BOOK REVIEWS

Elements of the Swiss Market for Electricity by MASSIMO FILIPPINI. (Heidelberg: Physica-Verlag, 1997), 229 pages. ISBN 3-7908-0996-9.

The most important contribution of this book by Massimo Filippini is not a comprehensive coverage of the Swiss market for electricity, but rather its nice illustration of how one can apply econometric methods to study electricity markets. Specifically, it analyses two important elements of the electricity industry in Switzerland: the residential electricity demand by time-of-use and the cost structure of municipal electricity distribution utilities. After a brief overview of the structure of the industry, Filippini goes on to discuss how neoclassical consumer theory (part 1) and production/cost theory (part 2) can be applied econometrically to analyze these issues.

In the first part on residential electricity demand in Switzerland, the main purpose is to estimate the price and expenditure elasticities of demand for peak and off-peak electricity. A secondary purpose is to identify the most important household characteristics determining the economic choice between peak and off-peak power. It is assumed that consumer demand for electricity is the result of a two-stage budgeting process: first the household decides the amount to spend on electricity and then it allocates this electricity budget among peak and off-peak consumption. Filippini employs three data sets in three different chapters. All three data sets have a clear cross-sectional nature (complemented with very short time-series), but differ somewhat in terms of price variation and information on household characteristics. Since three different data sets are available, three types of consumer models are employed. These are the representative consumer behavior model proposed by Muelbauer, an aggregate consumer model in which Lau's theory of exact aggregation is applied to an Almost Ideal Demand System (AIDS), and a classical household consumer behavior model.

The results from the estimations are similar, and all show high partial own- and cross-price elasticities of peak and off-peak electricity consumption. For example, the partial own-price elasticities are about -1.4 and -2.5 on average for peak and off-peak respectively, while the corresponding cross-price elasticities are close to 0.5. This, according to Filippini, suggests that "time-of-use pricing can contribute to a more efficient utilization of existing production and distribution capacity" (p. 119). The empirical results also indicate that the presence of children in the household and an electric boiler (allowing households to shift their water heating activities to an off-peak period), significantly influence the electricity demand pattern in Switzerland.

As a reader of this first part, one is struck by at least two things. First, the magnitudes of the reported elasticities are high compared to those found in previous studies, but Filippini never discusses whether his results are to be interpreted as short- or long-run responses. Still, his heavy reliance on cross-section data will most likely reflect long-run adjustments, especially if the conditions at the cross-section observations have been stable for some time. The high elasticities that are reported in the book tend to confirm this interpretation. Second, in his analysis the author puts much emphasis on theoretical consistency, and therefore allocates many pages to discussing how demand systems can be made consistent with the neoclassical theory of consumer behavior. For example, utility consistency and aggregation theory are discussed in depth in the first part of the book. However, theoretical consistency is not a good thing in itself. It is not always the case that the consumer of the product is also the one deciding which product to consume (and even the one paying directly for the product). For example, the process of prescribing and dispensing prescription of pharmaceuticals provides a situation that contrasts with the standard utility maximizing paradigm (Ellison et al., 1997). A similar argument can be made for the long-run response to changes in residential electricity prices. These are very unlikely to be determined by the household alone, but also by the choices made by the landlord and the residential owner. Filippini himself recognizes that "[s]ince the majority of Swiss urban households live in rented apartments, they cannot readily choose whether to use certain electrical appliances, among which are some of the most energy intensive such as an electric cooker or water heater" (p. 80). Hence, even if the author provides a very nice and comprehensive presentation of how the demand equations that are estimated can be made consistent with neoclassical utility theory, it can be questioned whether his efforts have been worthwhile pursuing.

The second part of the book is dedicated to the study of the cost structure of the Swiss electricity distribution utilities. The main purpose is to determine what factors affect the cost and the nature of economies of scale in the industry. The empirical analysis employs panel data for four years on 39 electricity distribution utilities. While the distinction between short- and long-run responses is not brought up in the first part of the book, this is explicitly recognized in this second part. After a detailed discussion on how to implement producer theory, Filippini goes on to specify a translog total (long-run) cost function for the industry and a short-run model based on a variable translog cost function (in which the capital stock is treated as fixed). Apart from many earlier studies, the heterogeneity of output in the electricity industry, i.e., the distinction between peak load and base load power, is accounted for by the introduction of the system load factor as an explanatory variable in the cost function. This allows Filippini to assess what are the cost effects of changes in peak load.

