CHAPTER 1

An Introduction to Energy Finance and Economics

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> He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may be cast.
>
> —Leonardo da Vinci, 1452–1519

> An investment in knowledge always pays the best interest.
>
> —Benjamin Franklin

SO WHY A BOOK ON ENERGY FINANCE AND ECONOMICS?

The purpose of this book is to provide the latest information and insights into the finance and economics of energy, based on contributions written by academics and practitioners who are experts in various areas of energy finance and economics. We strive to bridge the theory–practice gap, as the quote from Leonardo da Vinci emphasizes, between the scientific and technological foundations of energy and the real-world applications in the fields of finance and economics. Theory and practice go hand in hand, so that students and practitioners can better understand the what, why, and how of energy finance and economics to aid them in performing at a higher level no matter where "they may be cast." Likewise, investing in knowledge will lead to success for anyone working in the energy industry or a related area, as the Benjamin Franklin quote suggests.

The book is intended to be useful to both educators and executives interested in the broad topic of energy finance and economics, but it will be relevant to energy users in general. To our knowledge, this is the first book to provide this breadth of coverage on this topic. We strive to provide accurate and nonbiased information by experts in each of the subject areas. Surveys, an example of

which is described in Chapter 7, have shown that, in general, the public is very misinformed about what influences the prices of energy in our society. This is indeed unfortunate because learning the basics is fundamental to both citizens and politicians who make important decisions regarding energy. There is a desperate need for more education on energy, and we believe this book is a step in the right direction.

What do we mean by energy finance and economics? By this, we mean the finance and economics of energy involving the principles and tools necessary to conduct sound decision making and analysis. This also includes a broad understanding of the complex topics related to energy for a solid foundation. By linking both the economics and finance of energy in the book, we are striving to break down the silo mentality that sometimes separates two fields, especially in education, so that the knowledge flows freely between these two areas.[1]

This leads to the **learning objectives** of the book, which are:

1. To gain basic knowledge and key concepts of energy supply and demand, terminology, industry structure, and related concepts.
2. To analyze geopolitics and world energy use and learn about the outlook for the U.S. and global energy needs over the next 30 years and beyond.
3. To understand energy applications that all professionals should know for best practices in financial analysis. These include understanding the basics such as accounting standards that apply to oil and gas companies, financial statement analysis, capital budgeting and risk analysis for energy projects, valuation, financing, and related topics including renewable energy.
4. To explore value creation and decision making in the energy industry.
5. To learn about the types of energy derivatives and markets and utilize key hedging techniques that are useful for energy risk management.
6. To provide a firm understanding of the importance of the energy industry and the role that alternative energy sources can provide (and not provide) in meeting our future energy needs.
7. To analyze case studies related to energy financial analysis, such as the economics of buying a hybrid vehicle, Southwest Airlines' decision to retrofit their fleet of Boeing jets with blended winglets to save on fuel costs, and the economics of a wind energy project, among others.
8. More broadly, to achieve a strong foundation in leading best practices that apply to the field of energy finance and economics.

THE CHALLENGES OF ENERGY TRANSITIONS AND THE TRICKY TRADEOFFS

> Past energy transitions to inherently attractive fossil fuels took half a century; moving the world to cleaner fuels could be harder and slower.
>
> —Richard A. Kerr (2010)

There has been a large push for renewable energy (wind, solar, etc.) worldwide with the corresponding Chicken Little warnings that we are running out of oil. Contrary to what most people believe, peak oil has not happened, and there is no

Exhibit 1.1 Future Global Energy Demand

	2008 Actual		2035		
Consumption	**Quad BTU**	**% Share**	**Quad BTU**	**% Share**	**% Change**
Liquid fuels	173.0	34.3	225.2	29.3	30.2
Coal	139.0	27.5	209.1	27.2	50.5
Natural gas	114.3	22.6	174.7	22.7	52.8
Renewables	51.3	10.2	109.5	14.2	113.5
Nuclear power	27.2	5.4	51.2	6.7	88.6
Total	504.7	100.0%	769.8	100.0%	52.5
Oil and natural gas	287.3	56.9	399.9	52.0	39.2
Oil, natural gas, and coal	426.3	84.4	609.1	79.1	42.9

