BOOK REVIEWS

International Handbook on the Economics of Energy edited by JOANNE EVANS and LESTER C. HUNT (Edward Elgar: Cheltenham, UK Camberley, UK, Northampton, MA, USA. 2009), 848 pages, ISBN 978-1-84720-352-6, Hardcover, Online discount price £166.50.

This impressive *Handbook* admirably justifies its claim to be "a comprehensive review of the economics of energy." The 33 chapters written by acclaimed international experts, both academic and practitioners, span a wide range of key energy topics including history, demand, policy, efficiency, supply, environmental issues, energy-economy interaction modeling, security, taxation, energy-derivative markets, issues relating to individual sources (coal, natural gas, and electricity), energy trading and expectations, regulation, emissions trading, energy in developing countries, and climate change policy.

The book is aimed at last-year undergraduate and post-graduate students and practitioners with a good grounding in economic theory. Many chapters contain a strong theory component applied to energy issues along with an up-to-date survey of empirical work on the issues. I particularly appreciated these chapters as a good way to get up to speed on a particular issue and will use these chapters as references and supplemental reading for my students.

The editors provide a nice overview of each chapter in their introduction, and I follow their lead with summaries and comments on each chapter. Roger Fouquet's chapter (#1) on energy history broadly conveys the evolution of energy use from the agricultural revolution through the industrial revolutions and the switch to fossil fuels. The chapter contains interesting tidbits on the effect of population density, land ownership, and the increasing speed of transition from renewables to fossil fuels that may be relevant to a future transition back to renewables. His graphs of centuries of fossil prices show how cheap fossil fuels have become and help explain our immense dependence on these fuels. This broad overview, including a discussion of 20th century energy policy, is suitable for a general audience.

Thomas Weyman-Jones (#2) begins his chapter on the theory of energy economics with the premise that there is no such commodity as energy, so energy economics is really the economics of fuel markets. He discusses cost-benefit analysis and the efficient allocation of resources for capital-intensive industries as a benchmark for regulators. The chapter contains a good review of optimal-resource allocation, discounting, the social discount rate, and optimal pricing including peak-load pricing. The chapter concentrates on electricity-regulatory issues and also contains a fairly advanced discussion of market structure with small numbers.

Kenneth Medlock (#3) focuses on energy supply. He begins with the classic Hotelling model on optimal allocation of a depletable resource. He notes some of the empirical evidence that shows that the price path predicted by the model has not occurred. He then has a good survey of research that makes the simple model more realistic by including costs as a function of current production and remaining reserves, adding exploration into the model, and allowing for uncertainty. He finishes up with a discussion of peak oil in the context of the issues developed in the chapter.

Richard Gordon (#4) presents a skeptical discussion of energy policy and makes the now well-established distinction between (1) public interest in which the government intervenes in energy markets to right a market failure and (2) public choice in which the government policy makers may be motivated by their self interest rather than the public interest. He stresses U.S. policy missteps including the law of capture, prorationing, the energy-security measures that were gradually unwound in the subsequent decades, and the higher costs of standards-based environment policy and energy efficiency. He rejects the old arguments that energy efficiency will not be undertaken because capital markets don't hedge risk correctly or that energy efficiency will not be undertaken because of imperfect information. He concludes his topics with a discussion of government subsidization of non-competitive coal industries in Europe and elsewhere.

Medlock (#5) returns with a discussion of energy demand starting with review of energy accounting and energy balances that allow tracking energy use. He then discusses the key influences including the capital stock, its fuel efficiency, and energy use per dollar of GDP (energy intensity). Energy intensity tends to increase as countries industrialize but later declines as the industrial sector's share falls and technology improves. A changing economic structure implies that the effect of income increases may be different from that of income decreases because different industries are growing at different rates and some are even shrinking over time. Technological change implies that the later a country develops the lower is its peak intensity. Demand models for the firm are derived from cost minimization and for a household from dynamic utility maximization. He concludes with discussion of demand elasticities and econometric estimation.

