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# Eagle Ford Shale Oil Pay Zone

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The Eagle Ford Shale

Bulletin of the American Association of Petroleum Geologists

Governing Shale Gas

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The Price of Oil

Congressional Record

Please Give Us One More Oil Boom - I Promise Not to Screw It Up this Time

Eagle Ford Shale Task Force Report

Mapping of the Oil Window in the Eagle Ford Shale Play of Southwest Texas Using Thermal Modeling and Log Overlay Analysis  
Applying Decline Curve Analysis in the Liquid-rich Shales

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**HARRY SANTOS**

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The Eagle Ford Shale Cambridge University Press

This research project attempts to synthesis social movements theories in examining the responses of those individuals who are opposed and/or concerned with the process of hydraulic fracturing in the Eagle Ford Shale region of South Texas. The application of social movement theories of breakdown, framing, and emotion were applied to shed light on the processes of meaning generation among protest organizers and participants. The objectives explored in this study include who makes up the movement, how the movement frames their arguments, and the personal grievances individuals may have suffered as a result of the oil and gas boom in the Eagle Ford Shale region. Major findings include evidence of a "common sense" frame, another deemed an "unfairness frame" which we then placed under a central frame of "injustice." Support for this central injustice frame was also found through several emerging themes including the influence of money in politics and lack of regulation/oversight. Evidence of breakdown was found through the central frame of injustice, which also encompassed the "unfairness" frame, and themes of the influence of money in politics and lack of regulation/oversight, as well as through the grievances and concerns that participants voiced in the interviews.

*Bulletin of the American Association of Petroleum Geologists* Dog Ear Publishing

Hydraulic Fracture Modeling delivers all the pertinent technology and solutions in one product to become the go-to source for petroleum and reservoir engineers. Providing tools and approaches, this multi-contributed reference presents current and upcoming developments for modeling rock fracturing including their limitations and problem-solving applications. Fractures are common in oil and gas reservoir formations, and with the ongoing increase in development of unconventional reservoirs, more petroleum engineers today need to know the latest technology surrounding hydraulic fracturing technology such as fracture rock

modeling. There is tremendous research in the area but not all located in one place. Covering two types of modeling technologies, various effective fracturing approaches and model applications for fracturing, the book equips today's petroleum engineer with an all-inclusive product to characterize and optimize today's more complex reservoirs. Offers understanding of the details surrounding fracturing and fracture modeling technology, including theories and quantitative methods Provides academic and practical perspective from multiple contributors at the forefront of hydraulic fracturing and rock mechanics Provides today's petroleum engineer with model validation tools backed by real-world case studies

*Governing Shale Gas* Royal Society of Chemistry

Expanded production of hydrocarbons by means of horizontal drilling and hydraulic fracturing of shale formations has become one of the most important changes in the North American petroleum industry in decades, and the Eagle Ford (EF) Shale play in South Texas is currently one of the largest producers of oil and gas in the United States. Since 2008, more than 5000 wells have been drilled in the EF. To date, little research has focused on landscape impacts (e.g., fragmentation and soil erosion) from the construction of drilling pads, roads, pipelines, and other infrastructure. The goal of this study was to assess the spatial fragmentation from the recent EF shale boom, focusing on La Salle County, Texas. To achieve this goal, a database of wells and pipelines was overlain onto base maps of land cover, soil type, vegetation assemblages, and hydrologic units. Changes to the continuity of different ecoregions and supporting landscapes were then assessed using the Landscape Fragmentation Tool as quantified by land area and continuity of core landscape areas (those degraded by "edge effects"). Results show an increase in ecosystem fragmentation with a reduction in core areas of 8.7% (~333 km<sup>2</sup>) and an increase in landscape patches (0.2%; 6.4 km<sup>2</sup>), edges (1.8%; ~69 km<sup>2</sup>), and perforated areas (4.2%; ~162 km<sup>2</sup>) within the county. Pipeline construction dominates sources of landscape disturbance, followed by drilling and injection pads (85%, 15%, and 0.03% of disturbed area, respectively). This analysis indicates an increase in the potential for soil loss, with

51% (~58 km<sup>2</sup>) of all disturbance regimes occurring on soils with low water-transmission rates and a high runoff potential (hydrologic soil group D). Additionally, 88% (~100 km<sup>2</sup>) of all disturbances occurred on soils with a wind erodibility index of approximately 19 kt/km<sup>2</sup>/yr or higher, resulting in an estimated potential of 2 million tonnes of soil loss per year. Depending on the placement of infrastructure relative to surface drainage patterns and erodible soil, these results show that small changes in placement may significantly reduce ecological and hydrological impacts as they relate to surface runoff. Furthermore, rapid site reclamation of drilling pads and pipeline right-of-ways could substantially mitigate potential impacts.

