

# ECONOMICS *of* ENERGY & ENVIRONMENTAL POLICY



## Book Reviews

***Behind and Beyond the Meter. Digitalization, Aggregation, Optimization, Monetization***  
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***Empowering the Great Energy Transition. Policy for a Low-Carbon Future***  
by Scott V. Valentine, Marilyn A. Brown, and Benjamin K. Sovacool—review by Pippo Ranci

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## BOOK REVIEWS

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***Behind and Beyond the Meter. Digitalization, Aggregation, Optimization, Monetization,*** edited by Fereidoon Sioshansi (Academic Press–Elsevier, 2020). 423 pages. ISBN: 978-0-12-819951-0.

“Behind the meter” (BTM) refers to new assets and behaviours on the customer side of the electricity meter, leading to different patterns of consumption, or to generation and/or storage of electricity. It encompasses the idea that rather than everything interesting happening on the upstream or “system” side of the meter located at the customer premises, the demand side is now becoming more active and can contribute to system balancing either by changing net imports or becoming an exporter at times. Such a shift in focus has strong synergies with electric generation becoming less dispatchable, for example due to the large deployment of intermittent renewables.

Coherently with this idea, the new edited book by Fereidoon Sioshansi argues that we need to understand more about what is happening behind the meter and how it can best be integrated into the upstream system; in the editor’s words, this is the “most interesting, unexplored and potentially fertile area to explore” within the electricity sector.

The term “behind the meter” is itself not without contention in this context. Whether the new technologies and behaviours are “behind” or in front of the meter depends on which direction one is looking from. If we need to understand more about customer-side actions, perhaps we should put ourselves in the customer’s shoes, in which case the interesting thing is what happens on our side of (i.e., in front of) the meter. Using an expression such as “behind the meter” could be argued to miss the point entirely, since it adopts the industry’s perspective. Nonetheless, that is where the industry largely sits and is an accurate reflection of most of the topics covered in this volume which, with a couple of partial exceptions, present the industry point of view.

“Behind and beyond the meter” is the third in a series of collections edited by Fereidoon Sioshansi and gives a broad-ranging overview of case studies and issues arising in the industry relating to, in the words of the sub-title, digitalisation, aggregation, optimisation and monetisation of customer electricity assets. It comprises 20 chapters plus four introductory or concluding sections from a total of 45 named contributors. While organised thematically, each chapter is largely self-standing and most of them are based on case studies of one type or another, so it is a book that can be dipped into in any sequence. This swirl of concepts again is representative of the state of industry discussions on the topic, with lots of ideas and projects, not always clear which are competing and which complementary.

The compendium format does mean that the book is strongest in advocating the case studies included (often by their proponents), and less so in drawing out their weaknesses or inconsistencies between them. For example, the tension between some forms of community energy or virtual power plant models and efficient and equitable recovery of distribution costs is addressed but not confronted in the case studies. The same occurs with the potential tension between the currently valuable role of aggregation and increasing automation reducing transaction costs.

As a former regulator I may be biased, but the foreword and preface of the book, each written by current regulators (from NVE and CRE), are a great start to the book, concisely

outlining the policy and regulatory issues for the sector associated with behind the meter developments. The imagery of moving the distribution grid from a “black box” of connect and forget to a “coloured box of complex opportunities” sets up the pattern of the following chapters, each drawing snapshots of particular colours.

Part 1, titled “Visionaries, dreamers, innovators”, provides a range of case studies from an individual house, to aggregators, platforms and diverse business models. The detail of technologies applied to an individual house to get to a zero net energy position is fascinating, but far removed from most households and with gross imports of over 12,000 kWh from a mainly fossil fuel fired grid, more carbon intensive than the great majority of homes (despite claiming “carbon neutrality”).