David Ryan and André Plourde (#6) continue the discussion on demand. They focus on model development for econometric estimation and trace earlier methods on static demand estimation through lagged-endogenous models or stock-adjustment models and go on to system models noting examples and extensions along the way. They discuss system models with the translog example for producers and the almost-ideal-demand system for consumers. They include a fine intuitive discussion of the newer time-series cointegration procedures that deal with trended variables including error-correction models, vector autoregressions, autoregressive-distributed-lag models with bounds testing, and structural-time-series models. Their last topic is a discussion of an asymmetric response in energy consumption to price increase than to price decreases.

The next three papers deal with energy efficiency. Grant Allan, Michelle Gilmartin, Peter McGregor, Kim Swales, and Karen Turner model the system-

wide effect of energy efficiency. Energy efficiency decreases the cost of energy services, which has output, income, and substitution effects that could lessen fuel savings (rebound effect) or possibly even offset their effects (backfire). Using an open-economy consumption-maximizing model with all energy imported, a fixed domestic input, and a Cobb-Douglas production function, they show that backfire would occur with a free increase in energy efficiency. They then develop a tax policy ensuring no rebound or no backfire would occur. They generalize their highly stylized model in several ways. They also consider the effect on consumption for two efficiency changes—improvement in consumption and improvement in production.

Harry Saunders (#8) continues exploration of the rebound effect and its relation to substitutability. In a standard production-function framework, he graphically shows that higher substitutability makes it easier to substitute for energy implying less of an output effect from a carbon tax. However, the higher the substitutability, the greater would be the rebound effect. He extends his discussion to a dynamic situation using the Solow growth model and notes that one-time energy-price or efficiency increases do not cause permanent changes to the underlying growth rate of the economy or energy use, only continuing changes do. He also extends his discussion to a world with more than one productive sector and to a general equilibrium point of view. He ends each section with valuable notes on the most useful cited references to the subjects covered.

Steve Sorrell (#9) does a thorough survey of the rebound effect. He defines two energy efficiency-rebound effects. The direct effect includes an increase in an energy-service use from a cost decrease. With the cost decrease, real-income increases, which might induce an indirect effect through purchasing more other goods with embedded energy in them. The sum of the direct and indirect effects is the economy-wide effect. He notes that most policy analyses of efficiency standards ignore rebound effects. He includes a discussion of measuring energy efficiency, which may be in terms of heat content, physical quantities, or costs. From his survey and earlier work, he concludes that the direct rebound for personal transport and household use is likely to be 30% or less. Studies on the indirect effects are less plentiful, and he is skeptical of the results. Indirect effects can be measured through embodied energy use, through input output, or lifecycle analysis, but he did not report what, if anything, available studies discovered. Economy-wide effects are measured through macro models including computable-general-equilibrium (CGE) models, which find typical economy-wide rebound effects higher than 50%, and one macro econometric model that finds the economy-wide rebound effect of about 25%.

David Ryan and Denise Young (#10) continue the efficiency theme by reviewing energy policies toward energy efficiency with a helpful discussion on measuring policy impacts. They indicate that the initial evaluations of energy-efficiency improvements are often based on engineering estimates of potential savings. Methodologies for such estimates include life-cycle costs and payback periods. Uncertainties regarding the underlying assumptions in these methods

might be handled using Monte Carlo methods. Although engineering estimates purport to indicate which technologies may be less costly, they often do not include all the costs, which could include risk aversion, repair costs, information costs, risk of obsolescence, and complexity of use or take into account behavioral response or how fast the technology might penetrate the market. Thus, engineering estimates may often overestimate the effect of a new energy-saving technology. They conclude with a discussion of the strengths and weaknesses of the different methodologies.

Lorna Greening and Chris Bataille (#11) present a useful overview of bottom-up modeling that provides the technological explicitness necessary for many energy and environmental policy analyses. Such models may be regional, national, or even global. The authors trace the changes in these models from the early simple accounting models to more complex optimization and simulation models. They give examples of applications and describe the nature and evolution of the more prominent of these models. The authors also suggest a variety of other approaches to hybridize top-down macroeconomic and CGE models with more specific technological choices. They argue that although there has been some convergence of top-down and bottom-up models through hybrid models, they believe that both will continued to be used. However, they do include the characteristics they feel would be necessary for a completely harmonized model.