*Assessment of the Mexican Eagle Ford Shale Oil and Gas Resources* CRC Press

This report is a work of original reporting which investigates the proliferation of drug use and drug trafficking in the Eagle Ford Shale, a region of heavy oil and gas development in South Texas. Since 2008, the Eagle Ford Shale has seen an influx of people, money, and new infrastructure. This has created a "perfect storm" for drug traffickers. The region is historically poor and sparsely populated, and local law enforcement agencies find themselves unprepared to handle the growing drug problem in their communities.

*Company Profiles: Eagle Ford Oil & Gas Corp* Springer Science & Business Media

The horizontal well with multiple transverse fractures has proven to be an effective strategy for shale gas reservoir exploitation. Some operators are successfully producing shale oil using the same strategy. Due to its higher viscosity and eventual 2-phase flow conditions when the formation pressure drops below the oil bubble point pressure, shale oil is likely to be limited to lower recovery efficiency than shale gas. However, the recently discovered Eagle Ford shale formations is significantly over pressured, and initial formation pressure is well above the bubble point pressure in the oil window. This, coupled with successful hydraulic fracturing methodologies, is leading to commercial wells. This study evaluates the recovery potential for oil produced both above and below the bubble point pressure from very low

permeability unconventional shale oil formations. We explain how the Eagle Ford shale is different from other shales such as the Barnett and others. Although, Eagle Ford shale produces oil, condensate and dry gas in different areas, our study focuses in the oil window of the Eagle Ford shale. We used the logarithmically gridded locally refined gridding scheme to properly model the flow in the hydraulic fracture, the flow from the fracture to the matrix and the flow in the matrix. The steep pressure and saturation changes near the hydraulic fractures are captured using this gridding scheme. We compare the modeled production of shale oil from the very low permeability reservoir to conventional reservoir flow behavior. We show how production behavior and recovery of oil from the low permeability shale formation is a function of the rock properties, formation fluid properties and the fracturing operations. The sensitivity studies illustrate the important parameters affecting shale oil production performance from the stimulated reservoir volume. The parameters studied in our work includes fracture spacing, fracture half-length, rock compressibility, critical gas saturation (for 2 phase flow below the bubble point of oil), flowing bottom-hole pressure, hydraulic fracture conductivity, and matrix permeability. The sensitivity studies show that placing fractures closely, increasing the fracture half-length, making higher conductive fractures leads to higher recovery of oil. Also, the thesis stresses the need to carry out the core analysis and other reservoir studies to capture the important rock and fluid parameters like the rock permeability and the critical gas saturation.

*Shale Oil and Gas Production Processes* Springer

Shale Oil and Gas Production Processes delivers the basics on current production technologies and the processing and refining of shale oil. Starting with the potential of formations and then proceeding to production and completion, this foundational resource also dives into the chemical and physical nature of the precursor of oil shale, kerogen, to help users understand and optimize its properties in shale. Rounding out with reporting, in situ retorting, refining and environmental aspects, this book gives engineers and managers a strong starting point on how to manage the challenges and processes necessary for the further development of these complex resources. Helps readers grasp current research on production from shale formations, including

properties and composition. Fill in the gaps between research and practical application, including discussions of existing literature. Includes a glossary to help readers fully understand key concepts. *Reckless Endangerment While Fracking the Eagle Ford Gulf* Professional Publishing

Fracking - hydraulic fracturing of porous rock to enhance the extraction of fossil fuels - was first attempted in the mid-20th century, but has only recently been adopted as a viable source of hydrocarbons. This volume in the Issues series examines the technology, and its potential environmental implications.

**Mineralogical and Geochemical Assessment of the Eagle Ford Shale** Routledge

List of members in each volume.