braking point in sight.[2] Oil and natural gas supply capacity is growing worldwide at an unprecedented level that may outpace consumption, according to Maugeri (2012). As later discussed in Chapter 3 of the book, most forecasts of future global energy demand through the year 2035 show that sustaining even modest economic growth worldwide will require massive new investments in energy, particularly oil and natural gas (see for example, EIA 2012 and API 2012).[3] The latest projections of global energy needs in the year 2035 by the Energy Information Administration (EIA) indicate the energy mix shown in Exhibit 1.1.[4] This forecast assumes a 3.4 percent annual rate of growth in the global economy. As shown, oil, natural gas, and coal should still dominate the energy mix by providing 79.1 percent of global energy needs, as compared to 84.4 percent in 2008. Renewable energy is expected to grow from 10.2 percent in 2008 to 14.2 percent by 2035.

The good news is that having an increasing supply of oil and natural gas helps give us time to do the research and development necessary to shift to a more renewable-based economy. It also gives us time to solve a major challenge of renewables—building the infrastructure necessary to get the renewable energy where it is needed. It took the United States almost a century to build the system we have today to transport oil and gas efficiently throughout our country. It can easily take a similar time period to build new systems to take advantage of renewables.

Another challenge for renewables is that for the first time in the history of the world, we are attempting to move to new energy sources that are "less useful and convenient than the currently dominant sources: fossil fuels" (Kerr 2010). Historically, we have always moved to a more convenient and economic fuel, which makes the transition easier. In the 1800s, we shifted from wood to coal and then in the 1900s, from coal to oil. Shifting to renewables will require behavioral changes by all consumers of energy.

Another challenge for renewables lies largely with their inconvenience relative to fossil fuels and lack of infrastructure to get the energy from where it is produced to where it is needed. Whereas oil and natural gas can be transported easily by truck, rail, or pipeline to the point of use, wind and solar power do not have that flexibility. There is also a large difference in the energy density. Liquid

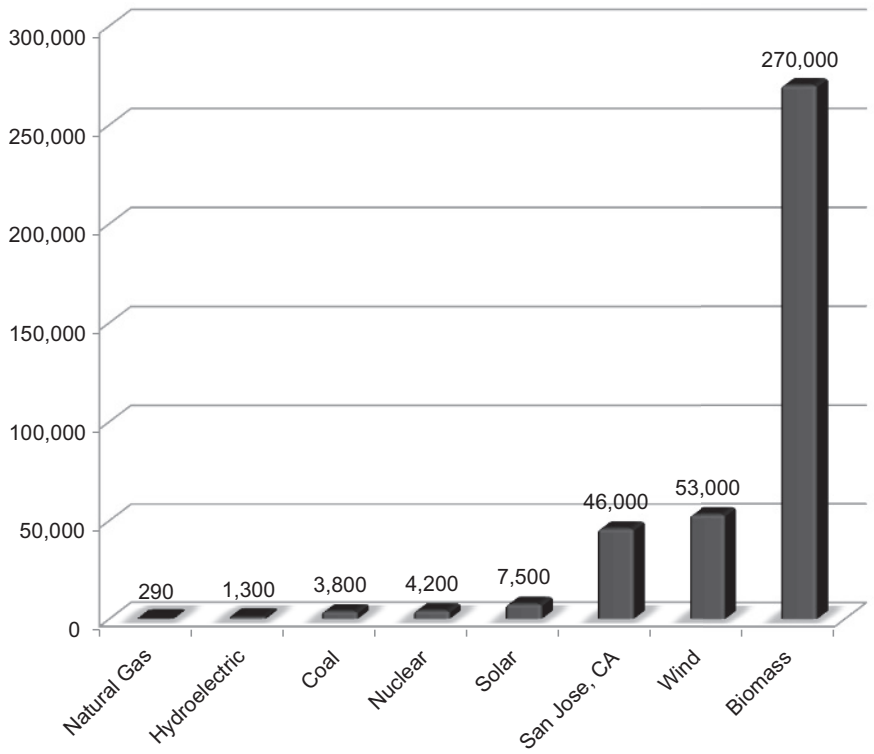

Exhibit 1.2 Land Area Needed to Provide Energy Sources in San Jose, California, Compared to Land (in Hectares) the City Occupies
Source: Based on research by Cho (2010), D. Spitzley, and the University of Michigan Center for Sustainable Systems, National Academy of Sciences, Department of Energy.

hydrocarbons have very high energy content per volume, or what we call "high energy density," compared to renewables. On a weight basis, oil has three times the energy of biomass and almost five times as much on a volume basis. In addition, wind and solar production is intermittent, whereas fossil fuel power plants operate 75 to 90 percent of the time. To make these renewables more attractive, they have been pushed hard with government tax incentives and subsidies to encourage their development.