Ramachandran Kannan, Paul Ekins and Neil Strachan (#12) more completely describe the MARKAL model and its application to the U.K. They include an aggregated sample of the model's reference energy system, which contains the technological details for energy flows to energy services. Energy-service demands drive the model, which chooses the technologies to minimize the cost of producing these services. The authors indicate strengths and weaknesses of the model, as well as the enhancements made in its current reincarnation, key assumptions, model calibration and validation, and some indicative runs with sensitivity tests out to 2050 that include undiscounted abatement costs for a 60% reduction in carbon emissions.

Mark Jaccard (#13) continues the top-down and bottom-up modeling discussion including ways to combine them to investigate induced technological change. He characterizes bottom-up models as those that represent changes in technology and their influence on energy use and the environment. These models typically compare technology costs or choose technologies based on their costs. He too notes the models are criticized for not including all the costs of new technologies. Top-down models often are more behaviorally based with estimation of energy use or share related to costs and sectoral and total output. Many difficulties arise in satisfactorily designing such models. He suggests that models that incorporate elements of both types of models might be more accurate and indicates that such hybrid models would require explicit representation of new technologies, a method to capture actual adjustment to future technology and policy, along with any feedback effects to the macro economy. He then describes a hybrid model that has been developed and applied to the Canadian economy.

His detailed discussion of the empirical derivation of model parameters should be helpful to other modelers. An application of the model to a portfolio of 2007 climate polices of the Canadian government shows that, as in the past, the policies are not likely to succeed.

Ian Sue Wing (#14) provides a cogent and fairly rigorous introduction to CGE modeling. He lays out the algebraic structure of these models and discusses their data bases, calibration, and solution techniques. Resolving these Walrasian macro models after inclusion of climate-policy taxes, subsidies, and quotas shows the changes in price and quantities for all sectors in the model in a theoretically consistent way and includes the direct and indirect effects such policies might have. He shows how to incorporate key variables into CGE modeling. He then gives an example of a simulation for the U.S. economy for a carbon-dioxide restriction and measures the sectoral changes as well as the reduction in GDP.

Claudia Kemfert and Truong Truong (#15) survey models with energy-economy linkages and present a useful taxonomy into which the models in this volume fit well. Since modelers typically focus on concerns of the day, earlier models tended to stress scarcity of resources, while more recent models tend more often to emphasize environmental issues. Complex models that consider the relationship among climate, ecology, and the economy are called integrated-assessment modeling. The chapter considers the theory, methodology, and design of such models. Applied models can be classified according to purpose (forecasting or policy evaluation), geographic regions or sectors, time scale, level of aggregation, or theoretical approach (top-down or bottom-up, hybrid). In hybrid models, the links between the models can be iterative or simultaneous. The chapter discusses data challenges including estimated parameters presented by large-scale models and ways to include environmental constraints and induced technical change. They survey a sampling of models that include induced technical change and wind up their topics with a view of energy from an ecologist's point of views.

Hillard Huntington (#16) presents a solid overview on oil-security externalities that may arise from three market failures—monopoly pricing by producing countries, private producers and consumers underestimating security risks, and private producers and consumers failing to consider the macroeconomic effects of a disruption in their decision-making process. He considers measures of these effects but notes that including military expenditures and costs of the strategic oil reserve would be double counting as they are responses to and not direct costs of the externalities. He includes estimates of the security premium from the literature with some discussion of methodology for measuring the risk of disruption both with and without excess capacity as well as the macro effects of price increases from actual disruptions. The price effects vary depending upon whether the changes are abrupt or gradual and whether the overall level of inflation is low allowing monetary policy to be accommodating. He notes that the effects of a disruption are more closely tied to the level of oil consumption than to oil imports.

