



MANAGING ENERGY RISK:

a nontechnical guide to
markets and trading

CONTENTS

List of Figures and Tables	ix
Acknowledgements	xii
Foreword	
by Jeffrey Roark, Southern Energy	xiv
Editor's Note	
by Dragana Pilipovic, SAVA	xix
1. Introduction: The "Top Ten Checklist" of Things to Do.....	1
2. The Bull, the Bear, and the Spark Spread	19
3. The Risk Management Policies and Procedures	47
4. Starting with Your Risk-Return Strategy	71
5. The Risk Roster: Personalities and Specialties	89
6. Energy Risk Boot Camp: "Must Know" Concepts for Managers and Directors	103
7. The Deal Process: From the Desk to Delivery	145
8. The Portfolio Process: Starting with <i>What Have We Got?</i> and <i>What Do We Want?</i>	165
9. Measuring Risk: How Might Our Portfolio Change?.....	203
10. Hedging: Navigating Toward Our Portfolio Objectives.....	233
11. Critical Path IT Issues.....	255
12. Looking Forward: The Next Ten Management Issues.....	267
Appendix	
<i>Items to Consider for Trading and Derivatives Policies, Guidelines, Controls, and Internal Procedures</i> by Andrea S. Kramer, McDermott, Will & Emery	281

**MANAGING ENERGY RISK: A NONTECHNICAL GUIDE
TO MARKETS AND TRADING**

Glossary321

Bibliography369

Index.....373

FIGURES

Figure 1-1:	Java Moments by Chapter.....	16
Figure 2-1:	What Makes an Efficient Market?.....	24
Figure 2-2:	Dynamic Structure of a Market.....	24
Figure 3-1:	The U.S. Constitution as Symbol of RMPP	49
Figure 5-1:	Concentric Circles Model	95
Figure 6-1:	The Price-Risk Pyramid	110
Figure 6-2:	Price-Mean Reverting Distribution	115
Figure 6-3:	Cinergy 5x16 Daily Forward Price Curve.....	115
Figure 6-4:	Entergy 5x16 Daily Forward Price Curve.....	116
Figure 6-5:	NYMEX Natural Gas Daily Forward Price Curve.....	116
Figure 6-6:	The Model Calibration Process	120
Figure 6-7:	Volatility Term Structure	123
Figure 7-1:	Overview of Deal Cycle	147
Figure 8-1:	The Hedging Cycle	167
Figure 8-2:	Simple Payoff Diagram.....	170
Figure 8-3:	Delta on Payoff Diagram.....	175
Figure 8-4:	Short Forward Position	176
Figure 8-5:	Probabilities of Outcome	177
Figure 8-6:	Long Call Option Payoff.....	181
Figure 8-7:	Profit Diagram for Call	182
Figure 8-8:	Parity Value of a Call Option	183
Figure 8-9:	Four Mirror Images.....	185
Figure 8-10:	A Long and Short Forward.....	187
Figure 8-11:	Synthetic Call Option	188
Figure 8-12:	Load Curtailment Contract.....	189
Figure 8-13:	Two Long Call Options	190
Figure 8-14:	Generator's Initial Portfolio	191
Figure 8-15:	A Dream Profit Diagram.....	199
Figure 8-16:	Profit Diagram by Risk Return Strategies.....	200
Figure 9-1:	Different Risk Measures	212
Figure 9-2:	Sample Risk Profiles.....	214
Figure 9-3:	Sample Delta Values.....	216

**MANAGING ENERGY RISK: A NONTECHNICAL GUIDE
TO MARKETS AND TRADING**

Figure 9-4: Delta by Underlying Price218
Figure 9-5: Portfolio Risks by Time Bucket223
Figure 9-6: Progressive Risk Limits.....229
Figure 10-1: Strategy Defines Hedging.....235
Figure 10-2: Comparing Initial & Objective Portfolios236
Figure 10-3: Achieving the Desired Portfolio.....237
Figure 10-4: Generator’s Initial Portfolio248
Figure 10-5: The “Temporary” Portfolio250
Figure 10-6: The Hedged Portfolio251
Figure 10-7: The “Bull Spread” Portfolio252
Figure 10-8: Collar Hedging Strategy252
Figure 10-9: Residual Risk.....253
Figure 11-1: Trading and Portfolio Management System.....257
Figure 11-2: Perceptual Map for System Selection.....264