Another challenge involves land. When the amount of land used to produce energy is considered, oil yields from 5 to 50 times as much power as a solar facility. Wind and solar farms have large land footprints as does planting crops for biofuels. This is illustrated in Exhibit 1.2, which compares the amount of land that the city of San Jose occupies in comparison to the amount of land needed for various energy sources to provide San Jose's power (see Cho 2010).

Clearly, there are many challenges ahead in energy but also many opportunities. This book is structured to cover core concepts and applications to help educate us for this journey.

SUMMARY OF THE BOOK CHAPTERS

As described earlier, the purpose of this book is to provide a broad coverage of energy finance and economics in order to educate practitioners and students alike. To achieve this goal, the book is organized into the following four sections:

Part One	An Overview of Energy Finance and Economics
Part Two	Financial and Economic Analysis in the Energy Industry
Part Three	Energy Risk Management and Related Topics
Part Four	Case Studies

Next, we provide a brief description of the author(s) and the chapters in the book.

Part One: An Overview of Energy Finance and Economics

Chapters 2 through 7 provide an excellent background by covering core topics: geopolitics, energy economics, myths and realities about sustainable energy, an introduction to the petroleum industry, the economics of renewables, and a survey of consumers' understanding of what drives energy prices.

Chapter 2, "Geopolitics and World Energy Markets," by Robert W. Kolb, provides insights into the story of energy, which is intertwined with international politics, all with dramatic effect on energy markets. Given the crucial nature of geopolitics, this chapter is a must-read for anyone interested in energy finance and economics. The author eloquently discusses geopolitics and world energy markets and describes threats to these markets. He illustrates how the effect of an oil supply disruption that affects only a single small country can be quite large and how the world nexus of energy supply draws many nations into simultaneous interaction. Kolb concludes by pointing out that the future of world energy is as likely to be determined by the interaction of nations as by the fluctuations in world supply of and demand for energy.

"Energy Economics: Past, Present, and Prospects for the Future" is presented in Chapter 3 by James L. Williams (owner of WTRG Economics) and Betty J. Simkins (Williams Companies Professor of Business and Professor of Finance, Oklahoma State University). James Williams, a leading authority on energy economics, has published the globally distributed newsletter, "The Energy Economist," for many years. Betty Simkins collaborates with James to provide a brief overview of the past, the present, and the prospects for the future of energy with a focus on the demand side: energy consumption, particularly petroleum. Their discussion begins with a brief history of energy usage in the United States, followed by coverage of energy consumption in the five primary sectors: transportation, power, residential, commercial, and industrial. The authors then move to a global viewpoint and investigate recent trends in world energy consumption and also discuss what influences oil prices. Finally, they peer into their crystal ball and examine future forecasts of energy demand before presenting their conclusion.

Five authorities on sustainable energy have co-authored Chapter 4, "Sustainable Energy: Myths and Realities." In this chapter, Olamide Shadiya, Jane

Talkington, John Mowen, Karen High, and Josh Wiener, all with Oklahoma State University, investigate the myths and realities of sustainable energy. They begin by providing a definition of sustainable energy. Implied in the term *sustainable* is the concept of time. When an energy source is said to be sustainable, what time period does this involve—25 years, 50 years, 200 years? Their analysis indicates that at current and expected future rates of depletion, the conventional energy sources (while nonrenewable) will continue to be used for at least 50 years. The authors also identify a series of alleged sustainable energy myths that have been proposed by various pundits and organizations. Of course, implied in these myths is the supposed reality. The authors also present the results of a survey of 900 consumers on their perceptions of various aspects of nine energy sources and identify four potential myths held by consumers about sustainable energy. They present a model for identifying the sustainability of energy sources and then apply it to the production of electricity in the United States. Their analysis identifies that it is critical to consider economics when establishing the sustainability of energy sources. This chapter finishes with a set of conclusions and a brief discussion of the importance of setting a time frame when identifying the myths and realities of sustainable energy.