Carole Nakhle (#17) considers petroleum taxation the best way to allocate hydrocarbon wealth between producing-country governments and interna-

tional oil companies and presents a good overview of different regimes. She notes that this taxation needs to consider the special features of the oil sector. Such taxation involves the problem of capturing rents without producing inefficiency. Oil-field management from lease to abandonment is a long, risk-filled process with high up-front costs. She indicates that an ideal tax should provide the appropriate level of risk sharing and be efficient, neutral, horizontally and vertically equitable, stable, clear, and simple and notes the conflicts among these goals. She discusses three types of rents—scarcity (Hotelling), differential (Ricardian), and quasi rent—that are often the target of tax authorities and evaluates the major types of tax regimes. She traces the historical features of concessionary and contractual regimes, such as production-sharing contracts, with a comparison across them.

Dalton Garis (#18) discusses the role of market fundamentals versus psychological effects in oil markets and why one or the other might be prevail. He discusses the three benchmark crude oils and their role in price discovery. He reviews the role of crude-oil futures markets, where these benchmarks are priced, and their uses for hedging and speculation. He notes that psychological tendencies of traders may affect future prices and feed back to spot prices. He defines the participants in futures markets, commercials that are active in the commodity market itself and non-commercials that deal in the financial but not the real market such as financial funds. If such funds are large with inexperienced players, they along with programmed trading may increase price instability in the market. Economists may be skeptical of some of the assertions in this paper that lack supporting arguments or evidence.

The next two chapters deal with energy sources. Gordon (#19) considers coal and the potential for coal substituting for a declining oil base. He reads economic-resource theory beginning with Gray and Hotelling as suggesting that worries of oil depletion are overstated. He maintains if there are market failures for oil, they are not well enough understood for any government to improve on a market allocation of any transition out of oil. He focuses the rest of the chapter on the coal market itself—its characteristics, a brief international history of coal production along with its increasing geographical and sectoral concentration into electricity generation, changing ownership patterns as oil companies entered and later largely exited the industry, mergers and acquisitions that created some large multinational coal companies, and world-trade patterns. He ends the chapter with discussions of U.S. coal policy relating to coal-mine health and safety, land reclamation, and coal-leasing policy on Federal lands.

W. D. Walls (#20) presents an interesting comparison of recent efforts at restructuring natural gas and electricity markets, which were once considered natural monopolies. He views regulatory failures in the U.S. natural-gas industry as impetus for restructuring gas markets, but restructuring electricity in the U.S. was more of a centrally designed process that had begun earlier in the UK and elsewhere. He includes the classic arguments for regulating a natural monopoly. He then considers markets in action and concludes that where markets are given

open access to transmission, they have in general succeeded, and where they were too rigid and centralized with poorly designed incentives, they have failed. He concludes that restructuring the U.S. natural-gas market has been relatively successful but restructuring in the more complicated real-time electricity markets has been more problematic when rules and pricing did not properly reflect economic constraints and incentives.

Thomas Weyman-Jones (#21) follows on the regulation-restructuring theme by including a helpful summary of incentive regulation in energy networks including price cap, benchmarking, and sliding-scale regulation. He begins with measurements of economies of scale and scope, which are traditional explanations given for natural monopoly in network industries. He then examines regulatory models in a game-theoretic principal-agent framework with two types of information asymmetries—hidden information (adverse selection) and hidden action (moral hazard).

Lullit Getachew and Mark N. Lowry (#22) consider costs and regulation of power-transmission and distribution networks in industrial countries. They treat determinants of transmission-system costs and estimate a translog cost function based on U.S. data for transmission and distribution. From their cost estimates, the authors conclude natural monopoly exists for both electricity transmission and distribution, which typically supports the regulation of services, territories, and rates. They discuss the older cost-of-service regulatory-rate approach as well as newer performance-based rate approaches such as multi-year caps on price or revenue. They present an impressive survey of the types of regulatory approach for electricity transmission and distribution across many of the more developed countries in N. America, W. Europe, and Asia. They conclude that countries with a long history of cost-of-service regulation have often stuck with it. Newer regulatory regimes with numerous regulated firms more often go with some form of performance based approach.

