

Consumer-centric service innovations in an era of self-selecting customers

Emi Minghui Gui and Iain MacGill
Centre for Energy and Environmental Markets (CEEM) and
School of Electrical Engineering and Telecommunications
UNSW Sydney

Abstract

Today's energy consumers are increasingly empowered, yet also potentially overwhelmed, by a growing multitude of choices including new distributed energy 'product' offerings such as rooftop solar, smart loads and energy storage, as well as energy service oriented options such as more cost-reflective tariffs, peer to peer trading and virtual power plant participation. This widening range of choices creates both opportunities yet also challenges for consumers ready, willing and able to engage in their service provision. In particular, self-selecting 'customers' of these products and services must make highly complex choices under considerable technical and financial uncertainty. Fortunately, a growing number of consumer centric service innovations are now seeking to assist consumers in such decision making. In this Chapter, we first describe and classify the growing range of produce and service offerings. We then describe some of the existing models for better understanding consumer decision making and present some insights about how we might better facilitate appropriate consumer decisions regarding energy service provision. Finally, we categorise and present examples of different key consumer-centric service models offering simple and no-frill services, customized and personalized solutions, or more fully integrated services.

Key words

Energy choice, consumer decision making, consumer behavior, non-utility service, consumer-centric business model

1. Introduction

As explained in other chapters of this volume, the development of distributed and smart grid technologies in recent decades has led to a new paradigm where consumers can choose to become more actively engaged in their energy supply. Such engagement may include demand response as market conditions change, energy production as well as consumption making them producer-consumers or prosumers, or with the further addition of energy storage, prosumagers. Behind all of these consumer possibilities lie new technology options, and growing consumer interest in greater participation in their energy service provision. As noted by the CEO of the Australian Energy Market Operator (AEMO) Audrey Zibelman (Parkinson, 2018),

"In 10 years time, the influence of distributed energy – rooftop solar, battery storage and smart software – would mean smart homes and consumers who understood their appliances, such as pool pumps, rooftop solar, fridges, would respond to price signals."

This phenomenon reflects the underlying economic benefits with greater consumer participation, yet also present commercial retail 'market' arrangements, and wider societal imperatives for improved energy sector outcomes. On one side, varied technology and service providers are 'pushing' a growing range of clean energy and energy efficient technologies, products and associated services to 'market'. On the other side, rising electricity costs, governments' policy incentives on clean energy and energy efficiency and consumer awareness and commitments to renewable energy and sustainability, are all driving market 'pull' for these new products and services (Gui and MacGill, 2018).

The strong growth in household investments in energy efficient and distributed energy products and services seen in many parts of the world is shifting the entire equipment vendor and service provider ecosystem, with significant implications for utilities and other energy products and services providers, old and new. In particular, some of the existing players are finding that the 'consumers' that they once served are now selecting to be 'customers' – customers whose business they need to win, and may perhaps lose.

All participants, old and new, therefore need to better understand the consumer decision making and behavioral processes that lie behind them choosing whether to engage in their energy service provision, and what such engagement will involve:

- what choices do energy consumers really have in view of the proliferation of new energy products and services, yet existing institutional and 'market' arrangements?
- how do they make energy related decisions in the context of the potential costs and benefits involved, yet also their demographic, personal and financial resources, and social networks, and indeed interest or otherwise in energy service provision?
- what 'consumer-centric' service innovations will allow providers to build business models for improving consumer outcomes taking into account consumer options and their decision making processes?

Some of these aspects have been discussed in the introduction of this book and previous chapters. In particular, Bruce Mountain's chapter discusses some of the challenges of meaningful end-user engagement in present retail markets, with a focus on the Australian National Electricity Market (NEM) – a jurisdiction that features in our own article. Stanley and colleagues' chapter reviewing new platforms for service trading, and Weiss and colleagues' description of how the large German utilities have responded to these and other disruptions to their traditional business model are also very relevant.

