

## **08 Power Markets and Enterprise Risk**

### **Program Overview**

#### **Program Description**

The energy business is prone to complex and substantial financial risk. This research program will help members make more effective business decisions, taking into consideration the variety of uncertainties that they face. These include:

- Price volatility of fuel, power, transmission and emissions
- Regulatory uncertainty, such as carbon restrictions, capacity markets, transmission load relief calls (TLRs), and transmission allocation or pricing schemes
- Load uncertainty, particularly potentially disruptive developments such as energy efficiency, demand response, and plug-in hybrid vehicles
- Uncertain effectiveness of demand response
- Credit risk

Program participants will be better prepared to assess marketplace dynamics, make decisions that reflect the trade-off between risk and return, craft a rich business structure that optimizes asset deployment while fulfilling obligations, and explore, evaluate, and act upon “enterprise risks” that are difficult to quantify.

Special attention will be given to address the full portfolio perspective—that is, how the full range of business risks “net out”—and incorporate the latest developments in financial engineering to the extent that they are deemed sound.

Research will be delivered via a mix of seminars, reports, software, webcasts, task force participation, and customized projects.

#### **Industry Needs and Issues Addressed**

This program provides:

- Decision support methods that reflect market dynamics and rely on market-based valuation and risk management principles
- The ability to forecast market behavior (i.e., forward pricing, volatility, and correlations) in support of planning and risk management
- The means to optimize selection and deployment of a portfolio of assets, both physical and financial, including generation, transmission, storage, demand response, obligations to serve loads, emissions allowances, and a variety of derivative contracts
- The ability to understand and respond effectively to changes in market conditions or structure, such as
  - CO<sub>2</sub> “cap and trade”
  - Transmission congestion pricing
  - Transmission load relief
  - Capacity markets
  - Demand response and energy efficiency
- Tools needed to integrate demand response and energy efficiency approaches into overall planning and risk management activities
- The means to deal with broader issues of risk that are less readily quantifiable, including “enterprise risk.”

### **Impact**

- Optimize the use of energy assets relative to risk while fulfilling obligations.
- Take into account uncertainties such as load, operations, regulations, and market prices of power, fuel, emissions, capacity, and other variables.
- Assess financial risk and ensure 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<sub>2</sub> cap and trade).
- Support functions such as trading, resource planning, risk management, forecasting, marketing, and financial offices.

### **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 groundbreaking 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 firms annually, mostly in North America, but internationally as well.

### **Current Year Objectives**

- Tactical frameworks for addressing changes in market structures, such as CO<sub>2</sub> cap and trade, transmission congestion, demand response, and capacity market mechanisms.
- 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.
- Assessment, integration and development of means to address broader “enterprise risk.”
- Program results delivered via reports, seminars, webcasts, spreadsheets, software, task forces and customized interactions.

### **Industry Involvement**

- Estimated 2009 funding: \$1.0M

### **Program Technical Lead**

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## Summary of Projects

Project Number	Project Title	Value
P08.001	Forecasting Prices and Volatility: Power, Fuel, Transmission, and Carbon	Provide capability to estimate future market behavior to enable planning, deployment, and risk management
P08.002	Optimizing Portfolio Risk and Return: Energy, Assets, and Carbon	Manage portfolios of contracts and assets to optimize financial benefit within permitted risk tolerances
P08.003	Enterprise Risk Management for the Energy Business	Adapt enterprise risk techniques for energy firms, with a focus on electricity companies
P08.004	Managing the Risk of Integrating Demand Response and Intermittent Resources	Understand the risk implications and optimize use of demand response and intermittent resources

## Project Descriptions

### **P08.001 Forecasting Prices and Volatility: Power, Fuel, Transmission, and Carbon (062068)**

#### **Issue**

Power and fuel market forward prices, volatilities, and correlations, along with those of related markets in capacity, transmission, and emissions, are *critical inputs* for a wide variety of business functions. These include resource planning, financial management, asset management, asset valuation, deployment optimization, and risk management.

Market forward prices and anticipated market behavior determine the expected cash flows that underlie the value of the assets of an energy firm. Such assets include generation, transmission, derivative contracts, demand response opportunities, storage, and obligations to serve retail customers.

Price volatility in these markets is often 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.

Having the capability to estimate forward curves and market behavior with confidence will ultimately help your staff make business decisions that minimize cash flow uncertainty and inspire confidence in stakeholders.

#### **Description**

This EPRI project provides 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 forecast methods are adapted to the current market environment.

