BOOK REVIEWS

Petroleum Resource Management, How Governments Manage Their Offshore Petroleum Resources**,** by John A. P. Chandler (Edward Elgar Publishing, 2018). 321 pages, eISBN: 978 1 78643 221 6; ISBN: 978 1 78643 220 9.

With the author's four decades of experience practicing law relating to mining and petroleum development, this text is a well-researched and detailed comparison of offshore petroleum leasing systems. The stated objectives "include identifying common features, strengths, and weaknesses" of the offshore petroleum management systems in Australia, Norway, and the UK. All three countries issued their first licenses in the 1960s, before it was known if there were commercial quantities of petroleum (oil and natural gas), and there were no relevant comprehensive regulatory leasing models for offshore development. Other similarities in the three countries include the evolution of their regulatory systems as the industry and regulatory theory has evolved. The most recent challenges for all three include attracting investment in mature basins while protecting the environment, ensuring good stewardship of their resources, and maintaining social acceptance of oil and gas exploitation while transitioning to a low-carbon future.

Each of the countries has conducted recent studies relating to difficulties in oil and gas production, which are well-described and referenced throughout the book. Each also has a single statute governing their offshore licensing system with the most recent renditions of these statutes being Australia's Offshore Petroleum Greenhous Gas and Storage Act 2006, Norway's Petroleum Act 1996, and the UK's Petroleum Act of 1988. These acts and all major provision of each country's governance system for conventional offshore oil except decommissioning are covered in the text.

Chapter 2 contains an overview of provisions for licensing systems in general as well as more particularly those in Australia, Norway, and the UK. Typically coastal countries claim undersea mineral resources within 200 nautical miles of their continental shelves. If countries do not have a national oil company, they prefer licensing systems, where the state relies on the private sector to explore and develop its resources and does not put its own capital at risk. The state identifies regions to lease and develops criteria and procedure for awarding and supervising licenses. Throughout the book, the author emphasizes that in developing successful procedures to attract capital, the license rewards must be commensurate with the risks. In addition, government resource managers need to take into account the interdependencies that can exist if one pool crosses lease boundaries. In such a case, the state would want to take advantage of any economies of scale that might be derived by cooperation across leases and also to prevent any inefficiencies in the production profile that might arise from the law of capture. Lastly, geological information increases as more work is done on leases. The state should consider ways to access and use this information for better resource management.

Chapter 3 deals with regulatory structures and regulators divided into: (1) commercial tasks and (2) regulations for protection of workers, the public, and the environment. To avoid conflict of interest, these functions are typically done by different regulators, and the chapter outlines who has these responsibilities in the three countries and how their thinking has changed over time. With the accumulation of high profile offshore petroleum accidents and increased environmental awareness, the weights accorded to regulatory protection has increased. As regulatory theory has changed, there has also been a push to improve regulatory function by making regulators independent from policy makers and giving them clear roles and objectives. In discussing governance, the author stresses regulatory theory on the importance of accountability, transparency, clarity of authority, and the resources needed for good governance or stewardship of the state's resources – geological information

and skilled regulators appropriately resourced. He lays out the general power of resource regulators along with legislative, institutional, and regulatory style across the countries.

Chapter 4 moves from the government regulators to a discussion of oil companies including three categories– the privately-owned international oil companies (IOCs), the government-owned national oil companies (NOCs), and a hybrid with government and private ownership called government sponsored companies (GSE). The author outlines a little history for these categories, some of their differences, interactions, and changing roles. He brings out the distinction between operators and non-operators in joint ventures and notes that participants in joint ventures may have incompatible goals.

In this chapter, I especially liked the research on annual reports and government documents in eight of the largest IOCs relating to their strategies for exploration and production, downstream operations, alternative energy, as well as reporting on sustainability and social responsibility. None of these companies disputed that we are experiencing climate changes, but they varied in how they are responding.

Chapter 5, "resource rent, value, and stewardship," considers how governments extract value from leasing their offshore assets and how they ensure proper company operating standards. Often maximizing resource value is equated with maximizing resource rents and the author includes a brief discussion of rents with some comparison of the properties of cash bidding (reintroduced recently in Australia), work bidding and various other taxes. For examples, taxes on production put more risk on producers, with profit taxes governments share more risk, whereas corporate taxes with interest deduction favor debt financing.