Part 2, “Implementers and disrupters”, mostly continues the approach of each chapter describing and assessing a particular case study, with examples from Germany, Australia, USA, UK, Austria and a European survey of smart meters. It includes more analysis, particularly in chapter 8 on “what’s in it for the system?” which starts to develop the economic impacts of alternative behind-the-meter approaches. Chapter 9 then develops insights about consumer behaviour and technology diffusion, recognising that the characteristic S-curves have little predictive power – “more a muddle than a model”. Applying the analytical framework from these chapters gives the reader clearer insights on the case studies throughout the previous and remaining chapters.

Part 3, “Regulators, policymakers and investors”, has a more academic flavour, focusing on issues such as tariff design and price response, giving a clear sense of the current state of the art. The penultimate chapter (19) finally centres on the customer perspective, addressing the 2.2million+ solar roofs in Australia and asking “what’s in it for the customer?” and how this varies across different states and customer types. Interestingly, the analysis suggests that what drove Australians to invest in solar roofs will not necessarily hold for other behind the meter technologies.

As Jesse Scott noted in her review of Sioshani’s previous compendium, “Consumers, Prosumers, Prosumagers” in this journal (Volume 8, Issue 2, September 2019), after reading the book I cannot refrain myself from observing that the electricity industry looking inward will only raise some of the relevant issues and we would strengthen our understanding through better engagement across sectors. However, for those coming to the power sector from other industries and backgrounds, this volume provides a thorough survey of the issues arising from “behind” the meter. As the epilogue highlights, decentralisation and digitalisation are surely well underway, along with activation of new interactions, whether through aggregators, platforms or other means, justifying the initial claim of the book to cover most interesting and fertile territory.

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***Appraising the Economics of Smart Meters: Costs and Benefits***, by Jacopo Torriti (Routledge, 2020). 172 pages, ISBN: 9780367203368

For anyone interested in the continuous transformation of the electricity sector and in understanding the complexity of the changes brought forward by new technologies this book is a fascinating read. The author focuses on smart meters, an apparently minor element of a much larger infrastructure, which “simply” measures the electricity that we consume over time. In fact, when considered from an economic perspective smart meters are much more than this. On the one hand, they involve complex investment and deployment decisions whose costs and benefits are difficult to identify; on the other hand, they offer new and mostly still unexplored opportunities to fully comprehend and eventually modify how we use electricity, both as individuals and as a society.

Overall, this book takes the reader on a vast journey through time, space and disciplines, providing a comprehensive overview of how policy makers and academics have thought about smart metering in the past and how they see it today. The first part of the book (Chapters 1 to 5) focuses on the European experience with conducting cost-benefit analyses (CBA) for the roll-out of smart meters. The second part (Chapters 6 to 8) reviews studies on consumers’ consumption choices and social practices, in connection with smart meters and other technological and tariff innovations (e.g., smart homes and dynamic tariffs). While the link between these two parts is clearly found in one of the main expected benefits included in the CBAs, namely, energy conservation, the book can also be appreciated by focusing on one aspect but not the other.

The first part of the book does a remarkable job in revising the original motivations for smart meters roll-outs, as well as the corresponding costs, benefits and risks captured in CBAs conducted in Europe following the adoption of the Third Energy Package (Directive 2009/72/EC). For instance, the reader is reminded about the expected cost-savings in field operations and customer services, as well as the potential positive effect on revenue protection for utility companies. At the same time, informed, and therefore responsive, consumers were seen as essential to reach energy efficiency and decarbonization targets in the European Union (Chapters 1 and 2).

As it turns out, the results of actual CBAs for smart meter roll-outs in several countries in Europe are difficult to compare. Chapter 3 and Chapter 4 shed new light on the particular assumptions and country-specific technological and institutional settings that explain observed discrepancies in per meter costs and benefits. The author’s interest, however, lays mainly in understanding whether the calculated benefits outweigh the costs. His key finding is that “the amount of energy savings plays a vital role in determining whether the Net Present Value in any CBA is positive or negative because of the scale of the roll-outs, which involve millions of users” (p. 9). While this observation leads to much further discussion and analysis in the second part of the book, its key supporting evidence, reported at the end of Chapter 3, unfortunately relies on black-and-white graphical illustrations that are rather difficult to read.