In 2009, this project will investigate special topics pertinent to making price/volatility/correlation forecasting more accurate, less labor intensive, and more transparent to decisionmakers. Forecasting forward prices for electricity, as well as the volatility and correlation of those prices, is a complex

undertaking that involves issues such as statistical estimation, valuation analyses, stochastic process modeling, data management, and investment behavior.

Specific topics will be chosen in close coordination with members in early 2009. Likely topics include:

- How to model CO<sub>2</sub>, capacity and transmission markets, and their impact on investment behavior.
- How to estimate the forward curve and volatility term structure for CO<sub>2</sub> allowance prices, along with relationships to other markets.
- How to integrate the impact of demand response and energy efficiency on forecasting, with emphasis on potential for price peak shaving and reduced volatility
- How to integrate option price information in fuel markets with historical price movements to gain insights into forward-looking volatility estimates of power prices.
- How to integrate the market projections of alternative forecasting methodologies.
- Identification of stochastic process models that can more faithfully represent the highly skewed distributions observed in locational market prices and financial transmission rights.

In 2009, this project will utilize a mix of research and user group funds to enhance its suite of forecasting products:

- The FastFit model adopts a *statistical* approach to estimating price/volatility/correlations from current and past market data. While not by itself suitable 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 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 Static Equilibrium model adopts a long-term view of candidate technologies to determine an appropriate long-term asset mix for the industry. In effect, it provides a long-term target range for the other forecasting methods.

### **Value**

The deliverables in this project will provide

- Enhanced accuracy and confidence in projections of market behavior,
- Reduced uncertainty in growth of cash flows
- More effective and efficient use of assets, and
- Increased stakeholder confidence.

### **How to Apply Results**

Energy firms increasingly tend to centralize their market forecasting activity and develop corporate specialists in this function. This is because forecasting results influence the work of numerous high-profile groups within the firm, such as risk management, trading, CRO, CFO, and resource planning for power, fuels, and emissions.

Members will gain knowledge and skills by attending EPRI seminars and webcasts, reviewing EPRI reports, participating in task forces, and implementing EPRI's software products. Once equipped, they may participate in research projects designed to help them solve the tougher problems, ultimately providing forecasts based on the extra insight needed to support the critical decisionmakers in their companies.

Studies performed in the special topics area will help ensure development of state-of-the-art software. Software implementation will serve as a test bed for research ideas, ensuring that the published studies are applicable to real-world problems.

## 2009 Products

Product Title & Description	Planned Completion Date	Product Type
<b>Forecasting Software – update</b>	12/31/2009	Software
<b>Webcasts and/or seminars on forecasting:</b> Seminars and/or webcasts on current topics related to forecasting, such as emissions pricing, emissions price influence on power price, and demand response.	12/31/2009	Workshop, Training, or Conference
<b>Special topical studies in forecasting</b>	12/31/2009	Technical Update

## P08.002 Optimizing Portfolio Risk and Return: Energy, Assets, and Carbon (062069)

### Issue

Energy companies are subject to a variety of risks, including fluctuations in power prices, fuel prices, demand response, emissions allowance availability and pricing (soon to include carbon), transmission congestion pricing, TLRs, capacity markets, load growth, credit exposures, unanticipated breakdowns, and 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. Others are new, hard to gauge, or subject to changes in market regulation and market design.

Decision makers need the means to assess the net risk of their portfolio of energy assets, both short term and long term. They need this information to guide adjustments in the portfolio mix and optimize cash flows while ensuring that risk remains within corporate policy and the expectations of stakeholders. 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—to avoid over-hedging that can ultimately *increase* risk.

Market risk exposure affects decisions regarding the deployment, use, purchase, and sale of assets, which in turn must be reflected in decisions regarding optimizing the portfolio with respect to risk. 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 issues influence a wide variety of job functions including trading, risk reporting, risk management, resource planning, marketing, and financial management.

### Description

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

This project will conduct timely topic-specific research studies to address newly developing issues as well as bridging the gap between risk management theory and practice. Topics chosen for special study will depend on funding and direction of members, but are likely to be chosen from:

- New opportunities not addressed adequately in existing frameworks for risk and optimization, such as CO<sub>2</sub>, demand response, transmission congestion, or capacity
- Optimization of hedging opportunities relative to portfolio composition and market behavior

- Market circumstances that do not fit existing models, such lack of liquidity or boom/bust behavior
- Market dynamics that do not fit existing models
- 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 and representations of price behavior
- 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
- Integrating the effects of poor market liquidity on risk modeling
- Relating business objectives to risk limits
- Integrating the tradeoffs among hedging different types of risk.