In Chapter 5, "A Brief Introduction to the Petroleum Industry: From Crude Oil and Natural Gas to Petrochemicals," Russell Simkins, co-editor of this book, and Ken Borokhovich, Lecturer in Finance at Miami University of Ohio, discuss the properties of crude oil and natural gas, the refining and processing methods, the end products, and the connection with the petrochemical industry. Throughout the discussion, the various end products, both from the refinery and the petrochemical industry, are highlighted with examples of end-use goods. The chapter also explains how an understanding of this topic is crucial to financial and economic analysis in the energy industry.

Chapter 6, "The Economics of Renewable Energy," by Brad Carson (Director of the National Energy Policy Institute at the University of Tulsa, Associate Professor of Entrepreneurship and Business Law, and General Counsel of the U.S. Army), critically examines the prevailing method of evaluating renewable energy projects and investigates alternative methodologies. The foremost method of estimating the cost of electricity, known as *levelized cost*, is discussed, and comparisons are made among different energy technologies. Altering assumptions are discussed including the tremendous impact these can make on levelized cost estimates, including the bedrock assumptions about what discount rate to use.

It is surprising how many people are misinformed on what drives energy prices. Sheridan Titman (Walter W. McAllister Centennial Chair in Financial Services and Professor of Finance, University of Texas at Austin) conducted a survey that shows just this. In Chapter 7, "How Our Political Views Affect Our View of Energy Prices," he summarizes the results of the inaugural University of Texas at Austin (UT) Energy Poll. In this poll, UT asked participants to identify the factors influencing energy pricing. Surprisingly, poll participants, who speak for a broad representative cross-section of the U.S. population, have it exactly backwards in what influences energy prices. They do not understand that supply and demand for oil, natural gas, and electricity are the most important determinants of energy prices. A closer look at the data reveals significant differences in the opinions of Democrats and Republicans. They are equally misinformed, but misinformed in

very different ways. This chapter highlights the importance of educating the general public on energy economics.

Part Two: Financial and Economic Analysis in the Energy Industry

Part Two of the book, Chapters 8 through 14, provides detailed financial and economic analyse, which are crucial topics for anyone desiring a strong foundation. To fully understand energy finance and economics and to correctly interpret financial statements of oil and gas companies, a background in accounting standards for oil and gas is essential. For this reason, Part Two of the book starts with Chapter 8, "Oil and Gas Accounting," authored by L. Charles Evans III (Partner, Grant Thornton) who has many years of oil and gas accounting experience. The oil and gas industry is unique in that there are two fundamentally different acceptable methods to account for its activities—successful efforts and full cost. Charles Evans discusses these methods in detail and how they impact the financial statements. The chapter includes coverage of required accounting disclosures, impairment, and conveyances, among other topics, concluding with a discussion of the current status for integrating U.S. accounting standards with International Financial Reporting Standards (IFRS).

"Financial Statement Analysis for Oil and Gas Companies and Competitive Benchmarking" is presented in Chapter 9. This chapter is co-authored by Siamak Javadi, a PhD Candidate at Oklahoma State University (OSU), Betty J. Simkins, Williams Companies Professor of Business and Professor of Finance, Oklahoma State University, and Mary E. Wicker, a PhD student at OSU. This chapter discusses how to analyze the financial statements of oil and gas companies and competitive benchmarking. Analyzing an oil and gas company is very different from any other type of financial statement analysis because it involves an in-depth analysis of the 10-K report notes. In this chapter, standard financial ratios are covered together with an in-depth analysis of the nine most important energy ratios that are used to analyze the upstream operations of oil and gas companies: production ratio, reserve life index, reserve replacement ratios, the cost of replacing reserves including finding cost and lifting cost, and the reserve value added ratios.

In Chapter 10, "Petroleum Economics, Risk, and Opportunity Analysis: Some Practical Perspectives," David Wood (a consultant with more than 30 years of international oil and gas experience spanning technical and commercial exploration and production operations, contract evaluation, and senior corporate management) presents an overview of financial analysis in petroleum. In energy finance, discounted cash flow analysis is one of the main methods employed in valuing projects, companies, and assets based upon their future cash flow forecasts. Wood presents practical analysis and perspective on petroleum economics, risk, and opportunities.

"Real Options and Applications in the Energy Industry" are defined and discussed in Chapter 11. What are real options? Kris Kemper (Assistant Professor, University of Wisconsin–Eau Claire) and Betty Simkins (co-editor of the book) explain that real options are option-like opportunities, such as business decisions and flexibilities, where the underlying assets are real assets, hence the term *real options*.