All three countries rely mainly on their tax systems (mostly separate from their regulatory and resource management agencies) to extract value from their resources. They all include the standard corporate income tax with another secondary tax relating especially to petroleum. The chapter contains detail on the provisions in the various tax regimes. There are nice discussions on the difference between maximizing cumulative production and maximizing economic value, tensions that can arise between governments (focusing on social welfare, intergeneration equity and overall project value) and companies (focusing on profits from their specific lease). Here the author notes that the UK principle of maximizing economic recovery might provide a clear objective to unify decisions across government organizations and the licensees over the lifecycle of the project.

Chapter 6 continues the discussion and comparison of good stewardship relating to economic recovery and good oilfield practice. All three countries require a field development plan unless a lease is relinquished. Australia cites an engineering policy target of development adhering to good oilfield practice. The UK's focus on maximizing economic recovery also mentions good oil field practice, whereas Norway has a more general term called prudent production guided by maximizing benefit to Norwegian society. In managing waste, Norway and the UK are more advanced in promoting field unitization than Australia.

Given the U.S. importance in the petroleum industry and its companies' global reach, the author traces U.S. legal history relating to conservation and the implied rules embedded in its oil and gas leases. Petroleum regulation was largely at the state level and related to physical surface waste, underground waste, and economic waste. Lease provisions focused on protecting the royalty streams of resource owners. The author also notes that what constitutes good field practice changes over time and cites some standard sources for such practices.

Chapter 7 focuses on the diversity and changes in resource management policy to develop a continuous stream of new projects that provide a financial return. How this is done has varied by country and has changed over time, with these variations affecting the relationships between licensees and the state. Australia and the UK have smaller oil and gas industries relative to GDP and are relatively laissez faire. Australia has had to wrestle with the tensions between the Federal and state or territorial government, and the author gives them the lowest marks for their resource policy. Australia's overriding principles have failed to clearly include economic principles or man-

age infrastructure issues across leases. Recent reforms in the UK have strengthened regulatory capabilities and economic guiding principles. Norwegian regulators have the best resources, with the state exerting significant influence in all phases of development including coordination across leases requiring unitization and the sharing of infrastructure. Their three guiding principles are exclusive state control to manage their resources, maximizing social benefits, and their prudent production principle. The author gives Norway the highest marks for resource policy and stewardship from these principles and their implementation.

Chapter 8 contains a digression on production sharing contracts (PSCs). They started in Bolivia and spread as a way for oil producing countries to maintain ownership of their resource while contracting with private capital for the exclusive rights to explore and develop these resources. Typically, the IOC takes on the upfront capital risk, gets paid back for capital from early production according to some prescribed formula, and after payback receives a share of the production. The NOC, sometimes on a committee with contractor representation, usually provides management oversight and approval. Since PSCs are often negotiated on a project basis, they tend to be less transparent. The author cites a number of more detailed varying provisions in different countries including Angola, Brazil, Ghana, Indonesia, and Malaysia. From interviews, he did not conclude that PSCs dominated leasing in two important management criteria – unitization and the sharing of infrastructure.

Chapter 9 addresses exploration. It has a fair amount of detail on the different procedures, strategies, policy documents, terms of the licenses, information requirements and their confidentiality protection by country, and indicates how Norway and the UK are bound by EU directives. The government releases acreage for bidding and provides seismic and other information on the prospective property. Applicants provide information on their technical capabilities, exploration approach, and amount of work proposed. In evaluating proposals, Australia puts the most focus on proposed work, whereas Norway puts the least. This focus may distort incentives because winning bidders may propose more work than is optimal and thereby dissipate some of the rent. Norway favors faster development in mature areas but a slower approach to gather information in frontier areas. Norway puts more emphasis on the technical capabilities and strategy of the applicants and may negotiate the work program and invite companies to form groups that optimize exploitation of their resources. Norway has more frontier prospects and has been more successful at maintaining a constant stream of exploration and development. The UK wants a balanced portfolio of mature and frontier areas,

Chapter 10 compares development management. Each of the countries requires field development plans and the chapter details the data requirements, provides references for guidelines and the level of government discretion in accepting and the review process if companies want to change plans. Australia and Norway have longer and more detailed documents than the UK. Norway and the UK have moved in the direction of putting stronger emphasis on the national welfare when approving such plans and both have requirements to provide economic and financial data with incentives for joint developments and unitization, whereas Australia's process is deficient in these areas.

Chapter 11 discusses issues relating to production. Often initial production plans are approved with the field development plan including initial commitments for facilities, wells, and plans for improved or enhanced recovery. Governments have the authority to increase or decrease production and this chapter considers how these governments set initial and subsequent production rates, how they review licensees performance and enforce compliance with license requirements, and gives examples of externalities where markets are likely to fail and governments might step in to improve welfare.