TABLES

Table 1-1	The “Top Ten Checklist” of Things for the New Manager to Do	4
Table 1-2	The Manager’s Bookshelf	11
Table 2-1	What Makes an Efficient Market?	22
Table 2-2	Applications of Marking-to-Market (MTM) Concept	38
Table 3-1	Differences Between Policies and Procedures.....	60
Table 3-2	Sample Outline for Risk Management Policies	62
Table 3-3	Sample Outline for Risk Management Procedures.....	63
Table 3-4	The Five Questions for Portfolio Analysis	66
Table 4-1	The Four Risk-Return Strategies	73
Table 4-2	Headline Stories Due to Strategic Conflicts.....	85
Table 6-1	Summary of the Five-Minute Energy Risk Manager.....	106
Table 6-2	Parlance for an Option’s Value.....	131
Table 6-3	Survey of Energy Options	134
Table 6-4	Traditional Price Risk Greeks	137
Table 7-1	Comparison of Settlements by Market	159
Table 7-2	Sample Expiration Date Rules.....	159
Table 7-3	Delivery Settlement Rules	161
Table 7-4	Payment Rules.....	162
Table 8-1	Comparison of Risk Management Definitions	166
Table 8-2	Basic Option Positions in Traditional Utility Terms	184
Table 9-1	Litany of Risks	204
Table 9-2	Portfolio Sensitivity to Price Spikes	221
Table 9-3	Sample Time Bucket Format	222
Table 9-4	Volumetric Risk Measures	225
Table 9-5	Steps for Setting Risk Limits	226
Table 9-6	Enforcement Techniques	227
Table 10-1	Hedging Technique by Risk Type.....	245
Table 12-1	Next Year’s “Top Ten Checklist” of Issues to Worry About	268

FOREWORD

**Jeffrey Roark,
Principal, Regulatory Affairs
Southern Energy**

As a graduate student in electrical engineering at Auburn University in the mid-1970s, I sometimes led tour groups through our AC Lab, a dusty hall filled with electrical machinery collected over 80 years. The old machines, meters, and switchgear gave the appearance of an electric power museum, if not a 1950s horror movie. During one such tour, a prospective engineering parent asked me, “Why would you want to study power? Power never changes.” Standing among the museum pieces, some still in use, I felt powerless to object, even though the term “Energy Crisis” had already entered the street vernacular several years earlier.

Twenty-five years of power industry experience later, I have the answer that I had needed on that day. The laws of physics never change. The Law of Conservation of Energy is immutable. (This law is the energy equivalent of “There is no such thing as a free lunch.”) But as with any human economic endeavor, the power industry never stops changing. And as with the entire world economy and political structure, the pace of change in the power industry has accelerated to a dizzying deregulating open market whirl today. May it never end!

In 1995, I was one of the first three full-time inhabitants of Southern Energy’s new Trading Center: a small corner office that only weeks before had housed a single occupant. As a 20-year veteran of tremendous change in the power industry, I found myself in yet another whole new world. My 1980s vintage MBA, though helpful, seemed like ancient history. I was in Risk Management 101 without a professor, a classroom, or even a book. Our one and only trader, Sean Murphy, had traded mortgages before, and he realized—electricity is different. We needed help! By chance, Sean found the names of Dragana Pilipovic and John Wengler, of SAVA Risk Management Corporation, and invited them to come to Atlanta to talk with us about energy trading and help us explore

the aspects of electricity that make it unique among commodities. A short few weeks later, they arrived in Atlanta. It was a pivotal moment for us all. John and Dragana, with knowledge and experience in oil and gas trading and risk management, were eager to learn about electricity. We were equally eager for them to learn about electricity and to help us out. Not only did I find in them a pair of professors for my rolling Risk Management 101, but I discovered that these were two delightfully intelligent and energetic people, and I have valued their friendship ever since.

Much has progressed since our first meeting. Southern Energy's Trading Center has grown to be the world's largest energy trading center, employing hundreds of employees, many of whom had not yet seen their twentieth year of life (much less of the power industry) when our "Corner Office" Trading Center first opened. In 1998, Dragana Pilipovic "wrote the book" on the subject—namely *Energy Risk*—with John's help of course. Energy risk management itself has become very hot news. After price spikes in eastern markets in 1998 and 1999 caused some notable bankruptcies, defaults, and early exits from electricity trading, the western price spikes in the summer of 2000 have even politicians demanding more forward hedging on the part of the local electric utilities. It seems that as an industry, and especially those living on the volatile margin, we learn through pain. (I am referring to both buyers and sellers of electric energy at the wholesale margin, as opposed to integrated utilities with rather stable average costs even in the face of wholesale price spikes.)