These opportunities are based on managerial flexibility and are commonly found in the operation of many corporate assets. Examples include the choice to expand into new markets and product lines when growth opportunities are available in the marketplace; the option to wait until more information is available (such as to delay investment and operating decisions in response to uncertainty in the marketplace); the option to switch between inputs, outputs, or processes (such as a dual-fired power plant that operates on two types of fuel and can switch from one fuel to another); the option to abandon or temporarily shut down operations when losses are being occurred; and hybrid options. The remainder of the chapter provides a brief history of real options, discusses the differences between financial and real options, describes the types of real options together with examples from the energy industry, and lists ways real options are valued.

Chapter 12, "International Petroleum Fiscal System Design and Analysis" was written by David Johnston, an engineer from the University of Rochester and an engineering and petroleum industry consultant who has worked and lectured internationally on the subjects of energy and technology for many years. The design and analysis of international petroleum fiscal systems is relatively new, although many of the principles of fiscal system design date back hundreds of years to early agricultural production sharing. Governments must at once design fiscal systems that maximize revenues and provide investors with incentives to explore for and develop hydrocarbons as efficiently as possible. Investors are looking to recover investments and share in the profits produced—with as little grief as possible. This chapter is a primer on fiscal system design and analysis, and exploration acreage allocation from the perspectives of host governments and investors.

Financing in the energy industry is a complex topic because many projects cost in the billions of dollars. In Chapter 13, "Financing Large Capital Projects," the optimal financing of large energy projects focusing on the oil and gas (O&G) industry is examined. There are two important issues that arise at the very outset. First, how important are large projects in the oil and gas industry, and what are their notable features? Second and more importantly, why do these projects merit special attention; that is, why can one not simply apply the standard corporate finance framework to finance these projects? This chapter was written by two experts on this topic: Stephen V. Arbogast (Executive Professor of Finance at the University of Houston) and Praveen Kumar (Texas Commerce Bank/Tenneco Professor of Finance and Chair, Department of Finance in the C. T. Bauer College of Business from the University of Houston).

No book is complete on energy finance without coverage of bio-fuels. In Chapter 14, "Financing Bio-Fuels Projects: Case Study Lessons," Stephen Arbogast, now at the University of Houston, discusses this topic. Stephen served from 1999 to 2004 as the Treasurer of ExxonMobil Chemical Company and has more than 30 years of experience in finance working with Exxon Corporation and ExxonMobil Chemical. His vast experience in the petroleum and petrochemical industries makes him uniquely qualified to author this chapter. Bio-fuels projects have been a growing factor in U.S. energy markets for over a decade. Today, corn-based ethanol plants deliver over 12 billion gallons per year into America's gasoline pool. Bio-diesel also exists, though on a much smaller scale. Rapid expansion of domestic bio-fuels manufacturing is now an official U.S. public policy objective. The Energy Independence and Security Act (EISA) of 2007 established aggressive

mandates for 2022. By that year, the U.S. gasoline pool is required to include 36 billion gallons of assorted bio-fuels. Only 15 billion gallons of corn-based ethanol is incorporated into this mandate. The rest is expected to come from "cellulosic-based bio-fuels (CBFs)" and other "advanced bio-fuels (ABFs)." What exactly are these new bio-fuels, and what is going to determine whether they appear on time or not? We encourage you to read this chapter to learn the answers to these questions.

Part Three: Energy Risk Management and Related Topics

With the high volatility in energy prices, managing this source of risk is a topic of great concern to both users and producers of energy. We begin Part Three, which focuses on energy risk management and related subjects, with five informative chapters.

Chapter 15, "Energy Derivatives and Markets," focuses on explaining the nature of derivative securities traded on energy commodities. Furthermore, the reader can learn about the history of energy derivatives, different instruments available for risk management, global perspective of the market, and how the exchanges deal with derivative instruments in energy. Craig Pirrong, who is Professor of Finance and Energy Markets Director for the Global Energy Management Institute at the University of Houston, and Mohsen Mollagholamali, a PhD student in finance at Oklahoma State University, co-author this chapter to give an insightful coverage on this topic.