*Hydraulic Fracture Modeling* Springer Nature

The Eagle Ford shale of South Texas has become one of the most active and most important shale plays in the U.S. This success has been possible because of the unique geology and richness of the play, allowing significant production of natural gas, condensate liquids, and oil; the rapid improvement of long horizontal lateral drilling and multi-stage hydraulic fracturing completion technologies; and a long-term period of sustained high oil prices. This study develops a probabilistic before-tax economic model to estimate the reserves of the Eagle Ford shale, under different stochastic parameters and scenarios usually not considered by evaluators. The model is used to assess impact and sensitivity on reserves and economic yardsticks considering the variability and uncertainty of project inputs such as production streams, commodity prices, capital investments, and operational costs. We use existing probabilistic methodologies for production and price forecasting and use public and private sources to develop statistical distributions for additional parameters, including differentials for commodity prices, natural gas content for the different production regions, and water/gas and water/oil ratios. We consider three evaluation scenarios-single-well, 100-well, and Full-well-in each of the proposed production regions of the Eagle Ford shale, with calibrated probabilistic inputs for each region. Single-well results show how it is hard to produce complete distributions of reserves all across the play, although production regions with better productivity are identified. Results from the scenarios with multiple wells, show how the commerciality of the considered development projects is

achievable in liquid-rich production regions and with moderate to high price forecasts. This study provides useful information and results to oil and gas professionals about key areas that influence the commercial development of Eagle Ford shale. The methodology to perform evaluations with probabilistic components enables better project development and investment decisions and can be applied to other shale plays. The electronic version of this dissertation is accessible from <http://hdl.handle.net/1969.1/151888>

*The Entrepreneurial Spirit of Aggeland* CRC Press

Developing long-term forecasts for unconventional oil, gas and condensate production have challenged both analysts and academics because the shale revolution is still in its relatively early stages. In this paper, forecast accuracy using limited data of oil and condensate production in the Eagle Ford has been improved using a Bass Diffusion Model that could be applicable to other shale field developments in the U.S., and eventually in other countries as well. Using only preliminary production data from 2006 through 2010, a Bass Model yields more accurate early predictions than more conventional, bottom-up, data/labor-intensive ordinary least squares (OLS) regression approaches. Further, the Bass Model suggests somewhat surprisingly that Eagle Ford oil and condensate production could reach as high as 2.6 million barrels per day by 2020, significantly above a recent analyst prediction of 2 million barrels, and far higher than the OLS regression forecasts ranging from between 450,000 and 1.4 million barrels per day.

*Application of the Bass Model to Unconventional Oil Production* Gulf Professional Publishing

This book addresses the need for deeper understanding of regulatory and policy regimes around the world in relation to the use of water for the production of 'unconventional' hydrocarbons, including shale gas, coal bed methane and tight oil, through hydraulic fracturing. Legal, policy, political and regulatory issues surrounding the use of water for hydraulic fracturing are present at every stage of operations. Operators and regulators must understand the legal, political and hydrological contexts of their surroundings, procure water for use in the fracturing and extraction processes, gain community cooperation or confront social resistance around water, collect flow back and produced water, and dispose of these wastewaters safely. By analysing and

comparing different approaches to these issues from around the globe, this volume gleans insights into how policy, best practices and regulation may be developed to advance the interests of all stakeholders. While it is not always possible to easily transfer 'good practice' from one place to another, there is value in examining and understanding the components of different legal and regulatory regimes, as these may assist in the development of better regulatory law and policy for the rapidly growing unconventional energy sector. The book takes an interdisciplinary approach and includes chapters looking at water-energy nexus security in general, along with issue-focused and geographically-focused case studies written by scholars from around the world. Chapter topics, organized in conjunction with the stage of the shale gas production process upon which they touch, include the implications of hydraulic fracturing for agriculture, municipalities, and other stakeholders competing for water supplies; public opinion regarding use of water for hydraulic fracturing; potential conflicts between hydraulic fracturing and water as a human right; prevention of induced seismic activity, and the disposal or recycling of produced water. Several chapters also discuss implications of unconventional energy production for indigenous communities, particularly as regards sustainable water management. This volume will be of interest to scholars and students of energy and water, regulators and policymakers and operators interested in ensuring that they align with emergent best global practice.