Chapter 5 takes a broader view and explains how quantitative economic analysis (CBAs, but also multi-criteria analysis, environmental impact assessments, etc.) have become the norm in supporting policy decision-making in the energy sector. Notably, they enable “inclusive and participative process, in which there is an opportunity for deliberation and consensus building” (p. 93). The observed increasing complexity of impact assessment practices presents, however, both advantages (e.g., better depiction of economic actors and intergenerational trade-offs) and disadvantages (e.g., increasing data requirements).

The second part of the book reflects on the idea that overcoming current limitations in conducting CBAs and lowering procurement and installation costs is not enough. Once the infrastructure for smart metering is in place, the focus should be on what these rather expensive assets are used for.

An impressive meta-analysis covering 40 years of empirical studies assesses the net energy conservation effects which can be expected from the direct communication of electricity consumption data and cost to end-users (Chapter 6). While figures estimated in early studies are above 10%, more recent and reliable studies bring this number to around 3%. Indeed, evidence whether the information that smart meters provide can nudge end-users to adopt long-lasting changes in their energy consumption behaviour is rather mixed.

We learn in Chapter 7 that consumption is not only guided by data-driven rational choices, but also habits, or ‘practices’ (how people organize their everyday life). Although the book takes a rather theoretical approach to the subject, the idea to study how people might collectively adopt different practices over space and time, and therefore change consumption patterns, appears to be a fertile area for researchers. It also assumes a rather poignant meaning, in light of the current health crisis.

The last chapter touches briefly upon a large number of topics with the goal of creating a stronger connection between smart meters and smart homes, smart meters and active consumers, smart meters and energy communities, etc. Although most of these topics are the subject of ongoing research, the book achieves the goal of providing a concise (sometimes critical) overview of what the future might hold. More interestingly (because rarely found elsewhere), the chapter includes also an excursus on the advantages and disadvantages of new tariff designs, from capacity-based tariffs to real-time pricing. This part of the chapter is sensibly debated and supported by evidence, if available. The chapter ends with a useful summary of the key messages from the book.

Altogether, I have learned a lot from this work, even though I considered myself an informed reader. I particularly appreciated the fact that it addresses key, fundamental questions about the adoption of smart metering in energy systems, shows how ideas about the potential use of this technology changed over time, but still support today a desirable change of paradigm – where demand adapts to the availability of (intermittent) supply and not vice versa. At the same time, given the focus on costs and benefits, I expected to find some information regarding the actual expenditures sustained by end-users for the installation and roll-out of smart meters or evidence of actual savings from utility companies. Furthermore, smart meters have a limited useful life. Italy is already preparing for the roll-out of a second generation of assets, that will replace those installed in the early 2000s. While the topic is addressed in the book, it is also interesting to recall that this marked the opportunity for the Italian National Regulatory Authority to employ a novel approach to determine a distribution company’s allowed revenues (Deliberation 646/2016/R/EEL). This involves the use of an incentive compatible menu of profit-sharing contracts, and a so-called progress control mechanism enabling the regulator to closely monitor the actual deployment of the smart meters. This example seems to confirm their role as catalysts for further innovations.

To conclude, I would recommend this book to a broad audience, from graduate students to analysts and policy makers, as an objective, evidence-based reference on the costs and benefits of smart meters. Learning from another’s scholar experience will also give guidance and perspective to researchers interested in studying high frequency energy consumption data to

enhance consumer participation in energy markets or to understand behavioural and social practices related to energy consumption.

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***Decentralised Energy—A Global Game Changer***, edited by Christoph Burger, Anthony Froggatt, Catherine Mitchell and Jens Weinmann (Ubiquity Press, 2020). 313 pages, ISBN: 978-1-911529-68-2.

A free book: in open access, from Berlin. You may think from the Berlin “Free University”; certainly not a business school working for free. You would be wrong. The leading editor (Christoph Burger) and another one (Jens Weinmann) are both from the business school blessed by the German industry: ESMT, Berlin.