In Chapter 16, "Introduction to Energy Risk Management," Ivilina Popova, Associate Professor at Texas State University–San Marcos, and Betty Simkins (co-editor of this book), join forces to provide an introduction on to how to manage energy risk using derivatives. Both authors, who received their doctorates from Case Western Reserve University and wrote their dissertations on aspects of derivatives, have spent many years working in the area. In this chapter, they explain the basics of hedging using different types of derivatives including futures contracts, options (both calls and puts), collars, and swaps. Many examples are provided to show how both users of energy and producers of energy can manage price risk. Ivilina and Betty also explain the unique aspects of energy markets where forward prices can be in either contango or backwardation. This chapter is a must-read for anyone interested in energy risk management.

Continuing on the topic of energy risk management, in Chapter 17, "Risks in Trading Energy Commodities," Divya Krishnan, formerly Market Risk Analyst with CITGO and now Senior Financial Analyst at Laureate Education Inc., discusses the major risks inherent in the trading of energy commodities. This chapter provides an excellent continuation of the previous chapter. As the author explains, there has been high volatility in the energy industry over the past few years, especially with regard to commodity prices. The key factors that drive energy price volatility are structural and are likely to have a long-term impact. Furthermore, significant events such as natural disasters, political uncertainty, and corporate misconduct have spurred instability in the energy markets. Increasing volatility and complexity of the energy commodities have made it an attractive market for financial players including hedge funds. Corporations use various hedging strategies to minimize or eliminate their exposure to risks. The goal of hedging is not to

make a profit, but to eliminate unwanted risk, which may be done by locking in a profit. This chapter examines the various types of risk and means of minimizing the risk.

"Carbon Management and Environment Issues," the title of Chapter 18, may sound like a topic from the past right now. The author, Evgenia Golubeva, is an RRT Assistant Professor of Finance and Adjunct Lecturer in Energy Management at the Michael F. Price College of Business, University of Oklahoma. Evgenia has an undergraduate degree in Oil and Gas Exploration Geophysics from Moscow State Academy of Oil and Gas (Russia), and worked several years in the oil and gas industry prior to obtaining her PhD in Finance from the University of Utah. Evgenia points out that while the cap-and-trade legislation in the United States has run aground, climate exchanges have closed, and emission allowance contracts have delisted, there are still important environmental issues that need to be addressed. The efforts of the international community, public pressure, and regulatory developments all shape the profile of environmental risks and opportunities that businesses in all industries will continue to face with increasing intensity. To understand the nature of the issues and the related uncertainties, costs, benefits, risks, and opportunities is important regardless of the regulatory status *du jour*. This chapter's objective is to provide an overview of these issues and discuss the past and the present challenges and realities.

"Hedging and Value in the U.S. Airline Industry," Chapter 19, is co-authored by three academics who are well known for their research on hedging in the airline industry. The co-authors are David Carter, Professor of Finance and Greg Massey Professor of Finance at Oklahoma State University, Daniel A. Rogers, Associate Professor of Finance at Portland State University, and Betty J. Simkins. The authors conducted a study of the fuel price hedging of 28 airlines from 1992 to 2003. This research paper, on which this chapter is based, was published in *Financial Management* (2006) and won the Addison-Wesley Best Paper in *Financial Management*. The chapter summarizes that work and is a reprint of an article previously published in the *Journal of Applied Corporate Finance*. In recent years, a growing number of companies have devoted major resources to implementing risk management programs designed to hedge financial risks such as interest rate, currency, and commodity price risk. Because of the increasing reliance on such programs, it is important to ask, "Does hedging add value to corporations?" And if it does, the obvious follow-up question is "How does it add value?"

Part Four: Case Studies

In Part Four of the book, we include six excellent cases that involve challenging analysis in different areas of energy finance and economics. In our opinion, any book on energy is not complete without case studies.

Chapter 20, "PKO Resources, Inc.: Valuing a Producing Oil and Gas Property," is a case study about the evaluation of a new exploration and production (E&P) project for PKO Resources, Inc. This case is co-authored by three experts in the field, John D. Martin (Carr P. Collins Chair in Finance in the Hankamer School of Business at Baylor University), J. Douglas Ramsey (Vice President and Chief Finance Officer of EXCO Resources, Inc.), and Sheridan Titman (Walter W. McAllister Centennial Chair in Financial Services and Professor of Finance, University of Texas at Austin). The analysis involves constructing a hypothetical example project to test

understanding of the cash flows generated by an E&P investment. The case also covers the implications of the use of hedging and the forward price curve for valuing oil and gas properties. The reader learns to construct and execute a simulation of the value of an oil and gas property where oil and gas prices are simulated using geometric Brownian motion with parameter estimates taken from historical price changes for oil and gas. The case also considers the impact of the option to abandon in the evaluation of unproved reserves.