Lullit Getachew (#23) continues the discussion of the power markets in developed countries from the point of view of market structure including how much integration or unbundling is optimal as well as public or private ownership of the assets. She notes the wide agreement about some sort of separation between transmission and generating and between distribution and retailing. In addition, equal and open access to both transmission and distribution should prevail. She notes the call for independent transmission-system operators arose to prevent transmission systems from favoring their own affiliates and discusses alternative options. She continues with an impressive characterization of first the types of transmission structures and then the types of distribution structures (including independent retailer, vertically integrated independent retailer, and a distribution company with no retail competition) that have evolved in more developed countries in N. America, W. Europe, and Asia with summary tables.

Juan Rosellón (#24) indicates that transmission congestion in electricity grids can increase market power in certain regions, impose barriers to entry, and reduce competition. To prevent such market power, it is necessary to attract in-

vestment to the transmission system. Electricity prices produce the short-term allocation of a non-storable product and should provide some guidance to long-term capacity expansion. However, Rosellón notes that the issue of how to attract investment to the transmission grid is unsolved because of the underlying complexities. He adds that the structure of the transmission grid can influence how new investment is attracted. In practice, he notes two ways to attract investment to the transmission system—performance-based regulation and the auction of long-term financial transmission rights. He lastly covers work combining the two approaches with performance-based regulation to satisfy short-term allocation efficiency with financial rights to promote long-term transmission expansion. More explicit definitions with more support for some of the assertions would have made this article more accessible to the uninitiated.

Mehdi Farsi and Massimo Filippini (#25) focus on efficiency in the electricity and gas distribution sectors. They note the different types of possible inefficiencies and their importance to decision making. They review basic production theory and define key issues. They discuss two methods for measuring economies of scale and scope along with efficiency—econometric estimation of cost or production functions and frontier analysis that measures inefficiency based on the distance from the best-practice firms. They discuss and give examples of both variants. They find a natural-monopoly market structure and economies of scope for both electricity and gas sectors. They conclude with a benchmarking experiment on Swiss distribution data. The heterogeneity of their rankings well illustrates the regulatory difficulty of measuring firm efficiency. They recommend the use of panel data to estimate efficiency to account for unobserved heterogeneity across firms and suggest that applying more than one technique might be useful with careful attention to varying assumptions when interpreting results.

Dmitri Perekhodtsev and Seth Blumsack (#26) provide a valuable international review of wholesale-power market-design components that provide generators incentives on pricing, operation, and investment. They describe the spot and forward energy markets plus markets for operating reserves, congestion management, and other ancillary services and the relationships among them. In moving from vertically integrated to restructured electricity systems, electricity markets need to be designed carefully to match supply and demand in real time, in the absence of storage with very inelastic short-run demand and supply elasticities. Day-ahead markets provide important signals for the planning of near-term power dispatch. They give examples and discuss the advantages and disadvantages of three types of day-ahead market. They note that design flaws can create arbitrage opportunities and adverse incentives within and across these markets that create inefficiencies. They note where market power can arise, ways to measure market power, and international examples of the exercise of market power. Although regulators' efforts supposedly stress preventing excess profits, they must also ensure that profits are high enough to provide for capacity maintenance and investment. This may be done with capacity payments or capacity requirements, and the authors discuss variants of both and problems that have arisen.

They note that nearly every international market has had failures on some of these issues that have caused amendments to the design.

Luciano Losekann, Adilson de Oliveira, and Getúlio Borges da Silveira (#27) further discuss the problem of ensuring sufficient capacity in restructured markets. They note that during congested periods in a competitive market, scarcity rents would signal investors to put in more capacity. However, in a regulated market with price caps, this mechanism is thwarted, and profits would be too low to encourage optimal capacity additions. This effect has been called the "missing-money problem." In an interesting twist, they discuss the problem for Brazilian hydro power.