Apart from being itself a business case on how to share research outputs (the book got already 900 downloads in less than five months), what does the book do? It aims to conclude the topic firstly addressed seven years ago with another book: what do we know about energy decentralisation and the corresponding business changes – following it or pushing it?<sup>1</sup>

Four conclusions are worth to remember. First, the growth of decentralised energy is not a single factor novelty, but the result of a multitude of different factors. In the past decade, several technologies for renewable electricity generation became competitive. These technologies were accessible enough to spread almost everywhere around the world and ignite a truly global revolution. Storage appeared doable, both technically and financially. Added value was created with decentralised energy. Digitalisation permitted new ways of managing grids and the whole electricity system, and of creating new business models.

Second, several innovative mechanisms of governance contributed to the emergence of decentralised energy. The authors find eight of them that are key. Among them I would like to pick seven: data availability; customer choice; procurement of system flexibility via markets; coordinating local energy systems; establishing coexistence of local and central grids; reassessing investments in long distance grids; and, last but not least, defining a new regulatory framework with significant ‘performance-based’ incentive tools.

Third, if one looks beyond the existing subsidy schemes to support renewable energy and tries to identify self-sustained new business models, corresponding more or less to a new normal in a decentralised energy world, what would he or she find? The authors find three models based on:

- a) energy self-production for various kinds of prosumers, extending up to mini-grids in Bangladesh or off-grid solutions in East Africa;
- b) offering new energy services, such as guaranteeing energy performance of buildings or conceiving energy autonomous houses;

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1. Burger C. and J. Weinmann, *The Decentralised Energy Revolution. Business Strategies for a New Paradigm*, Palgrave Macmillan, 2013.

- c) digitalisation of interactions, such as platforms for peer-to-peer energy trading or for aggregating demand response at the retail level and sell it at the wholesale level.

Fourth, what competencies and skills do companies need for their corporate decision-makers to fully benefit from these new business model trends? A lot is the short answer. As they are six in total:

- i. digitalisation: from simple data management to full artificial intelligence;
- ii. customer centricity: no power plant's output to sell on the mass market, but customer smart segmentation to create value;
- iii. innovative financing enabling prosumers, up to crowdfunding and virtual currencies;
- iv. technology and product innovation, including sensors, drones and micro-grids;
- v. strategic partnerships, as no single company can master all the key ingredients and follow up on them, at a time in which large corporations enter the renewables area from outside the energy industry;
- vi. mastering of platforms and ecosystems, to avoid investing in redundant asset ownership and be able to develop sharp coordination skills.

The book has very strong bones. The ESMT team (Burger and Weinemann) shared the editorial function with a team from the University of Exeter (C. Mitchell and A. Frogatt) that brings another two pairs of sharp eyes and cumulated experience. Together they have gathered ten other contributors, including Arturo Lorenzoni, professor and deputy mayor in Padova, Italy. This group of 14 authors review seven countries and perform seven companies case studies. The common output is strong, honest, useful and unrivalled.

Of course, like any collective book, it has the limits of a collective work (even if avoiding the 'Tragedy of the Commons'). For example, renewables undertaking can be both centralised or decentralised. Centralisation is dominant in China (a very centralised renewable push, only decentralised by the double nature of the Chinese state – being Beijing plus 34 territories). Another form of centralisation is also there with Orsted in Denmark and Equinor in Norway, two heavy headquarters of the ongoing renewables push. As wind offshore and 'utility solar' projects are globally pushed by a few big players all over the world. The size of the players is so relevant in this subpart of the renewables adventure that some traditional European utilities are becoming world players, as it is for instance the case of Enel, EDF, EDP and Engie. And several oil & gas European leaders, like Shell, BP and Total, were announcing major renewable strategies, before being impoverished by the Covid-19 crisis.

Apart from this push on the renewable scene by big players, another questioning of the decentralised energy future comes from the blossoming of "energy communities". It is not so obvious that decentralisation pushes in the direction of a larger role for communities. If we follow the Australian renewables revolution, well described by this overall excellent book, extreme decentralisation comes with prosumers: individual prosumers with individual storage, not within new "commons".