Both model specifications (the long-run and the short-run) have their weaknesses. Filippini finds that the total cost function is well behaved, i.e., it satisfies the regulatory conditions, but it assumes that electric utilities instantaneously move from one long-run (cost-minimizing) equilibrium to another as relative prices change. Given the long-lasting capital equipment in the electricity industry, this assumption is probably unwarranted. The variable cost function removes this weakness, and even though it is a short-run formulation it allows one to infer long-run behavior by equating the shadow cost of capital (which is determined endogenously in the model) with the rental cost of capital. However, a common problem with this approach is that multicollinearity between the output and the capital stock variable often results in a violation of the non-increasing regulatory condition (indicating a negative marginal product of the capital stock). Filippini's short-run model also suffers from this shortcoming, and for this reason he does not report any long-run elasticities.

Two important results do however come out of the author's exercises. First, the results support the notion that economies of scale exist in the distribution of electricity in Switzerland. This leads Filippini to conclude that in Switzerland "side-by-side competition is less cost-efficient than the monopolistic distribution of electric power, and deregulation is not likely to yield efficiency gains in the distribution of power" (p. 205). Second, the study confirms that improvements in the load factor can significantly reduce total costs. This leads to policy recommendations such as the implementation of time-of-day or time-of-season pricing, which ensure a decrease in peak load, in the Swiss market. In sum, Filippini's book is an excellent illustration of the problems that arise as one tries to implement economic theory econometrically. Although the empirical results are mainly of regional interest, everyone with an interest in applied econometrics will find the book worth reading. The book is especially recommended to graduate students who, so far, primarily have struggled with pure theoretical problems.

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Reference

Ellison, S.F., I. Cockburn., Z. Griliches and J. Hausman. (1997) "Characteristics of demand for pharmaceutical products: an examination of four cephalosporins." *RAND Journal of Economics* 28: 426-446.

Deregulation of Electric Utilities, edited by GEORGES ZACCOUR. (Boston: Kluwer Academic Publishers, 1998), 368 pages. ISBN 0-7923-8134-3.

This volume is a collection of fourteen, mainly applied, economic papers examining electric utility deregulation in many parts of the world. These papers were presented at the International Workshop on Deregulation of Electric Utilities held in Montreal, Canada in September 1997. As the title suggests, these papers cover a broad range of topics. Despite the book's scattershot approach, a small subset of contributors asks a fundamental question: Is the industry sufficiently deregulated? This book succeeds in providing some concrete and well-analyzed examples that examine this important question.

Bergara and Spiller's paper, "Competition and Direct Access in New Zealand's Electricity Market" squarely addresses the question of whether deregulation has gone far enough. In particular, does the distribution network need to be a regulated monopoly or is a soft, or light-handed, regulatory framework sufficient? As the authors note, New Zealand provides a natural experiment on the issue of allowing direct access suppliers (network providers) to negotiate with their customers regarding operational standards as opposed to having regulators mandate what those standards should be. The authors analyze two years of data of direct access and conclude that it is having, at least qualitatively, the expected effects of improving quality standards and overall industry efficiency. In addition, more competitive entry and increased customer switching occurred in retail markets with a higher proportion of large users and high-income users.

Boyer and Robert in their theoretically oriented paper ask whether the existing deregulated framework (i.e., price regulation of transmission and distribution) can be dispensed with and replaced with a different framework. Such an alternative framework would rely on antitrust rules, possibly augmented with ownership restrictions limiting vertical integration, and the creation of a trading mechanism with specific price discovery rules, among other features. They conclude that the transition toward increased competition is a difficult task and that a well-planned course and certain procedures such as global price caps or smart market auctions could avoid much of the transition costs associated with deregulation.

Other papers examine in detail the move from vertically integrated regulation to de-integration and electricity supply competition. For instance, Burns and Weyman-Jones present a review of the UK electricity markets followed by a detailed discussion on price caps and sliding scale regulation. They conclude that although the UK industry has been a model for deregulation, the role of the regulator remains critical. Green also presents a paper on electricity deregulation in England and Wales and concludes that this experience should not be applied unthinkingly, but despite some problems, the industry is

performing better after than before privatization. Further reflection by these authors on whether further deregulation is worth pursuing in the UK would have been interesting. Finon provides a theoretical paper on the transition from regulated integration to deregulated de-integration and reasons that there are no longer any fundamental obstacles to establishing coordination between decentralized agents to preserve externalities and manage the constraints of the system through vertical integration.