#### Peeking at Peak Oil Springer

Natural gas and crude oil production from hydrocarbon rich deep shale formations is one of the most quickly expanding trends in domestic oil and gas exploration. Vast new natural gas and oil resources are being discovered every year across North America and one of those new resources comes from the development of deep shale formations, typically located many thousands of feet below the surface of the Earth in tight, low permeability formations. Deep Shale Oil and Gas provides an introduction to shale gas resources as well as offer a basic understanding of the geomechanical properties of shale, the need for hydraulic fracturing, and an indication of shale gas processing. The book also examines the issues regarding the nature of shale gas development, the potential environmental impacts, and the ability of the current regulatory structure to deal with these issues. Deep

Shale Oil and Gas delivers a useful reference that today's petroleum and natural gas engineer can use to make informed decisions about meeting and managing the challenges they may face in the development of these resources. Clarifies all the basic information needed to quickly understand today's deeper shale oil and gas industry, horizontal drilling, fracture fluids chemicals needed, and completions Addresses critical coverage on water treatment in shale, and important and evolving technology Practical handbook with real-world case shale plays discussed, especially the up-and-coming deeper areas of shale development *Regulating Water Security in Unconventional Oil and Gas* Gulf Professional Publishing

As the shale revolution continues in North America, unconventional resource markets are emerging on every continent. In the next eight to ten years, more than 100,000 wells and one- to two-million hydraulic fracturing stages could be executed, resulting in close to one trillion dollars in industry spending. This growth has prompted professionals ex **Disruptive Oil and Gas in the Eagle Ford Shale** University of Texas Press

The Eagle Ford play in south Texas is currently one of the hottest plays in the United States. In 2012, the average Eagle Ford rig count (269 rigs) was 15% of the total US rig count. Assessment of the oil and gas resources and their associated uncertainties in the early stages is critical for optimal development. The objectives of my research were to develop a probabilistic methodology that can reliably quantify the reserves and resources uncertainties in unconventional oil and gas plays, and to assess Eagle Ford shale oil and gas reserves, contingent resources, and prospective resources. I first developed a Bayesian methodology to generate probabilistic decline curves using Markov Chain Monte Carlo (MCMC) that can quantify the reserves and resources uncertainties in unconventional oil and gas plays. I then divided the Eagle Ford play from the Sligo Shelf Margin to the San Macros Arch into 8 different production regions based on fluid type, performance and geology. I used a combination of the Duong model switching to the Arps model with  $b = 0.3$  at the minimum decline rate to model the linear flow to boundary-dominated flow behavior often observed in shale plays. Cumulative production after 20 years predicted from Monte Carlo simulation combined with reservoir simulation was used as prior information in the

Bayesian decline-curve methodology. Probabilistic type decline curves for oil and gas were then generated for all production regions. The wells were aggregated probabilistically within each production region and arithmetically between production regions. The total oil reserves and resources range from a P90 of 5.3 to P10 of 28.7 billion barrels of oil (BBO), with a P50 of 11.7 BBO; the total gas reserves and resources range from a P90 of 53.4 to P10 of 313.5 trillion cubic feet (TCF), with a P50 of 121.7 TCF. These reserves and resources estimates are much higher than the U.S. Energy Information Administration's 2011 recoverable resource estimates of 3.35 BBO and 21 TCF. The results of this study provide a critical update on the reserves and resources estimates and their associated uncertainties for the Eagle Ford shale formation of South Texas. The electronic version of this dissertation is accessible from <http://hdl.handle.net/1969.1/151324>

#### Bulletin

A book unlike any other Aggie-related publication, *The Entrepreneurial Spirit of Aggieland* details the insightful, fascinating and inspirational stories of twelve Aggies who've chased their entrepreneurial dreams, conquered obstacles and succeeded beyond their wildest imaginations. Their stories will serve as a roadmap to success for current and former Texas A&M students with their own entrepreneurial dreams, as each first-person narrative features advice to aspiring entrepreneurs. These innovators have walked the Texas A&M campus and achieved tremendous success, and they each believe you can, too! Every penny of proceeds from book sales will be donated to Startup Aggieland, a multidisciplinary business incubator and accelerator devoted to helping current Aggies pursue their dreams. This is truly a one-of-a-kind book designed to propel current and former students to reach their entrepreneurial goals!