Blumsack and Perekhodtsev (#28) provide a companion piece to their wholesale-market transition with an international comparison of the transition to retail-electricity competition. They begin with a discussion of rate-of-return regulation and its inefficiencies, including the failure to set the correct marginal cost of electricity by time and rate class and the alleged incentive to overinvest in capital. They identify motives for introducing retail competition. They note common features of retail-competition programs and provide descriptions and examples of them. They survey retail experiments in the U.S., Europe, and New Zealand. Using the number of retail customers or retail load that switches away from the default supplier as their metric of success and their survey results, they offer regulatory guidelines for open access to the transmission and distribution grids,

Luke Reedman and Paul Graham (#29) consider CO2 emissions trading in the electricity and transport sector in Australia. They note that energy is the dominant source of greenhouse gas (GHG) emissions in Australia, especially for stationary sources. Under business as usual, these sources are scheduled to increase significantly. The authors acknowledge that an emission-trading scheme should, however, be extended to economy-wide sources to ensure minimum cost of abatement. In particular, they extend previous analysis to include not only stationary sources but also transport, which together account for almost half of Australia's GHG emissions. They argue that previous work that focused on only the electricity sector underestimated the cost of carbon abatement at $AU10-60 per ton. However, abatement in electricity will not be enough to meet the targets, and the costs in other sectors are likely to be much higher with the marginal abatement cost setting the CO_2 price. They use a partial-equilibrium bottom-up model that includes both electricity and transport because of the potential for technology convergence with the adoption of hybrid or electric vehicles.

Ronald Ripple (#30) provides a solid introduction to international energy-derivatives markets and notes their fundamental purposes of mitigating risk and providing price discovery. He provides basic descriptions of forwards, swaps, futures, and options with basic valuation formulas for them as well as for a crack spread. He outlines the typical provisions in futures and options contracts that trade on exchanges and provides information on contracts sold in the twelve exchanges worldwide that trade energy derivatives. He also shows that the data

indicate neither a general increase in price volatility nor the swings in crude-oil prices from 2004 to 2008 are attributable to a rising role of outside speculators in the oil market. I would add that the price volatility is likely to have attracted the non-commercials rather than the other way around and the market may have been even more volatile without them. One useful observation indicates the size of the futures market relative to the cash market. A common misconception is that the futures market is much larger than the cash market. For example, he notes that the cash market for oil may be 87 million barrels a day, but the open interest in the futures market could be 483 million barrels. However, the 483 million barrels represent contracts going out for many months while by definition the cash market covers only the present. When a valid comparison is done on trades for a given month, the futures market represent less than 20% of the cash market for crude oil and natural gas.

Reinhard Madlener (#31) asserts the importance of "sufficient, reliable, and sustainable" energy for economic development. Since more than a billion people do not have electricity and even more are reliant on inefficient traditional fuels, strong global challenges arise to enhance these lives while managing environmental impacts. He surveys the literature on energy economics and policy relating to developing countries with eight themes - technology transfer and diffusion, energy intensity and income-energy causality, energy-market transition and reform, energy environmental impacts, oil price development, energy planning, energy financing, and energy development modeling. He cites other survey work and also looks at individual studies within each category. He indicates studies of energy-development causality come to contradictory results, that energy models for developing countries should take into account their specific features such as their informal economies, supply shortages, degree of penetration and efficiency of the electric power section, the role of biofuels, and the migration from rural to urban areas and that energy financing is understudied in the development literature.

Christoph Frei (#33) presents speculation about possible energy visions or energy futures that can deal with energy security and climate change, both of which he considers public goods. He presents four extreme models for dealing with increasing needs for transportation and electricity–clean coal, nuclear, bio society, and what he terms energy 2.0. The last combines distributed power from renewables, a smart grid, hydrogen batteries for transport, efficiency improvement, and technical change. He notes that the results of such models are quite sensitive to discount rates. I especially liked his discussion and critiques of the Stern review on the economics of climate change. Stern based his conclusions on an integrated-assessment model but with a social discount rate that is much lower than many others have used. Frei concludes with some discussion of whether climate policies might better be considered as insurance rather than consumption smoothing.

I found this book thought provoking and challenging. I especially appreciated the chapters that provided good overviews of particular methodologies

or issues with recommendations for further reading. I believe that other readers will find many chapters to be excellent introductions to a particular topic. As with any anthology, there is some overlap in topics, but it is not excessive and in some cases is helpful. It is a good reference book for economics students and practitioners. Individual chapters can be used as extra readings in courses related to energy, natural resources, and regulation, and I would urge faculty to recommend it to their libraries.

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