Completing this volume are papers on transmission pricing in Texas, an historical comparison of Quebec and Ontario regulatory paths, an examination of introducing competition into Quebec's concentrated system, prospects for competition in Spain, and demand-side management investment or disinvestment decisions by U.S. electric utilities. In addition there are papers on World Bank investment policy pertaining to electricity industries in developing countries, peak-load pricing, and the relationship between transmission contracts and investments in oligopolistic electricity markets. As this list of papers indicates, this volume covers a wide range of topics. Although most of these papers are interesting to examine independently, the reader is left wondering how they fit together, if at all.

This collection updates the reader on many topics throughout the world on the issue of electricity deregulation. It also enables one to begin to examine an important question that is looming on the horizon: Are countries going far enough with deregulation? A future collection of papers on this topic should prove to be interesting reading.

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The Economic Appraisal of Natural Gas Projects by WILLEM J. H. VAN GROENENDAAL. (Oxford: Oxford University Press, 1998), 230 pages. ISBN 0-19-730019-7.

An unhealthy gap prevails between the theory and the practice of project appraisal, both in terms of what is being done and by whom. In terms of what is being done, theory is becoming increasingly divorced from the realities of practice, focusing, for example, on theoretical model refinements that may mean a 1 or 2 percent adjustment to a valuation result. This occurs even though model inputs such as the investment cost have an error band of plus or minus 25 percent. In terms of who is doing what, it used to be that those who developed the models of project appraisal were also the ones doing the appraisals. Today there is little overlap. Theorists value theoretical projects, and practitioners value real ones.

In *The Economic Appraisal of Natural Gas Projects*, a publication of the Oxford Institute for Energy Studies, Willem Van Groenendaal demonstrates that he is able to bridge the gap. He is conversant with the theoretical economics of project appraisal and at home digging up engineering cost data. The aim of the book is to clarify a number of methodological issues that arise when applying the theory of economic and financial project appraisal to large energy infrastructure projects with long economic and technical lifetimes. The issues are illustrated by material from his three-year involvement appraising the construction of a $2 billion natural gas transmission system on the Indonesian island of Java. In fact, the book tends to emphasize the practical over the theoretical. In the Preface, Van Groenendaal candidly admits that, once confronted with the bureaucratic influences over the project and the absence of energy markets in Indonesia, "I soon realized that much of what I learned about economic theory is of little use in practice."

Van Groenendaal's analysis covers the estimation of natural gas demand, a route survey for the pipeline, and the pre-design of the pipeline, the last two aspects of interest mainly for providing an estimate of project capital costs. The demand analysis largely ignores the traditional economic approaches that emphasize substitution elasticities and income effects and is instead based on a bottom-up engineering analysis of gas consumption in the energy-intensive sectors of Java. He does allow price to affect demand, but only to the extent that some firms and sectors have the opportunity to switch between fuels. The approach requires microstructure data that link current and anticipated manufacturing technologies with their probable fuel dependence. Where the data were not available, manufacturing plants were randomly surveyed, emphasizing Van Groenendaal's reluctance to use broad-brush economic models that gloss over industry specifics. The attention to detail at this level, however, is undone in some respects by inattention at others. First, there is no economic consideration of the usual development and balance of payment impacts that such projects generate in developing countries. Second, growth in industrial output, and through this growth in fuel demand, is linked to a 25-year forecast of Indonesian economic growth that is nothing more that "an educated guess." Third, the ultimate project cash flows, which are so painstakingly calculated twice, once based on financial (accounting) concepts and once based on economic concepts that take into account user costs, are then discounted at 10 percent, the ad hoc rate recommended by the World Bank. The extensive sensitivity analysis discusses at length the implications of uncertainty on project discounting (and hence project value), but then this is cast aside in favor of the World Bank standard. Finally, with the project being built in three separate stages, the analysis lends itself to a staged investment valuation within a real options framework. Yet Van Groenendaal appears to be unaware of this recent advance in project analysis. In fact, most of his references are dated, which may

indicate that he has perhaps strolled a little to far from the modern theory of project appraisal.