In Australia, the regulators have neither the skill, resources, or mandate to conduct regular comprehensive production performance reviews but are to be informed of development and production operations and can give advice and recommendations relating to the mandate of enforcing good oilfield practices. Norwegian regulators are in a much stronger position with stronger skills and more resources. They are able to sit in on joint venture meetings and receive regular reports and

have conducted reviews in conjunction with industry on how to improve field performance. The UK conducts an annual review of production efficiency. With its emphasis on maximum economically recovered reserves, it has taken a looser approach to regulation than Norway, but it has a stewardship strategy and an interesting program of collecting survey data with anonymous benchmarking for company efficiency in production and recovery as well as costs of operating and decommissioning. Enforcement authority in each country ranges in severity from informing the lessees of non-compliance, engaging with the lessees to resolve non-compliance issues, levying fines, up to revocation of licenses.

Chapter 12 defines infrastructure and gives examples that can be divided into pipelines and other facilities. Often economies of scale would dictate the sharing of pipelines from the government point of view, but tensions for sharing can arise between existing pipeline owners and new project developers. Governments can leave this problem up to producers to sort out as is more the case in Australia or can be more proactive. In large enough systems, governments wanting to improve efficiency, increase competition and reduce monopoly profits may require open access for critical infrastructure with an independent operator as is the case for Norway's offshore natural gas export pipeline system. The author considers general legislation in the EU and Australia for open access and how these have informed and influenced management of offshore resources. Both the UK and Norway require consideration of infrastructure in the licensing process and provide mechanisms to mediate negotiations between owners and those requesting pipeline access.

Chapter 13 sums up lessons learned and speculates on the future of offshore petroleum resource management. In looking forward, Chandler reiterates that licenses are a bargain between the state and the lessees that need to balance profitability and risk, then concludes that states should provide regulatory clarity and stability, states should determine important risk with appropriate designation of responsibility and mitigation plans, and states need good governance structure, well resourced regulators, and channels for communication and dispute resolution across stake holders.

All three countries have evolved along different paths in managing their petroleum resources. The author has consulted and referenced numerous government reports, legislation, the media, company reports, academics and personal interviews to provide an unusual level of detail on how these paths have evolved. The level of detail and redundancy will provide a wealth of material to others intimately involved in new petroleum provinces or leasing regimes including lawyers, regulators, policy makers, and academics. Others such as myself more broadly interested in petroleum markets or regulation of natural resources appreciate less the wealth of detail but favor the higher level discussion on offshore research management and regulation. I found the case of Australia with the tensions across state and federal jurisdictions interesting and hope the author will turn his analytic skills and expertise into a comparison of the Australian and U.S. offshore cases.

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Energy Economics, by Peter Schwarz (Routledge, New York, 2018), 432 pages, ISBN 978-415-67677-9.

Energy garners much attention and controversy. It is at the center of the climate debate. We worry about what it costs, whether it will be available, and whether there will be global access. This book, billed as a textbook, draws motivation from current events, the popular press, and views from non-economists as it strives to show how economics can improve our thinking about all such energy-related issues. The author is a full Professor of Economics and an Associate of the Energy Policy and Infrastucture Center at the University of North Carolina Charlotte. He has a long experience in energy issues and his research has appeared in many leading journals, including *The Energy Journal, The American Economic Review,* and *The Rand Journal of Economics.*

Schwarz's book has five sections relating to: Fundamentals of Energy Economics, Conventional Energy Sources, Alternative Energy Sources, Electricity Regulation and Restructuring, and Energy Policy. After an introductory chapter, the focus in the other three chapters on fundamentals is on economic efficiency. Chapter 2 provides a verbal description of static efficiency, market failure, and trade-offs between efficiency, equity, and sutainability. Chapter 3 uses basic micro tools--supply, demand, consumer and producer surplus, isoquants, cost curves--with algebraic and graphical anlysis (and some calculus in an appendix) to think about static market efficiency and losses that could arise from monopoly, public goods, externalities, and subsidies. Readers with a grasp of intermediate economics will find this chapter a refresher with energy examples. Readers with less background will need to spend more effort on these basic tools.

One of the strengths of the book is its treatment of dynamic efficiency in Chapter 4. Using graphical and algebraic analysis, the author shows dynamic efficiency in a Hotelling framework. Readers of this section will gain a solid grasp of why the prices of commodities that are truly fixed in supply will rise over time. Also included is how monopoly, deviation between private and social discount rates, and changes in demand, interest rates, backstop technology, and reserves can be fit into the model. The chapter does not go beyond the basic Hotelling framework to show how a continuous increase in the economically recoverable portion of the resource base can mitigate the effect of resource depletion. There is also no discussion of whether the historical data supports the Hotelling view of long-term oil supply

In Section II on conventional energy sources, there are chapters on oil, natural gas, coal, and nuclear. Each contains a brief economic history of the fuel, production, consumption, relevant environmental issues as well topics that vary by fuel (e.g. oil (cartels, futures and options); natural gas (levelized cost, price regulation); coal (cost by sector to generate electricity); nuclear (levelized cost, waste disposal, terrorist threats).