What better timing could there be for John's book on energy risk management aimed not at the quantitative whiz kids, but at managers of electric utilities? Regional transmission organization (RTO) formation is on the horizon. Every step toward competition adds risk to the energy supplier's business. California in 2000 has shown that we still have plenty to learn about risk management. And if today's popular backlash against competition in electricity is successful, it will have occurred because of a failure to grasp and embrace risk management principles.

The entire deregulation of the industry is an exercise in exposing risks that were hidden by regulation, and allocating, through markets, the various risks to those best able to manage them. Competitive energy suppliers risk billions of dollars on physical generating assets, and

MANAGING ENERGY RISK: A NONTECHNICAL GUIDE TO MARKETS AND TRADING

manage those risks through geographic diversity, fuel diversity, efficient plant operation, and trading and marketing of energy products. Transmission owners will manage the physical availability of their assets to maximize their profits. Users of the grid will find usage prices to be volatile, much like energy prices, and will manage their transmission price risk through tradable contracts, whether these are physical or financial. It is important that any company operating in this environment learn to analyze its risks and manage them appropriately. And, it is important that risk managers understand and internalize the concepts behind risk management in the electricity industry, rather than just learning the right things to do. Learning this stuff by rote is an instant recipe for learning through pain, because that which is right today will change tomorrow. We don't really know what will happen next. (This is much more fun than, "Power never changes.")

Complexity is not escapable in the electric utility industry. Efforts to ignore it fail. The Pennsylvania-Jersey-Maryland (PJM) independent system operator (ISO) tried to ignore it, and failed. New England tried to ignore it, and failed. California tried to overpower it with a "simplified" system, and failed. New York tried to embrace complexity, and found more devils in the details. But it always makes me smile when I see another one hit the dust. Folks, the complexity in power generation and delivery is real. It cannot be forced to look like or behave like gas or oil. And without regulation to cram all of the risks onto consumers, these complexities will continue to dog market participants until they deal with them explicitly. Unfortunately, we will likely find that consumers do not want to deal with the complexities or the volatility inherent in electric service.

This, I believe, forms the challenge for risk managers in our industry—to deal with and absorb the physical complexities and the concomitant financial complexities associated with electric service, providing price stability, efficiency, reliability, and simplicity to electric consumers. Given the unavoidable complexities, this is a tall order. The work has barely begun. Many practicing traders, marketers, and risk managers in electricity don't even understand their jobs yet. And though many are new to the industry, they are already actively resisting change from what they already know how to do. They want to settle in and do trading and make

money; unfortunately, the final rules of the game are hardly in place.

This book, *Managing Energy Risk*, offers a valuable tool in meeting this challenge dealing with market realities. This book helps demonstrate how risk management *theory*, not just practice, can become second nature to those of us in this industry. These kinds of risk management ideas will help us absorb and control the many changes that lie ahead. Complexity in electricity risk management will increase. (In time, simplicity will return to consumers if they demand it.) But this time, if we listen closely to the market and respond wisely, we can make “good” with our new market opportunities, with its full complexity contained once more in an envelope of market-developed risk management tools and techniques properly designed around the physical realities.

This book is an introduction to energy risk management aimed at utility engineers and managers. For those engineers with an MBA or other quantitative business background, this book will help direct some of that educational experience toward a new way of thinking about the energy business. For those engineers, and especially managers, without a quantitative business background, I hope it encourages them to find an MBA program and place it firmly into their background. Of course, there will always be jobs in the utility industry in a quiet, sheltered environment with a relaxed pace of change and little exposure to risk. Unfortunately these are likely to be low paying, uninteresting jobs of lesser value. This book is for those who want to embrace the change and accept risk and risk management as means to a more exciting and better paying future in the electric utility industry. In fact, for many this will come of necessity, because the electric utility industry of the future will look very different from that of today.

Like the old AC lab at my alma mater, the electricity industry continuously collects new ideas to join the old ones. The secret to our success in dealing with new market challenges is how well we integrate new market-oriented ideas with our traditional engineering duties in generating power. Just as understanding physics is important for being an engineer, understanding risk management is increasingly important for being a manager of an energy business in the future. But the engineer with an MBA has an advantage—understanding of both physics and risk

MANAGING ENERGY RISK: A NONTECHNICAL GUIDE TO MARKETS AND TRADING

management. Though people have a natural preference for simplicity, the physical complexities of the electricity business have reasserted themselves time and again. Good engineers and good managers alike are needed to make sense out of the risks that are driven by the fundamentals, the ones that don't fit well into quantitative analysis. There yawns a gap that needs bridging, and in this industry it is uniquely important. Engineers can and do build bridges. In this book, may you site your landing on the other side.