An innovative aspect of the analysis is the recognition that this particular project, whose investments will span some 15 years, will require continued monitoring and re-evaluation. Van Groenendaal develops a Decision Support System to allow the Indonesian government continually to update the project inputs as new information becomes available. The decision system embeds simulation into Mintzberg, Raisinghani, and Theoret's 1976 model of unstructured decision processes and is something that I have not seen addressed before in this type of project analysis.

In sum, this is in most respects a valuable and detailed demonstration of the linkages between engineering, economics, and decision sciences when evaluating a large energy infrastructure project. As I have noted, Van Groenendaal's approach has its weaknesses, and these raise my doubts about the ultimate project value that he calculates. I would also argue that the book's title is broader than its subject, and caution potential readers that a more appropriate title would be An Engineering-Economic Appraisal of a Natural Gas Transmission and Distribution System: An Indonesian Case Study.

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Energy and the Making of Modern California by JAMES C. WILLIAMS. (The University of Akron Press, 1997), 465 pages. ISBN 1-884836-16-x.

I read this book with some interest and was not disappointed. I would characterize *Energy and the Making of Modern California*, as two different books. The first is a history book of energy use in California, as the title suggests. This is a story worth telling not just for Californians but all who are interested in energy use. As the author accurately points out, most studies ignore the West, and California did evolve much differently from most other states.

The history of energy is important for energy economics. It reminds us of the hazards of forecasting and believing that current trends will continue indefinitely. I am thinking of the horribly inaccurate forecasts that energy economists made in the 1970s and early 1980s that projected continuing increases in real energy prices. The lesson I draw from history is that energy shocks and disruption are relatively common and that energy prices never stayed long on an upward trend.

To its credit, this book reminds us of some basic lessons. The quote from the head of the State Geological Survey in 1861 is a reminder of the hazards of forecasting. "It is a matter of congratulation that the State will soon cease to be dependent upon other regions for her supplies of fuel." He was not correct in the short or long run.

The author links energy use with other developments. Of particular interest is the role of energy in promoting agriculture. In California, agriculture has developed differently with farmers having larger tracts and having to use irrigation because of the climate. Energy played an important role, especially in allowing mechanization. The author also links energy to political movements. I did not know that part of the Progressive era criticism of railroads was based on the costs of transporting kerosene and other petroleum products.

The author also gives us some interesting facts about historical California, some of which explain what we see today. For example, California is dotted with eucalyptus groves. Their presence is a mixed blessing as they helped feed the disastrous Oakland Hills fire of 1991. Early Californians did not plant these groves for windbreaks or ornamental reasons but for firewood. Moreover, who would have thought that the Comstock mines used between six and eight tons of candles per month and that these candles were a major energy import.

I said earlier that the author had really written two books. The second book is an analysis of energy policy and trends, with an emphasis on the last 30 years. As a reader, what comes through is a longing for the good old days of simple energy production and I do not mean 17-cent gasoline either. For example the author writes, "centralized energy systems evolved into extremely complex and thereby vulnerable systems, undermined user control, and ultimately demand that people pay dearly for sophisticated back-up systems to avoid energy intermittency." I disagree, to the extent that Californians pay dearly for energy, it is because of energy policies that were designed to avoid supply interruptions, policies that in retrospect were not necessary. Another topic that the author deems important is the loss of individual independence in making energy choices. This situation is true in so many arenas of our modern lives, why is it important with regards to energy? My biggest objections are with statements that praise California's emphasis on alternative methods of electric power production and energy conservation for providing a softer, more environmentally benign, and more efficient energy path. Yes, California's energy consumption relative to gross state product declined, as did most other places in the world. Prices matter. California did implement some alternative polices, but they left the state with much higher energy costs and the diversification did little for the state. If there had been a massive disruption in petroleum supplies, the state would have benefited. The question that needs to be answered in retrospect is were alternative energy sources a reasonable form of insurance? I suspect they were not. I also argue with the characterization of

alternative sources as environmentally benign. To some, windmills are an aesthetic blight and, as the author acknowledges, a major source of migrating raptor mortality. Moreover, they are an expensive source of electricity. Similarly, the author describes the problems for small-scale hydropower. This seems to undermine the environmentally benign nature of California's alternative energy policy. The author did not discuss or did not treat adequately some major events. A topic that fits into that category is the discovery of the Alaska North Slope oil fields and the resulting changes in West Coast oil markets. His history of the 1970s failed to mention that the price disruption in 1973, before the OPEC-induced oil price shock, was a function of price controls and inadequate refining capacity.