This project attempts to incorporate new methods of financial engineering to the extent that they are deemed reliable. For example, a "real options" approach to valuation of physical assets is now considered mandatory for assets that have operational flexibility in volatile markets.

Existing software tools, such as the *Energy Book System* for asset valuation and risk management, will be incrementally improved as research suggests new ideas for implementation, and funding from members and user groups is available.

### **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

Deliverables will improve capabilities in the following essential business functions:

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

### **How to Apply Results**

Energy companies form teams to perform the functions of risk management, resource planning, trading, and centralized financial analysis and reporting. Team members can improve their capabilities by participating in EPRI task forces, seminars and webcasts, as well as studying the associated reports and implementing EPRI software. Further, such staff can help direct EPRI research, thereby ensuring that EPRI is addressing their most pressing needs.

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.

Studies performed in the special topics area will help ensure development of state-of-the-art software. Software development and implementation will serve as a test bed for ideas developed in the studies.

## 2009 Products

Product Title & Description	Planned Completion Date	Product Type
Software for risk analysis and portfolio optimization: Update to software for risk analysis and portfolio optimization, reflecting market changes such as carbon or demand response.	12/31/2009	Software
Webcasts and/or seminar in risk analysis and portfolio optimization	12/31/2009	Workshop, Training, or Conference
Topical studies on risk management and optimization	12/31/2009	Technical Update

## P08.003 Enterprise Risk Management for the Energy Business (067433)

### Issue

The term “Enterprise Risk Management” (ERM) has been coined to cover the endless variety of risks to which businesses are subject, along with attempts to assess and address such risks. In the case of energy companies, these risks include:

- Market Risk: Risk associated with markets such as power, fuel, emissions, interest rates, and foreign exchange rates
- Volumetric Risk: Risk associated with the quantities of goods and services that customers will demand
- Credit Risk: Risk associated with the ability of customers and vendors to pay or deliver
- Operational Risk: Risk associated with the performance of technical or managerial systems
- Event Risk: Risk associated with unfortunate events such as fire, earthquake, terrorism, flood, or theft
- Regulatory Risk: For example, risk associated with changes in market design or the introduction of restrictions on carbon
- Legal Risk: Risk associated with the interpretation or enforcement of contracts and laws
- Model Risk: Risk associated with the use of theoretical models for valuation or risk management
- Public Perception Risk: Risk associated with stakeholder perception of your firm, which can influence market share, pricing, willingness of firms to engage in long term contracts, employee retention, and relationships with regulators

Some types of risk are clearly more easily quantifiable than others. Some have received a lot of attention, such as commodity risk, to the point that there is a large body of well-developed theory, practice and infrastructure pertaining to them. Others have not.

Frameworks have been developed outside of the energy industry for systematically uncovering and dealing with enterprise risks, such as COSO. Various consultants and industry organizations, such as the Committee of Chief Risk Officers (CCRO), have attempted to develop industry-specific frameworks for the energy industry.

**Problem:** To varying degrees, energy companies have been addressing this larger array of risks utilizing some of the frameworks, but the effort is uneven and they are often concerned that they may be “reinventing the wheel.”

**Description**

This new project will facilitate and accelerate the energy industry’s ability to assess and deal with “enterprise risks.” This project will use existing work to the extent possible, provide a source of consolidated information, identify research needs, and develop research projects as dictated by the priorities of members. The project will have a bias toward collaboration with existing industry institutions that focus on enterprise risk, and will coordinate with research in related EPRI programs as well.

This project begins by surveying existing frameworks and studies of frameworks that have been developed either specifically for the energy industry or more generally by the risk-management community. The project will then survey ERM practitioners to see which frameworks and approaches have been tried and are most successful, and to identify open questions that will serve as a basis for further research. Project participants will proceed to focus on different types of risk and, in each case, determine how successful efforts to date have been in quantifying and alleviating the risk, as well as how urgently additional work is needed.

The initial deliverable will consist of a report and one or more webcasts. It may also include seminars that will not present a favored approach but rather an overview of the frameworks available, and their apparent strengths and weakness in practice, so members can determine how their current approaches compare to others and make effective adjustments.

**Value**

This project will help members identify risk exposures and deal with them in most the expedient way. Participants will save time, identify the most successful approaches, and ultimately smooth out cash flows as well as public perceptions of their risk profiles. In some cases, the effort involved in focusing on enterprise risk may prevent substantial financial difficulty.

