approaches that regulatory bodies are taking to ensure adequate energy resources will be built over the longer haul. Capacity markets are becoming popular as a means of addressing this problem, despite their added complications. This topic will provide methodologies for assessing capacity pricing and the impact on portfolio composition and deployment.

Work in this project will be coordinated with research in related EPRI projects to provide maximum leverage and value.

Value
This project will enable participants to steer their energy business with increased confidence and stability in the face of the highly uncertain and continually changing regulations and market environment.

How to Apply Results
Some firms have specialists that study implications of changes in energy market design; others rely on their existing technical specialists in areas such as risk management and resource planning to assess implications of regulatory changes. Regardless, such staff will benefit by collaborating with their peers at other firms on solving the market-design related issues that most trouble the industry. Participants will direct the research, provide case study data (at their option), and ultimately receive results that improve their ability to plan and adapt to industry changes.

2008 Deliverables

Deliverable Title & Description	Planned Completion Date	Deliverable Type
Strategies Under Changing Market Structures: Begin Typing Here	12/31/2008	Technical Update

P08.004 Assessment of Power Market Designs for Demand Response and Energy Efficiency (065559)

Issue
Considerations ranging from economic pressures to global climate change and the rollout of advanced metering systems are increasing the needs and opportunities for energy firms to consider demand-side alternatives, such as demand response and energy efficiency. Key questions in this area include the following:

- How can a power market design impact the effectiveness of energy efficiency and demand response programs and enhance their value?
- Which market designs are most compatible with system reliability, economic power, and energy efficiency goals?
- What are the business and technical hurdles facing implementation of new programs and markets accommodating demand response and energy efficiency?
- Which approaches to demand response and energy efficiency will be facilitated by any given market design, and how might energy firms respond?

Description
This project provides a regional assessment to improve understanding of the interrelationship between power market design and energy efficiency and demand response. Design parameters that inhibit or encourage widespread integration into existing utility businesses are identified.

The investigation includes the following two approaches:

The first approach is an empirical investigation of the potential for such programs to provide new value to utilities and customers by providing a practical method for identifying the most promising demand-side prospects under specific business conditions (e.g., rate structures, market design, and energy prices).

The second approach investigates the electricity supply chain and decisionmaking from bulk electricity production and transmission to end-use. Especially important is the performance of power markets and the ability to realize the benefits of demand response and energy efficiency under evolving regulatory and market conditions.

Value

This project provides answers to questions such as the following:

- What is the “big picture” perspective of integrating and capturing the value of new energy efficiency and demand response programs into existing businesses?
- What are the details of compatible rate structures and the timing and content requirements of data transfers along the electricity value chain?

Ultimately, this project will help energy firms incorporate demand response and energy efficiency into their portfolios, from both an economic and operational perspective. Regulators will find the projects insights helpful for understanding the fine points of market design.

How to Apply Results

Energy efficiency and demand response program and market designers at all levels (i.e., regulatory, market, and system operators, and electric utilities) can use the initial products of this project to enhance value from integration of demand-side resources. These stakeholders will learn new methods of valuing specific projects in their services areas. They will also be able to better create functional specifications to integrate into their existing business operations and to support business.

2008 Deliverables

Deliverable Title & Description	Planned Completion Date	Deliverable Type
Value and Risk Management of Price Responsive Demand: Begin Typing Here	12/31/2008	Technical Update