Despite the criticisms, there is much to recommend about this book. The lessons from history are worth reading again.

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Energy Policy in the European Union by JANNE HAALAND MATLARY (St. Martin's Press, 1997), 174 pages. ISBN 00-312-17295-8.

This book is concerned essentially with the politics of energy sector decisions in some of the member countries of what is now the European Union (formerly the European Common Market). It attempts to demonstrate how such national interests in energy have helped or hindered moves (mainly the latter) towards the creation of a Common Energy Policy. Matlary's conclusion (dating from 1995) on the prospects for such a development is pessimistic, namely, "important national differences in market structures, energy policies and market philosophies . . . are not likely to disappear . . . and in the later 1990s it is more uncertain than ever that it will be able to do this" (p. 160). Events over the past three years suggest, however, that this pessimistic conclusion will not be justified. Rapidly evolving similarities in structures, policies and philosophies amongst the member states, *vis-a-vis* fundamental issues in the economics of energy supply and demand, now seem likely to overwhelm the differences which the author saw to be robust.

The book's conclusions and the reasoning behind them emerge from the central attention given to the form (the politics), rather than to the substance (the economics of supply and the environmental concern over demand) of changes in the European energy sector. On the one hand, the already abandoned (in most countries) or now disappearing attention to indigenous coal (in the rest) is

minimizing one of the hitherto most important contrasts in national interests amongst Europe's nations. On the other hand, the acceptance of natural gas as the energy source to favor, whether from indigenous production or from imports throughout the Union (except for Sweden) for both environmental and technical reasons, is creating a widely held view in favor of an extensive and highly-reticulated infrastructure for its supply, whether by continuing state-owned or regulated national monopolies or within the framework of a liberalized market. In this context national supply networks-hitherto seen as sacrosanct by policy makers-are now becoming viewed as simply elements in a European-wide system. Given an increasing number and the growing geographical diversification of suppliers, together with appropriate formal inter-state arrangements for access to storage and back-up supplies, the earlier nationally orientated concern for security of energy supply-as demonstrated in the book is rapidly retreating.

Even more so, a populist pan-European Union view in favor of energy conservation and reduced emissions of greenhouse and other gases is leading to steps which serve to constrain energy demand and/or to emphasize enhanced supplies of renewable sources of energy across the continent. The author picked out the growing significance of the energy/environment interface (pp. 65-71), but presented it as a 'problem' for European energy policy, because member states could not agree on a common approach. The fact that it is happening, under the aegis of EU policy decisions albeit with implementation according to national predilections, suggests that the 'problem' is merely one of timing.

Meanwhile, as shown in the book, other energy sector European Union-level policies are falling steadily into place. These range from the moves towards the harmonization of taxes, to the standardization of energy-efficiency standards for electrical and gas appliances and to the 'Europeanization' of access to market opportunities for investment in and the supply of goods and services to upstream oil and gas activities. These are the 'meat' of energy sector moves towards a European-wide set of policies, rather than the sideshows of meetings of Energy Ministers or the politicking of the European commission for the creation of an institutionalized and legalized system under which all member countries must operate their energy sectors. Dr. Matlary's book is quite definitive in showing the futility of that approach over the 1985-95 period (or, indeed, over earlier decades which are evaluated only briefly in this book).

The author "posits three major challenges in the energy field in Europe; viz. supply dependency, the environment and the need for an open market" and argues that these will form "the core of an EU energy policy" (pp. 155-6). Maybe attention to these is what the Energy Directorate of the Commission will see as its main responsibilities and thus ensure that the issues will form the main topics of debate amongst the politicians in the European Parliament and by the Energy Ministers at their frequent meetings. Your reviewer, on the contrary, would expect that if that be the case, then the policy makers will be left behind,

as they have been to date by the markets and by the responses of the suppliers of the energy itself and by the manufacturers of the appliances in which it is used. They have already been Europeanizing the energy sector for 25 years and the process will continue!