Jeffrey Roark
jeffrey.d@mindspring.com
Atlanta, GA
December 2000

Jeffrey D. Roark, a 29-year student of the electricity industry, is Principal, Regulatory Affairs, for Southern Energy, Inc., in Atlanta, GA. He holds Bachelor's and Master's degrees in Electrical Engineering at Auburn University, and an MBA from the University of Alabama at Birmingham. His experience in the industry includes transmission and generation planning in Southern Company's regulated business, as well as seven very interesting years of market analysis work in Southern Energy's trading, marketing, and asset development business in the United States and abroad.

**INTRODUCTION:
THE “TOP TEN CHECKLIST”
OF THINGS TO DO**

Managing Energy Risk: A Nontechnical Guide to Markets and Trading introduces the issues that executives in the electricity and energy markets alike must understand in order to manage market risk. This understanding may remain at a high level, with more emphasis on the business implications of choices rather than the more technical details. That’s why managers hire teams of people including traders, risk managers, analysts, and the full risk roster. But as the sentry on watch in the uncharted waters of deregulation, a manager at a utility must stand upon certain core principles of market behavior and risk. This book’s purpose is to define and explain these principles to help the manager control an otherwise perplexing and challenging enterprise. In writing this book, I kept the following picture of the target reader in mind: the reader is an engineer with an MBA who now manages a business unit that faces market price risk—or will so soon. With luck, this book will also benefit a much broader audience, from the boardroom down to new hires. Furthermore, the book can prove useful “horizontally” as managers move from a purely regulated environment to a deregulated one.

petition in the general market. Marking-to-market entails both pricing and processes; every employee from the trading desk to the salespeople should understand the concept. The clever manager should always ask “but is it marked-to-market?” (See Chapter 2 for more details.)

GUEST ESSAY

Kick Starting Risk Management at the “Reluctant Utility”

by T.C. Coates

The electric utility industry has a credible record for embracing and developing technological change to increase reliability and reduce costs in the physical realm. Yet it is surprising that technologically savvy utilities would be reluctant to embrace opportunities that a developing technology for energy risk management offers. What some energy industry market players seem to know intrinsically, others have yet to realize.

Energy risk management technology is essential to a company’s long-term success in the market place. Even the most traditional of utilities must recognize that the skills and tools of energy risk management represent a new class of “technology” that must be incorporated into the company’s already sophisticated non-financial technologies. For those utilities that continue to operate resources and manage their own wholesale power transactions, such new technology is not a luxury, it’s required.

Spotting a Reluctant Utility

Even when the need is clear, managers/leaders with a vision for the value of energy risk management technology may find the challenge daunting in selling their vision in the halls of a reluctant utility. Let’s be blunt: reluctance is a state of mind. Utilities are not reluctant, people are. You would think that everyone knows and is concerned about the effects of a changing, dynamic energy market. It is no secret that electricity prices are much more volatile today than last year or the year before. Thanks to rising volatility, utilities and their customers have traded sides

The following books represent “must haves” on your office bookshelf. Even if you don’t read them, these titles guarantee to impress visitors and job applicants alike.	
Bernstein, Peter, <i>Against the Gods: The Remarkable Story of Risk</i> , John Wiley & Sons, 1996.	The perfect holiday present for <i>your</i> manager. Fun-to-read introduction to how humans feel about risk. No equations! An audio version is even available.
Hull, John C., <i>Options, Futures, and Other Derivative Securities</i> , Prentice-Hall, Inc., Englewood Cliffs, NJ, 1993.	The Basic Text. A well-written text for those wanting to understand derivatives theory by looking under the hood.
Jarrow, Robert and Turnbull, Stuart, <i>Derivative Securities</i> , South-Western College Publishing, 1996.	Written for MBA students, this encyclopedia of futures and options is a great reference for the generalist.
Pilipovic, Dragana, <i>Energy Risk: Valuing and Managing Energy Derivatives</i> , McGraw-Hill, 1998.	My personal favorite and a very successful book by my lovely wife Dragana! This book details how energy markets differ from money markets and provides new tools to handle these differences.
Wilmott, Paul, <i>Derivatives: The Theory and Practice of Financial Engineering</i> , John Wiley & Sons, 1998.	A comprehensive reference for generalists wanting to become specialists.

Table 1-2: The Manager’s Bookshelf

coach (the manager) must also develop the complete team. The manager should blend skills (risk, marketing, engineering) as well as personalities. Traders with “Type A” personalities play an important role, but should not be allowed to bully risk managers or analysts who have “Type B” personalities. (See Chapter 5 for more details.)