Do you own a hybrid car or are you considering buying one? If so, you will want to read Chapter 21. This case study, "Financial Analysis of the Purchase of a Hybrid Consumer Vehicle," is co-authored by Don M. Chance (James C. Flores Endowed Chair of MBA Studies and Professor of Finance at Louisiana State University), Pratik Dhar (Financial Controls Analyst at The Shaw Group Inc.), and Betty Simkins. This case analyzes the incremental cost and financial benefits of 15 hybrid vehicles in relationship to their standard counterparts. For most consumers, hybrids cannot be justified on a purely financial basis, with an incremental all-in present value cost ranging from $1,600 to $3,500 for standard-size vehicles. Standard-size vehicles can, however, likely be justified for businesses that drive a large number of miles in a city. In contrast, large SUVs do provide clear financial benefits for consumers but not because of mileage improvement. Rather, these vehicles are costly even in the standard version, and the manufacturer is reluctant to mark them up as much as it does smaller vehicles.

It is important to cover the topic of relative valuation in energy mergers and acquisition in the book. We pick our favorite recent energy acquisition and publish a case about it in Chapter 22, "ExxonMobil Corp.'s Acquisition of XTO Energy, Inc.: An Exercise in Valuation." Allissa Lee (Visiting Assistant Professor of Finance at the Spears School of Business at Oklahoma State University) and Betty Simkins collaborate to provide an insightful tutorial on relative valuation. As the title implies, this chapter covers ExxonMobil's acquisition of XTO Energy, with the purpose of illustrating to the reader how to conduct relative valuation of an energy company and determine if the acquisition price is justified. Was XTO worth the $41 billion offered by ExxonMobil? The case addresses five questions: (1) What should the acquisition price for XTO shares have been? (2) Which comparable firm is the best comparison firm for XTO? (3) Why did ExxonMobil want to acquire XTO? (4) Based on the analysis, did ExxonMobil overpay for XTO or get a bargain? And (5) What additional information could help with this analysis?

Chapter 23, "Southwest Airlines: The Blended Winglet Project," examines Southwest Airlines' decision to retrofit part of their fleet with blended winglets to save on jet fuel costs. The blended winglet project was a proposed technology that would cost Southwest Airlines approximately $762,000 per aircraft to install and promised to provide improved range, greater fuel savings, and reduced noise and emissions. The project was aimed at providing Southwest with an additional cost advantage over its competitors, an important source of competitive advantage for the company. One of the most interesting elements of the case is the illustration of the teamwork necessary to analyze a complex capital budgeting project. The winglet project required analyses conducted by the engineering, facilities, and flight operations groups before the economics could be fully assessed. The process lasted approximately one year, and the first blended winglet technology could be seen on a Southwest flight in early October 2003. This case provides an excellent

example of how to analyze a project involving energy savings and is co-authored by Aaron Martin with Sempra Energy, Daniel Rogers, Associate Professor at Portland State University, and Betty Simkins.

A book on energy finance and economics is not complete without a case study analyzing the economics of wind energy. In Chapter 24, "Wind Energy Power Company, Inc. (A): Analyzing a Wind Energy Investment," the three authors of Chapter 20, John Martin, Doug Ramsey, and Sheridan Titman, come together again to write another excellent case. This case presents the reader with the decision as to whether or not it is economical to invest in a wind energy project. The time period is the summer of 2008, when dramatic increases in the cost of fossil fuels and concerns over greenhouse gases and global warming have made the development of alternative energy sources increasingly attractive. At this time, natural gas prices rose to $13 per MMBtu, which made wind power generation very attractive, and huge investment projects were undertaken. Most notably, Boone Pickens announced plans for the largest wind power generation farm in the United States. In the case, the Wind Energy Company (TWEPCO) announced its plans to build a 2,500 MW wind generation farm near Vernon, Texas, in July 2008 when natural gas prices were at their peak. By October 2008, the price of natural gas had dropped to $6 per MMBtu, and TWEPCO is reconsidering its plan to build the new wind farm. Chapter 24 raises questions about whether the wind energy project economically viable and what TWEPCO's next steps might be.