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Global Energy Perspectives edited by NEBOJSA NAKICENOVIC, ARNULF GRUBLER, AND ALAN MCDONALD. (Cambridge, UK: Cambridge University Press, 1998), 299 pages. ISBN 0-521-64569-7, no index.

Global Energy Perspectives describes six interesting scenarios for the energy system's evolution over the next century. Although based upon model-generated results performed by experts at the International Institute for Applied Systems Analysis (IIASA), this book's primary audience is the group of government and corporate advisors and decisionmakers who will shape the energy sector's future. It is well worth examining. The volume provides a lot of value. For reasonable costs (both a hardback and a softback book is available), the reader obtains a well written discussion of the key economic, technical, and scientific factors shaping the industry, a set of carefully constructed color graphs highlighting the key points, and a special multimedia computer presentation that would be a hit in any executive boardroom. The authors devoted considerable time to discussing their results with a set of regional experts, resulting in a process that anticipated many possible limitations.

The authors consider six scenarios: a middle-course or "muddling through" outlook (B), three high-growth cases where technology expands the opportunities for oil and gas (A1), coal (A2), and renewables (A3), and two policy-driven cases where governments push for local and regional as well as global commitments to reduce pollution. One scenario (C1) allows nuclear energy to be phased out with fossil fuels by 2100 resulting in greater dependence on renewables, while another (C2) sees gradual public acceptance of smaller-scale and safer reactors. Some readers may find the 100-year horizon as being too pie-in-the-sky meanderings, but there are several reasons for a volume that pushes beyond the 25-year outlooks provided by government agencies. Energy transitions are long lived with many energy supply technologies being interwoven and not being replaced within the next 5 decades. Additionally, the possible serious costs associated with growing carbon concentrations will not be experienced until well into the next century.

The authors discuss a lot of important topics—market exclusion, technology penetration and R&D, primary and secondary energy, and alternative measures of aggregate economic output. The volume excels in combining opportunities for energy technological advancements with conditions favorable for faster economic growth. It views technology and economic growth as having a very strong complementary relationship.

Given the ambitious scope, the volume has some limitations, although they do not detract seriously from the book. Three issues could have received more attention: coal-based synthetics, the relationship between the development of new energy technologies and other innovations elsewhere in the economy, and energy prices.

If the climate change problem becomes serious, the potential shift to a coal-based energy system will become very important. Direct use of coal is likely to be replaced in many applications, but many analysts foresee the major development of a coal-based synthetic fuel. Such a shift will require major policy decisions and a new infrastructure that the book does not really address in any detail. If policy can prevent this new industry from materializing, the future climate change problem may be a lot less threatening than implied in many available projections.

The authors' emphasis on the effects of "learning by doing" on technology costs and adoption may lead some readers to assume falsely that the costs of new technologies will necessarily fall as we learn more about them. The fundamental issue is how one distinguishes between those technologies where advancements can be made and those that continue to reallocate significant resources from other sectors of the economy even after years of development. While the volume had made considerable progress in understanding technology's role, we need to know more about the possible prospects and limitations of technology-pushing strategies for capturing potentially lower costs in the future.

And finally, the authors do not discuss energy prices in much detail but they argue that they will be less important than long-term technology and economic factors in shaping long-term outlooks for energy systems. Although I am somewhat sympathetic to that view, I believe that one can gain much insight by considering the simultaneity between prices and the demand and supply of physical outputs. A common set of prices is critical for balancing supply and demand conditions in any particular scenario. The reader never really learns what kind of energy price paths the world would be following in any of the scenarios. The authors suggest that they would be relatively low but I am not convinced. First, they discuss average costs (including the inframarginal as well as the marginal units) because other factors may contaminate their shadow prices. They didn't explain this problem much except that I think that they believe that many environmental and other societal constraints become wrapped up into the shadow prices that they extract from their programming models' solution.

The other problem is that they discuss price changes briefly for a very lengthy 50-year period, a horizon over which energy prices are unlikely to escalate at a rapid pace. Judging from the little price information that they report, the price increases through the year 2020 look very comparable to the ones used by many government groups. They seem remarkably similar across many IIASA scenarios, in the inflation-adjusted $40 to $45 per barrel range by 2020. Obscuring the price trends and avoiding the problems of explaining rising energy prices confuses the energy outlook considerably.

These limitations, however, are not major problems. Energy experts and policy advisors will, and should, examine this volume in considerable detail.