#### **Economic Impact of the Eagle Ford Shale**

With the emergence of liquid rich shale (LRS) plays like Eagle Ford and Northern Barnett, the petroleum industry needs a simple, easily applied technique that provides reliable estimates of future production rates in this kind of reservoir. There is no guarantee that methodology that has proved to work in gas reservoirs will necessarily be appropriate in LRS reservoirs. In this work, we found that without corrections of early data, the Stretched Exponential Production Decline (SEPD) model, designed for

transient flow, usually produces pessimistic forecasts of future production. The Duong method, another transient model, may be reasonable during long term transient linear flow, but notably optimistic after boundary-dominated flow (BDF) appears. For wells in BDF, the Arps model provides reasonable forecasts, but the Arps model may not be accurate when applied to transient data. A hybrid of early transient and later BDF models proves to be a reasonable solution to the forecasting problem in LRS. In addition, use of diagnostic plots (like log-log rate-time and log-log rate-material balance time plots) improves confidence in flow regime identification and production forecasting. In some LRS's, BDF is observed within 12 months. In any case, it is essential to identify or to estimate the time to reach BDF and to discontinue use of transient flow models after BDF appears or is expected. We validated our methodology using "hindcast analysis"; that is, matching the first half of production history to determine model parameters, then forecasting the second half of history and comparing to observed production data. We also found that application of pressure-corrected rates in decline curve analysis (DCA) may substantially improve the interpretation of data from unconventional oil wells flowing under unstable operating conditions. Fetkovich (hydraulically fractured well) type curve analysis can be added to improve confidence in flow regime identification from diagnostic plots and to estimate the Arps hyperbolic exponent  $b$  from the matching  $b$  stem on the type curve, which can then be extrapolated to determine estimated ultimate recovery. The electronic version of this dissertation is accessible from <http://hdl.handle.net/1969.1/152507>

#### *Drugs and Oil Flow Through the Eagle Ford Shale*

This book discusses the economic, political, and environmental issues surrounding the international exploration and exploitation of conventional and unconventional natural gas. Shale gas development in recent years has changed the energy discussion in the US as existing reserves of natural gas coupled with horizontal drilling and hydraulic fracturing make exploitation of these reserves economically feasible; the discussion is quickly becoming international in scope. The potential expansion of natural gas development impacts many regions of the globe and spans multiple perspectives. In a volatile international climate, one of intense geopolitical conflict between Russia and the West, economic slowdowns in Europe and China, military conflicts in the

Middle East and northern Africa, and widening income disparity in the U.S., a relatively inexpensive and plentiful energy source like shale gas could play a key role in mitigating such conflicts. In an energy interdependent global community, however, multiple factors such as oil prices, differing rates of exploration, environmental concerns, strategic initiatives, institutional changes, legal and regulatory issues, and actions of the nations involved all have the potential to influence future outcomes. This book discusses each of these in turn, detailing the issues most prevalent in each geographical area. The first volume to provide a comprehensive global view of the impacts of shale gas development, this book fills a gap in the current research literature, providing vital information for the scholarly community and the public alike. This book will be of interest to researchers and students of economics, energy policy, public administration, and international relations as well as policy makers and residents of the regions that are experiencing shale gas development. *Impacts from Above-ground Activities in the Eagle Ford Shale Play on Landscapes and Hydrologic Flows, La Salle County, Texas* Unconventional resources, particularly shale reservoirs, are a significant component in oil and gas production in the United States as they represent (as of May 2015) 48 and 58 percent, respectively, of the total oil and gas produced. However, there has been a deceleration on oil and gas production in general because of low market prices. The drastic decline in oil and gas prices that started in 2014 has companies struggling to continue their operations, resulting in negative financial outcomes for 2015 for most companies. The present work examines the financial results of three companies, EOG Resources, Pioneer Natural Resources, and Chesapeake Energy, along with their particular well productivity using the Logistic Growth model to forecast production in one of the most prolific shale plays in the United States, the Eagle Ford. This work also examines the economic feasibility of drilling new wells when oil prices are low using a discounted cash flow model for each company. The financial analysis shows that from the three companies, Pioneer Natural Resources has the best financial results; its high cash-flow-to-debt ratio, and low debt and debt-to-equity ratios make it an attractive company to invest in. In contrast, Chesapeake has the worst results which represents high risk for investors, and EOG has moderate results that still make it a good company to invest in.