There is no doubt that speculators can sometimes exert significant influence on energy markets. Before ending the book, we include our favorite case on this subject: Chapter 25, "A Case Study on Risk Management: Lessons from the Collapse of Amaranth Advisors L.L.C." This chapter is authored by Ludwig B. Chincarini, an Assistant Professor at Pomona College, who has studied the forensics on this hedge fund collapse. Ludwig, who received his PhD from the Massachusetts Institute of Technology, provides a detailed and insightful coverage of what went wrong at Amaranth Advisors. In September 2006, the activities of Amaranth Advisors, a large-sized Connecticut hedge fund, sent menacing ripples through the natural gas market. By September 21, 2006, Amaranth had lost roughly $4.942 billion over a three-week period, or one-half of its assets primarily due to its activities in natural gas futures and options. Shortly thereafter, Amaranth funds were being liquidated. This case study uses data obtained from the Senate Subcommittee on Investigations, energy exchanges, and other sources to analyze exactly what caused this spectacular hedge fund failure. This case also analyzes Amaranth's trading activities within a standard risk management framework to understand to what degree reasonable measures of risk measurement could have captured the potential for the dramatic declines that occurred in September. Even by very liberal measures, Amaranth was engaging in highly risky trades. This chapter provides insight into this fascinating debacle.

Instructors can find additional material on www.wiley.com.

WHAT DOES THE FUTURE HOLD FOR ENERGY?

> When one door closes another door opens; but we often look so long and so regretfully upon the closed door that we do not see the ones which open for us.
>
> —Alexander Graham Bell, inventor of the telephone

Current trends show a resurgence in fossil fuels with the innovations in fracking and other engineering advances in hydrocarbon recovery. For example, the August 2012 issue of *SmartMoney* boasts the headline on the cover of the issue: "The Return of Fossil Fuels."[5] But at some point, we will be out of the age of fossil fuels. If your time frame is 1 million years, fossil fuels are renewable. Our time frame is much shorter, so the trillion-dollar question is: "What is behind the next door?" Will the fuel of the future be a mix of the alternatives we are currently developing or will there be a new invention or discovery of a totally new source of energy we have not envisioned yet? Daniel Yergin forecasts that higher oil prices will produce "a great bubbling of innovation" across the energy spectrum.[6] There may also be a game changer out there we have not even envisioned yet.

It is impossible to know the answer at this point in time, but it is exciting to ponder. In the short run, we will see enormous new oil and gas discoveries in the United States, which will have a very positive impact on the U.S. economy. These same technological breakthroughs in harvesting conventional energy will have a global impact, too. This is good news. Regardless, alternative energy sources have big shoes to fill and challenges to overcome to supply our future energy needs. Fossil fuels are finite resources, so at some point, even if it is gradual, we will be forced to see what is behind the next door.

CHAPTER QUESTIONS

1. List and describe advantages and disadvantages of renewable fuels and renewable energy sources.
2. This question requires you to think outside the box. What types of alternative fuels or energy sources can you think of that are not discussed in the chapter? Disregard economic or practical considerations and brainstorm possible future sources of energy. Use the Internet, if you wish, to assist in your answer.
3. Using the Internet, research the history of energy usage. What were the great transition points and what drove those transitions?
4. What is peak oil, and who came up with that theory? (You will have to do a little research for this.)
5. What topic would you like to see included in this book that is not covered? Why?

NOTES

1. Silo mentality is an attitude found in some organizations that occurs when several departments or groups do not freely share information or knowledge with other individuals or groups in the same organization. A silo mentality reduces efficiency and hurts innovation.
2. A braking point is where social and economic progress is halted due to a lack of energy (Stansberry and Reimbold 2008). As the name implies, peak oil is the point in time when world production of crude oil reaches a maximum, after which the rate of production is expected to enter terminal decline.
3. For the latest forecasts, the API report is available at www.api.org/energyzingamerica, and EIA reports are available at eia.doe.gov. Other energy forecasts are available from the IEA (www.iea.org and www.iea.org/weo/ for the world energy outlook), BP (www.bp.com/energyoutlook), and ExxonMobil (www.exxonmobil.com/Corporate/energy˙outlook.aspx). All reports are available for free.

4. See EIA (2011).
5. See the August 2012 issue of *SmartMoney* published by the *Wall Street Journal*.
6. See Yergin (2012).

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