Additional benefits are likely to include greater access to capital markets and lower interest rates. At least one bond rating firm (S&P) has announced plans to assess ERM efforts as part of their process of rating energy companies.

**How to Apply Results**

Staff responsible for enterprise risk as a whole (e.g., chief risk officer) or who analyze and manage particular risks will work with the EPRI task force, engage in surveys, benefit from reports, webcasts and seminars that emerge from this project, and participate in customized TC-eligible collaborative research projects.

**2009 Products**

Product Title & Description	Planned Completion Date	Product Type
<b>Report illuminating methodologies for managing enterprise risk:</b> Study reflecting the program’s most immediate need with respect to regulatory uncertainty.	12/31/2009	Technical Update
<b>Webcasts and/or seminar related to managing enterprise risk for energy firms: Webcasts and/or seminar related to managing an energy business under regulatory uncertainty</b>	12/31/2009	Workshop, Training, or Conference

## **P08.004 Managing the Risk of Integrating Demand Response and Intermittent Resources (065559)**

### **Issue**

Energy companies are rapidly increasing their use of demand response and intermittent resources due to considerations ranging from economic pressures to global climate change to the opportunities offered by advanced metering systems. Several key issues involve risk management and market designs:

- A company's short- and long-term risk management may need to accommodate the differing characteristics of demand response and intermittent resources relative to traditional resources.
- Adjustments to risk measures and risk reporting may be needed.
- New models or changes to existing models may be required.
- New avenues of communication may be needed within a company.
- Adjustments to hedging practices may be required.
- Questions about the role of market design in facilitating the effective use of demand response and intermittent resources must be answered:
  - How can a power market design impact the effectiveness of demand response and intermittent resource programs and enhance their value?
  - Which approaches to demand response and intermittent resource investments will be facilitated by any given market design, and how might energy companies respond?
  - What are the business and technical hurdles facing implementation of new programs and markets accommodating demand response and intermittent resources?

### **Description**

This project provides a risk-centered assessment of the behavioral characteristics of demand response and intermittent resources. Central to this effort will be aspects such as:

- Techniques for triggering the resource,
- Profiling and modeling the uncertainty of availability
- Enumerating the relationship to the availability of other resources (correlations, positive or negative)
- Seasonal and regional considerations
- Relationship to other enabling resources, such as transmission

This project will then assess the impact on standard and suggested energy risk practices, with an emphasis on net portfolio risk looking forward over months and years, as well as stress testing (dealing with "black swans"). A portion of this effort will involve surveying existing practices as a source of ideas as well as calibration to see where the *de facto* research frontier lies.

This project will pay particular attention to the relationship between regional market designs and their impact on the effectiveness, availability and integration of demand response and intermittent resources into the energy portfolio. Design parameters that inhibit or encourage widespread integration into existing utility businesses will be identified.

Project activities will include the following two approaches:

- Empirically investigating the potential for such programs to provide new value and risk mitigation techniques to utilities and customers by providing a practical method for identifying the most promising prospects under specific business conditions (e.g., rate structures, market design, and energy prices).
- Investigating the electricity supply chain and decisionmaking process, from bulk electricity production and transmission all the way to end use. Especially important is the relationship to power markets and the ability to realize the benefits of demand response and intermittent resources under evolving and uncertain regulatory and market conditions.

### Value

This project will help members answer questions such as:

- What is the big picture perspective of integrating and capturing the value of new demand response and intermittent generation programs into existing businesses?
- How can demand response and intermittent resources be integrated into the risk management practices of the company and ultimately lead to greater stability of cash flow?

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

### How to Apply Results

Energy efficiency, demand response, and market design decisionmakers at all levels can use the initial products of this project to mitigate risk and enhance the value to be captured by integrating demand-side resources. Members will learn new methods of integrating and capturing value from specific projects in their services areas. They will also be better equipped to create functional specifications to integrate demand-side resources to support their business objectives.

Energy risk managers will use the results to adapt their procedures, reflecting the behavioral characteristics of demand response and intermittent resources.

### 2009 Products

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Product Title & Description	Planned Completion Date	Product Type
<b>Managing the Risk of Integrating Demand Response and Intermittent Resources:</b> This report will instruct stakeholders on methods of integrating and capturing value and mitigating risk from demand-side resources in their services areas, with particular emphasis on managing the risk of such entities within the energy portfolio and relationships to alternative market designs.	12/31/2009	Technical Update

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