The discounted cash flow model demonstrate that under the cost assumptions and estimated production used in this work, EOG gets the best results from their wells located in the Eagle Ford with break-even prices bordering the 40 \$/bbl compared to the other companies with break-even prices above 87 \$/bbl for Pioneer and 89 \$/bbl for Chesapeake. From the discounted cash flow model, it can also be concluded that none of the companies in the analysis is expected to gain revenue from drilling new wells if oil prices are under 40 \$/bbl, and that companies that are quick to respond to the low prices by reducing their drilling and completion costs can significantly improve their well economics.

#### **Where Texas Meets the Sea**

We report that porosity and permeability are key variables that link the thermal-hydrologic, geomechanical and geochemical behavior in rock systems and are thus important input parameters for transport models. Recent neutron scattering studies have indicated that the scales of pore sizes in rocks extend over many orders of magnitude from nanometer pores with huge amounts of total surface area to large open fracture systems (multiscale porosity, cf. Anovitz et al., 2009, 2011, 2013a, b, Wang et al., 2013; Swift et al., in press). However, despite considerable effort combining conventional petrophysics, neutron scattering and electron microscopy, the quantitative nature of this porosity in tight gas shales, especially at smaller scales and over larger rock volumes, remains largely unknown (Clarkson, 2011). Nor is it well understood how porosity is affected by regional variation, thermal changes across the oil window and, most critically, hydraulic fracturing operations. To begin providing this understanding we have used a combination of small and ultrasmall angle neutron scattering from the GP-SANS instrument at ORNL/HFIR, and the NG3-SANS (Glinka et al., 1998) and BT5-USANS instruments at NIST/NCNR (Barker et al., 2005), with SEM/BSE imaging to analyze the pore structure of clay and carbonate-rich samples of the Eagle Ford Shale. The Eagle Ford Shale is a late Cretaceous unit underlying much of southeast Texas and probably adjacent sections of Mexico. It outcrops in an arc from north of Austin, through San Antonio and then west towards Kinney County. It is hydrocarbon rich, straddles the oil window, and is one of the most actively drilled oil and gas targets in the US. The first successful horizontal well was drilled in 2008, and 2522 permits were recorded by Sept 1, 2011. While the oil

and gas reserves in the Eagle Ford have been known since the 1970's, prior to the invention of horizontal drilling/hydraulic fracturing it was not considered economic. Several important trends in the rock pore structure have been identified using our approach. Pore distributions are clearly fractal but, as was observed for the St. Peter sandstone (Anovitz et al., 2013a), are composed of several size distributions. Initial porosity is strongly anisotropic, as expected for shale. However, this decreases for shale, and disappears for carbonates with maturity. In both cases significant reduction occurs in total porosity, with most of the change coming at the finest scales (

*Deep Shale Oil and Gas*

The term "Peak Oil" was born in January 2001 when Colin

Campbell formed the Association for the Study of Peak Oil & Gas (ASPO). Now, Peak Oil is used thousands of times a day by journalists, politicians, industry leaders, economists, scientists and countless others around the globe. Peak Oil is not the end of oil but it tells us the end is in sight. Anyone interested in food production, economic growth, climate change or global security needs to understand this new reality. In *Peeking at Peak Oil* Professor Kjell Aleklett, President of ASPO International and head of the world's leading research group on Peak Oil, describes the decade-long journey of Peak Oil from extremist fringe theory to today's accepted fact: Global oil production is entering terminal decline. He explains everything you need to know about Peak Oil and its world-changing consequences from an insider's

perspective. In simple steps, Kjell tells us how oil is formed, discovered and produced. He uses science to reveal the errors and deceit of national and international oil authorities, companies and governments too terrified to admit the truth. He describes his personal involvement in the intrigues of the past decade. What happens when a handful of giant oil fields containing two thirds of our planet's oil become depleted? Will major oil consumers such as the EU and US face rationing within a decade? Will oil producing nations conserve their own oil when they realize that no one can export oil to them in the future? Does Peak Oil mean Peak Economic Growth? If you want to know the real story about energy today and what the future has in store, then you need to be "Peeking at Peak Oil".