In Section III, the author turns to alternatives for conventional energy sources. Chapter 9 contains discussion on the advantages of nondispatchable renewables (solar and wind), government support policies (e.g.feed-in-tariffs, renewable portfolio standards, net metering), levelized costs, and barriers to their acceptance. It also touches on some of these same issues for hydropower and geothermal. The chapter could benefit from some discussion of an all renewable world. For example, Jacobson et al. (2015) believe that 100 % reliance on renewable energy is feasible with today's technologies, while others such as Clack et al. (2017) believe otherwise.

Chapter 10 introduces a range of possible next generations energy sources including hydrogen vehicles, improved solar, wind, nuclear, and battery technologies, cellulosic biofuels, nuclear fusion, tidal power, fuel cells, and continuing with fossil fuels but using carbon capture and sequestration. Somewhat surprisingly there is no mention of electric vehicles. The author notes that most of these technologies are unlikely to be adopted without a price on carbon. A nice addition to this chapter would be some inclusion of what we know about the current levelized costs for these alternative technologies.

Energy efficiency is another source of increased energy services, and as noted by the author in Chapter 11, it is considered by many to be the cheapest source. The chapter includes a discussion of energy efficiency versus energy intensity and the difference between energy and economic efficiency. Isoquants and indifference curves are used to analyze the possible effect on energy efficiency on industry and non-industry consumption. The author considers standard reasons why energy efficicncy might not be invested in even if it is cheaper (e.g. high discount rates, bounded rationality, principal-agent problems) or perhaps efficiency really is not cheaper (e.g. more efficient might be attached to poorer quality, or the efficiency savings might not be worth the effort to find and implement them). He compares mandatory and voluntary efficiency standards and notes how improved efficiency that makes energy services cheaper might lead to a rebound effect with some of the fuel saving offset by more consumption of the energy service. Why economists typically favor cap and trade or energy taxes over standards is alluded to, but would benefit from more analytical support.

Section IV has two chapters focused on electricity. Chapter 12 considers the traditional view of the electricity sector as a regulated natural monopoly and heavily draws on the U.S. experience. There is a brief history of the industry and its evolution out of whale oil and kerosene. Global trends are touched upon. The electricity supply chain, consuming sectors, rate classes, and rate of return regulation and issues are presented along with some alternative forms of regulation (e.g marginal cost pricing, peak load pricing, and incentive regulation).

Chapter 13 contains newer views and experiments on electricity deregulation and restructuring, including some of the legislative and structural changes. It briefly considers the UK case. In its early years of restructuring, the UK market was still rather concentrated. The author uses the Cournot, Bertrand, and a 2x2 game theory model as analytical tools. The U.S. has seen regulatory changes at the federal level as is touched upon with regional examples including California, Texas, and PJM (originally Pennsylvania, New Jersey and Maryland but now covering 13 states and the District of Columbia).

The book is rounded out by the remaining 4 chapters in Section V named "Policy." Chapter 14 considers energy and the environment with a short discussion on the growth of the environmental movement, examples of energy externalites (oil spills, NOx, SOx, acid rain, and mercury) and examples of environmental legislation. It touches on a number of topical issues including zero emission vehicles (are they really?) hydralulic fracturing, blue skies over Beijing, nuclear waste disposal, and carbon trading. There is the acknowledgement that economists tend to prefer incentive-based regulation although there may be situations where command and control is more suitable (e.g. toxic waste).

Chapter 15 begins with some of definitions and ethical views on sustainability. Growing world energy consumption has been supplied at relatively low fossil prices, but with stresses on the biosystem. For future possibilities the author returns to themes encountered elsewhere in the book – renewable energy sources, carbon capture and sequestration, energy efficiency and policies that may move us in that directon – feed-in-tarifs, renewable portfolio standards.