I assume that the leading authors, from Berlin and Exeter, now know that I am nervously awaiting their next decentralised book: please, before 2027...

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***Empowering the Great Energy Transition. Policy for a Low-Carbon Future***, by Scott V. Valentine, Marilyn A. Brown, and Benjamin K. Sovacool (Columbia University Press, 2019). 336 pages. ISBN: 9780231185967.

The expression “energy transition” encompasses three main changes, presently under way. First, the growing share of renewable energy in the overall energy mix. Second, the growing share of electricity in the final uses of energy, with a transformation of the electricity system from a hub-and-spoke cobweb to a more decentralized and flexible model. Third, a net change of energy demand resulting from two opposite trends: on the one hand, an increase in demand originated by a growing population and the diffusion of the energy-intensive Western way of life at the world level; on the other hand, a decline in energy demand produced by technology-induced efficiency and by rising awareness of the risks associated with that model.

These lines of change are originated by many, only partially interdependent, drivers: population, technologies, cultures. They overlap and interact, creating a “Great Energy Transition” that should be not only recognized, but “empowered”. These are the ingredients to the book by Valentine, Brown and Sovacool which I will conveniently call EGET.

Models are being produced in research centres, to represent interactions and to build scenarios. However, beyond forecasting, understanding is needed. Here is where EGET helps, with a wide panorama of issues and a wealth of cases that illustrate the variety of contexts and choices.

Most readers will be already well aware of the complexity of the energy transition, although perceptions are often partial and different aspects are seen as unique or overarching. EGET helps readers in assembling information and reaching a more complete, balanced viewpoint.

The transition is happening, whatever we do. Yet, individual behaviour, company choices, and government policies affect its shape, speed and scope. Before arriving at the conclusion that indeed a quick and radical transition is needed, EGET explores, in the first two chapters, the forces working in favour and against it. The approach is objective. At first all forces at work are described, and conclusion is that, considering their overall impact, a faster movement should be expected. Closer attention is thus focused, in chapter 2, on the forces that work against. This exhaustive, but sometimes repetitive, double listing sets the basis for all the following chapters, which provide a deeper and more complete description of the issues.

Not all arguments in favour or against a quick and radical energy transition are equally convincing. The “growing evidence of declining fossil fuel stocks and rising prices” that is set at the beginning of chapter 1 as trend number one, looked less than certain to me when I started reading EGET, and even less now, due to the looming, and unforeseeable, recession.

Maybe the transition looks slower than it could be expected because we are still used to making mental reference to linear changes, where speed is constant, while learning and diffusion of new technologies often follow an exponential growth, characterised by an increasing speed. At the same time, material and cultural obstacles are strong at the beginning and then weaker, when ways for overcoming them are found or agreed upon.

It has been a wise choice to devote one chapter (chapter 3) to deal with the uncertainties regarding climate change. A “wait and see” attitude with respect to climate change policies looks like common sense in front of an uncertain risk and a costly action. Unfortunately, it is still widely accepted and followed. Serious prevailing scientific opinion is getting mixed with few, isolated and unreliable opposite opinions, and an apparently balanced “middle course”

results, among opinions of very unequal reliability. The immediate perception of little environmental change (in wealthy regions) and the high costs of innovative policies also lead to inertia today, and to higher risks tomorrow.

One main obstacle to the energy transition is the long list of potentially sunk costs, ranging from the fossil-fuelled power stations and industrial plants to the fleets of traditionally powered vehicles, to the value chains and complex productive and commercial systems around them. This is a problem in search of intelligent, path-breaking solutions, for which a correct timing is decisive.

The weight of sunk and potentially sunk costs represents a threat to the expected value of many companies, especially in the fossil fuels industry, and even if the threat regards the future, stock markets see it today. Such companies find themselves in an uncomfortable straitjacket, which calls for an exceptional inventive skill in their managers, and also sets a backstage for some deplorable and, alas, effective exercises in an interested manipulation of scientific information by the “merchants of doubt”. No definition is better than this title of another important book, rightly cited in EGET, where, by the way, an ordered and traditional bibliography is missing.