Brush Up on Risk Basics

The manager may not be a risk manager but he/she should understand the basics of risk. This book attempts to introduce these basics. (If you are in a hurry, try reading the “Five- Minute Manager” in Chapter 6.) In addition, the manager should develop a personal library of books; Table 1-2 recommends the *Manager’s Bookshelf* of must-have texts. The manager need not read all these books cover-to-cover; just keep them nearby for specific questions. (If nothing else, the book titles should impress visitors.) In addition, subscribe to as many risk magazines and newsletters as

THE BULL, THE BEAR, AND THE SPARK SPREAD

TALE OF THREE STATUES

A statue of a large bull stands in New York's Wall Street neighborhood. In downtown Columbus, Ohio, the corporate headquarters of powerhouse AEP features an even larger monument—this one stylized from two huge, historic turbines.¹ As a corporation, Enron fits somewhere between these extremes of money and megawatts, two types of assets kept apart by regulation since the days of Thomas Edison. Fittingly, an abstract sculpture² sits in front of Enron's tower in Houston.

Enron's sculpture best represents the confusion of many power executives as they first encounter new market dynamics during the course of deregulation. Unbridled price competition may at first look appear amorphous, even frightening. But markets do have structure; prices do tend to follow some sort of understandable behavior; complex contracts can be digested in terms of simpler building blocks.

discovery involves the diversity of players. No single player should be able to exert “undue market influence.” Market efficiency depends in part on a blend of buyers (who are *short* or want to buy the asset) and sellers (who are *long* or want to sell the asset.)

In terms of risk, this buyer/seller exchange allows one player to assume the risk of another—for a price. This is the speculator’s role and should be respected as such, lubricating the market by allowing companies to free themselves of unwanted risk. In this sense, we should remember to not equate the word “speculator” with a negative image. Speculators are part of the risk management industry. As Southern Energy’s Jeffrey Roark suggests: “The buyer of risk can follow different strategies: a) hold it in the hopes of profit; b) diversifying the risk within a portfolio; or c) otherwise managing the risk better than the one he/she bought it from. The whole point is that the various types of risk would end up in the hands of those best able to manage them, either through diversity brought about by the market reach of the trader, or by other physical or managerial means.”

Price discovery depends upon finding an aggregate balance of supply and demand. An individual company’s preferences may not necessarily correspond with the aggregate market. This issue is at the heart of a set of very common questions: *If power prices have such a strong tendency to spike, why would I ever want to sell my generation through a forward contract? Why wouldn’t I hold onto the power and take advantage of the spot market?* If indeed you believe that markets are efficient, these forward prices will embed all potential price spike information.

However, if your company believes that markets are inefficient, the firm’s trading strategy ought to take advantage of any perceived under- or over-valuations in the forward price market. The ultimate answer is a function of your business strategy. If your company’s profit strategy is based on spot price trading, then don’t sell forward. In fact, your company then believes that the market is undervaluing the forward contracts and is willing to take the “naked” price risks. If your company, on the other hand, wants to forego large potential profits in order to avoid large potential losses, it will lock in lower profits through hedging; then selling forward is appropriate.

The U.S. power market also inherited a market-structure from centralized generation points (such as the Palo Verde, AZ, yard with generation assets owned by multiple companies) and pre-defined regions. After the blackouts of 1965, the power industry created the “reliability regions⁴” of the North American Electric Reliability Council (NERC). These regions followed natural transmission costs, with sub-regions (called “coordinating areas”) around major generators. These regions formed nascent markets in which utilities would trade electricity with each other both for profit and to fulfill their end of the social contract: reliability. Within this “brotherhood of reliability”—to coin a phrase—electric utilities formed early counterparty relationships. The NERC regions also help increase the “liquidity” of information about transmission and generation expansion plans. During early stages of deregulation, these NERC regions and coordinating areas provided convenient monikers for individual markets, giving name to some of the first widely traded, over-the-counter North American power markets. Certainly NERC probably did not foresee the role that their regions would play in deregulated markets, but the industry can certainly be credited for taking advantage of a natural opportunity.

Natural gas markets followed a slightly different history, with markets defined less as regions and more as delivery points relative to a single, major hub. NYMEX’s fabulously successful natural gas contracts specify delivery at the Henry Hub in Louisiana. Local gas markets are then quoted as basis spreads to this NYMEX point. Interestingly, when NYMEX first launched their power contracts, they defined them likewise as delivery points (namely California-Oregon Border—or COB—and Palo Verde, AZ).

- Finally, our current process of unwinding electricity’s social contract for energy supply is no different from similar first-regulate-then-deregulate cycles of other industries. Power executives can take comfort by remembering the bumps experienced by banking, airline, telecommunications, and other deregulated industries.