As with sustainability, there is some confusion about what is meant by energy security but typically energy insecurity involves quantity disruption (accidential or deliberate), or price spikes, or both. In Chapter 16, the author explores definitions of energy security including some of the economic, environmental, social, and political aspects. It traces some crises, mostly oil and the responses (e.g. the Arab oil embargo of 1973 and the Strategic Petroleum Reserves, the Gulf War in 1990 and military costs, causes of the oil price spike of 2008 and oil price volatility thereafter, and the 2003 Northeast U. S. electricity blackout). It suggests some current issues of concern including natural gas accidents, extreme weather events resulting from climate changes that distrupt supply, nuclear accidents, measuring electricity outage costs using value of lost load, and the use of microgrids and the smart grid as potential alternatives in replacing aging electricity infrastructure.

The concluding chapter argues that energy policy has largely been conducted piecemeal, market by market, crisis by crisis. A first-best solution would be to consider a holistic approach that gets the prices right for both the goods and the bads in these markets. If first-best is unobtainable, second-best polices may have to suffice. It reiterates economist's preference for incentive based programs (taxes and trading) over command and control (e.g. fuel efficiency standards, requiring certain technologies). It considers important U.S. policies by major sector (transportation, electric utilities, commercial buildings, residential buildings) and discusses whether the policies are first or second best.

Schwarz's book essentially presumes that the reader has a basic understanding of economics, preferably through an intermediate level with little knowledge of energy issues. A strength of the book is the wide use of real world energy issues and studies to motivate the use of economic tools. Such issues sprinkled liberally throughout the book often in separate boxes should be highly motivational for readers of the book, might also be of interest to more general readers, and could provide useful examples to instructors of other more general courses in micro, regulation, environmental

economics, policy, political economy, and even more advanced courses in energy economics. The breath of issues in energy economics is also impressive. Since the cost of this breath is sometimes a failure to clearly connect the models presented with the real world problems, instructors using this text would want to fill in any missing links.

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Energy Economics: Theory and Applications**,** by Peter Zweifel, Aaron Praktiknjo, and Georg Erdmann (Springer 2017) 324 pages, ISBN 2192-4333. Hardback

This book provides a broad approach to energy economics that, while theoretically based, focuses on empirical results. The first seven chapters of the book focus on background and basic models and theory, while the rest of the book focuses on specific energy markets. The approach was one that intrigued me as a potential text for graduate level energy economics courses.

The background section of the book begins with a philosophical and historical perspective of energy, including a brief overview of the evolving relationship between civilization, the use of energy, as well as the more recent considerations of ethics and social justice associated with energy consumption. This provides the cornerstone for the study of energy from an economic perspective and a brief introduction into the concept of energy markets, price formation, market failure and intervening policies.

Chapter 2 provides an introduction to energy from the natural sciences perspective, including a presentation of useful conversions and energy units, and linkages to energy markets. Chapter 3 focuses on the time value of money, capital investment, risk, capital asset pricing, and real options. The authors also provide examples from energy markets.

Chapters 4 and 5 provide an overview of bottom-up and top-down energy demand modeling, contrasting the macro and the micro approaches to energy demand modeling. Both chapters provide an overview of the basic formulas that are used to develop the modeling. For example, in the micro, bottom-up approach, a model for appliance stocks is developed and discussed in detail. This is one of the first chapters where the authors attempt to provide both the theoretical background and empirical examples from the literature.

The background and basic models part of the book conclude with chapters 6 and 7 focusing on energy reserves, sustainability, and externalities associated with energy production and consumption. While the chapters provide basic background, with brief presentations of key theories and models appropriate for the topics presented, the presentations are abbreviated, and the topics diverse, which results in chapters that, while they provide a good overview are, at times, disjointed. This results in a background and modeling portion of the book that is a good reference, or a good text for students with a strong microeconomics and resource background, but may be frustrating for those without the appropriate background.

The second half of the book focuses on specific energy markets, including liquids, gases, solids, uranium, and electricity grids. The construction of each chapter depends on the topic. For example, the liquid and gaseous fuels chapters begin with background of the types, properties, and infrastructure, while the solid fuels and the uranium chapters begin with a discussion of technology. This results in chapters that have a very different focus, depending on the topic. While discussion of price formation is a substantial part of the liquid and gaseous fuels chapters, the focus in the solid fuels chapter is on CO2 markets and the focus in the uranium chapter is more on nuclear waste and risk. The electricity grid chapter provides an overview of the integrated industry, as well as a focus on the unique aspects of the electricity market and price formation.

Overall, the chapters in the book are fairly stand-alone, with little integration between. Thus, the background and modeling in the first half of the book is not necessary for considering the specific energy market chapters. For practitioners or students who are looking for stand alone reference chapters on major energy economic topics, this may be a good choice. It will not, nor does it purport to, provide a comprehensive presentation of energy economics, with the important interdependencies between markets. The brevity of the book requires this.

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