EGET is rich in the description of different cases, and this makes an interesting, involving, and rewarding reading. It provides very useful insights into possible policies.

Alternative ways for the decarbonization of the energy industry are evaluated. For instance, defensive strategies of the energy companies are placing an excessive confidence in carbon dioxide removal and its subspecies carbon capture and sequestration. These are absorbing large amounts of private and public investment with an uncertain future.

Decarbonization implies a substantial investment effort. From the point of view of private operators, investment is profitable when emissions are taxed at a high enough level. The cost of emissions reduction was estimated at 80 \$/ton in 2010 and foreseen down to 25 \$/ton by 2020 (p. 121). It is interesting to notice that the price of emissions as set by the European emission trading system (the largest in the world) is around 25 €/ton now, hopefully to be prevented from plummeting during the recession under way. Diffusion of emission trading schemes around the world is convincingly recommended.

Public investment can be financed in part from revenue from emissions taxation. This way, carbon taxes (or tradeable allowances) provide revenue that can be spent either to promote decarbonization, or in social spending, to balance the regressive impact of a carbon tax on income distribution.

Investment is also seen as crucial in developing countries, where financial barriers must be removed to reach the twin goals of making the existing energy systems more sustainable, and of extending them to provide clean energy to the millions who are still deprived.

Innovation is key to a clean future, and appropriate policies are needed. Not only subsidies and compulsory regulations, but also information and nudging, like labelling, audits, and systemic benchmarking. All these are ways to influence those preferences that economists usually take for granted, and companies try to steer towards their sales. Policymakers can orient them to socially positive goals with a low-cost strategy which can trigger chain effects.

Consumers enjoy wonderful chances of undertaking new functions. Inertia can be overcome through transforming an innovation, like improving the energy efficiency of one's home, into a “social event” that draws interest, admiration and imitation among neighbours, one that even laggards cannot bear to miss out on, the same way as buying a car was a “social event” one century ago, and buying a colour TV set in the 1950s.

Enacting a positive governance of global issues is a much more complex and challenging task than just advising a government on what it can do directly. Issues may be “wicked”, carrying ambivalences and unwanted effects of well-meaning initiatives. A holistic approach is effectively illustrated in the book through various examples in different countries.

A world challenge is here to be taken up. Starting with a neutral approach, the authors turn to a passionate exercise in persuasion: the great energy transition will happen anyway, but it will provide net advantages to society only if political decision-makers see it clearly and work towards orienting it, at all levels.

The great energy transition is inevitable, in that it is moved by “compelling forces”: this is clear, but these compelling forces are quite diverse and the scope and the timing of the transition itself are uncertain.

Regarding the extent to which the present energy system is going to be transformed, one open question is the role of nuclear in future scenarios. This book carefully explores the variety of arguments in favour of nuclear as an emission-free source of energy, and against it because of other risks and undesirable effects. It is interesting to learn how these arguments are considered in widely different contexts and time. At the end, a reader comes out with a feeling that nuclear does not belong to a desirable future, although research and innovation may open new ways.

Regarding the timing, well, uncertainty over the time profile of climate change itself looms large, and again the variety of regional and national political contexts suggests caution.

Uncertainties notwithstanding, EGET ends with clear recommendations, directed not only to policymakers but also to all “individuals who wish to make a difference”, and even more so if they are organisational leaders. All of us can be “political decision-makers”, in force of the diffusive effects of our beliefs and actions, including advocacy, changing individual lifestyle, commitment to steering companies and organisations toward increases in energy efficiency. While a scholar will appreciate the wealth of evidences supporting or weakening the basic statements which lie at the core of the present debate, non-professional readers may also appreciate this book and find an opportunity for broadening their understanding of complex issues and for taking a clear and practical stand in favour of sustainability.

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