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Energy Modelling Beyond Economics and Technology edited by BERNARD GIOVANNINI AND ANDREA BARANZINI. (Geneve: Centre Universitaire d'etude des problemes de l'energie, 1997), 162 pages. ISBN 2-940220-00-X.

This edited interdisciplinary volume is compiled from a 1996 Geneva conference on cultural and institutional elements in energy analysis, modeling and policy making sponsored by the International Academy of the Environment and the Center for Energy Studies.

Traditionally modelers have often modeled energy economy interactions either from the top down, using aggregate historical relationships, or from the bottom up, using an engineering approach to model end-use efficiencies and various mixes of technologies and services. These authors wonder whether these approaches are up to providing the necessary information and policy guidance for global climate control. They argue that both of these models have deficiencies and there is the need to supplement them. The top down approach ignores nonlinear and chaotic behavior and the role of habit, convenience, fashion, culture and rules of thumb in the decision making process. The bottom up approach does not take into account the feed back from the economy to changes in technology. Although useful simplifications of reality, neither approach captures the social processes of learning and adapting to change and technology. Their omission becomes particularly important in the long run up to 100 years. These authors address this omission by seeking ways to incorporate learning, interaction and feedback mechanisms into energy modeling.

Shove notes that energy modeling exists to provide policy guidance, while policy choice in turn changes the forecasts and scenario results. Most

energy models are economic and technical and do not incorporate social change, which requires the inclusion of economic, technical, social and natural or biological aspects to the model. However, different time frames and spatial dimension to changes within these four dimensions complicate the modeling process.

de Laat notes that models are embedded in a social and political process. That much like innovations, their development and dissemination is an interactive procedure between the players in the process. He calls this process the sociology of models and argues that one aspect of socializing models should be the study of this process. In a slightly different twist, Taylor draws on his experience as a commercial modeler to explore model building as part of the learning process to give the client a better understanding of the behavior modeled.

Wilhite argues that not only should socio-cultural effects be included in energy models but he also provides us with a nice example of how to do it using Japanese space heating and cooling appliances. He relates the dramatic increase in these appliances not only to income and cost considerations but also to changes in building design, increased air conditioning at the office, and cultural changes that favor a more Western life style.

Strang looks at energy modeling from an anthropological frame of reference. Basic needs, which include physical sustenance, reproduction, shelter, safety, social interaction, development of identity, self expression, and status, are behavioral and cultural drivers. These along with physical constraints and the individual's context, whether at the household, community or societal level, will influence energy demand. Understanding their interactions will help make better energy models and policy. Michaelis borrows an analogy from biology to explain how technology and behavior evolve. Just as the trial and error of evolution in complex biological environments cause the fittest to survive, so does the trial and error of trying new technologies in a network of social interactions sort out the winners from the losers.

Schwarz in an esoteric piece tries to convince us that systems dynamics will be the new paradigm to model complex systems replacing the current materialistic mechanistic scientific paradigm. Giovannini also feels that systems dynamics is the way to go in a transdisciplinary framework with the collaboration of both academics (experts) and non-academics (clients). Since systems dynamics allows hypothetical rather than observed relations, he feels that it along with the interactions between the modelers will generate a wider range of futures to consider.

The last three papers conclude with possibilities for a research agenda. Morovic and Wortmann argue the need to convince policy makers that modifying climate change requires not only technical solutions but also behavioral change. Thus, there is the need to match up technical and social models. C. Weber vaguely considers three foci that could be the center of an

agenda for modeling consumer energy consumption- a focus on the structure including actors and network of interactions, a detailed focus on the interactions or a focus on consumer behavior. L. Weber has a more detailed agenda for studying energy consumption change in industrial buildings in order to find out what non-technical variables are most important in determining this change.

This book would be of interest to energy modelers and policy makers who are consumers of such models. Thinking about social and network aspects of energy decisions, behavioral change, as well as interactions between modelers, between models and modelers, and between modelers and policy makers is beneficial, even if these are not formally incorporated into the model. I found the chapters that were simpler, more explicit and less laden with jargon such as Taylor and Wilhite more useful. As with most edited volumes the quality across articles was variable, but the variation was wider than is often the case. Some articles were well thought out and crafted, others read more like hastily written and unfinished conference pieces.

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