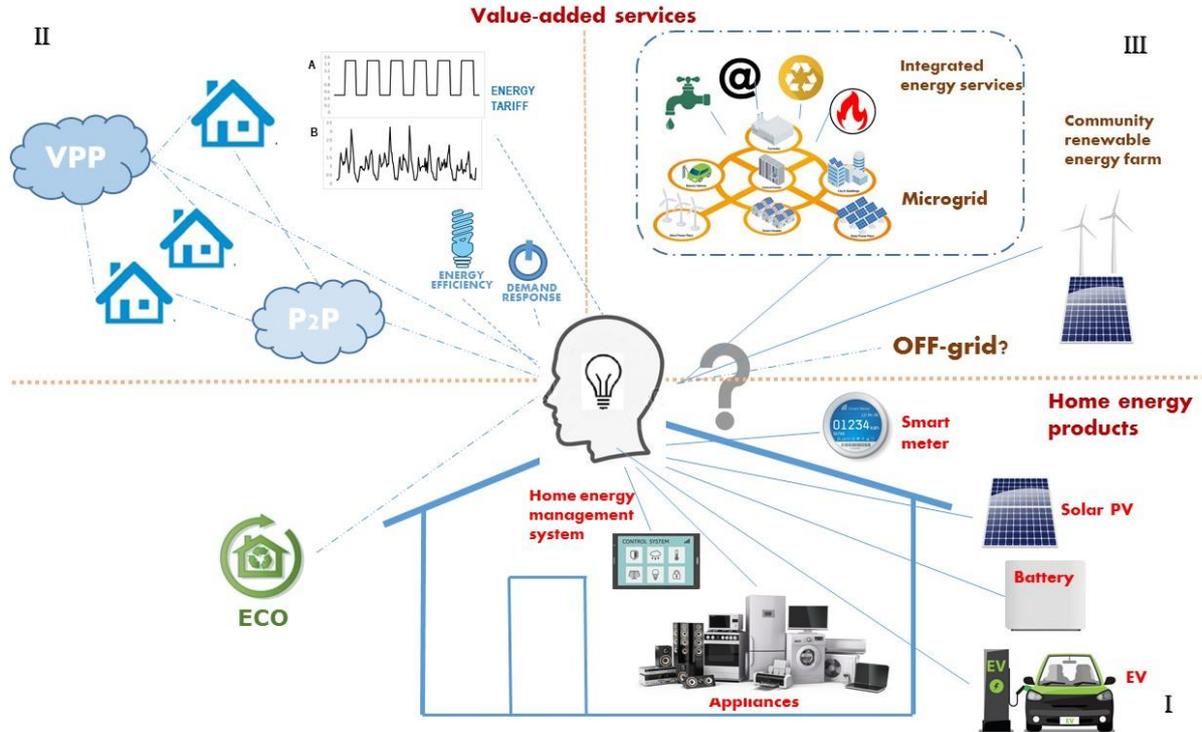
Our contribution in this chapter focuses on the three questions identified above – in summary, what are the key behavioral factors of engaged consumer decision-making in an energy future full of complex and interacting choices, and what business models and strategies are emerging to better facilitate such consumer decision making.

This chapter is organized as follows: Section 2 reviews three key groups of choices of energy products and services that are available to energy consumers in today's electricity sector; Section 3 analyzes the process of consumers' decision making and behavior, as well as the external and psychological factors influencing their decisions; while Section 4 provides some case studies of utilities and new players developing consumer-centric service models, and discusses their value proposition and potential.

2. Widening set of energy choices

Technology innovation in home energy management, home automation, distributed energy, and smart grids is creating an ever-widening set of energy choices for consumers, provided by an expanding set of providers. Based on their functional characteristics, three key opportunities for consumer energy products and services can be identified, as illustrated in Figure 1.

Figure 1. Key categories of consumer energy products and services



Source: authors own illustration (some images from Shutterstock.com)

- I 'off-the-shelf' physical products that customers can purchase, such as LED lighting, energy-efficient electrical appliances and water heaters, thermostat, home energy management devices and systems, solar PV panels, battery storage, electric vehicles; in general, products that are typically modular and address specific demand or supply side needs;
- II 'add-on' services on top of the first group of products that change the nature of service provision such as more cost-reflective dynamic electricity tariffs, demand response, energy efficiency, virtual power plants and peer-to-peer trading. Although requiring no or little extra capital investments, they involve greater customer interaction and management of their electricity-derived service activities; and
- III community based energy solutions or community invested energy projects that can be managed by either communities themselves or third parties, such as community energy projects, community microgrids, integrated energy systems; in general, activities that require community level planning and governance.

The first two groups involve primarily individual decisions, and these choices are typically not mutual exclusive; for example, consumers can purchase appliances and systems they desire, while still participating in different service arrangements. The third

type is community based, hence requires a certain level of community consensus and involvement, and the choices tend to be mutually exclusive, customers may need to choose to engage in one solution or the other.

In general, the first and third groups require considerable up-front investments, thus are subject to consumers' willingness-to-pay for these products and services, and budgetary constraints. These choices can be competing with each other, for example, a budget constrained consumer may choose to invest in energy-efficient appliances and participate in a time-based electricity tariff, rather than purchasing solar PV and battery storage. In contrast, others may invest more on the supply-side technologies by installing solar PV and battery storage in order to gain savings and rewards from greater self-sufficiency as well supply to the grid.

At the same time of course, there are likely to be many consumers with no interest in engaging with their energy service provision beyond buying end-use equipment if and as required, and with little interest in its performance beyond whether it delivers the desired energy service, and paying their electricity bills as they come in. Such consumers are, effectively, self-selecting to not be customers for any of these products and services.

The focus of this book chapter is on consumer-based products and services described in group I and II. Further discussion on community-based solutions can be found elsewhere in this book; for instance, the chapter by Koirala and colleagues examines the socio-technical, economic, and institutional requirements for the development of community energy storage, while Couture and colleagues discuss decentralized energy systems in the context of off-grid electrification applications.

Our chapter also focusses, of course, on potential 'customers' for such products and services; that is, those self-selected consumers who are ready, willing and able to engage in their energy service provision. However, it needs to be kept in mind that even with all the exciting new products and services, and emerging business models to provide them, electricity industry arrangements still need to cater for those consumers who 'self-select' not to be customers. This may well be a sizeable proportion of consumers, as discussed further in Section 3.4.

2.1 Consumer energy products

Consumer energy products are mostly modular products around homes or small businesses that typically allow consumers to self-generate own electricity and/or self-manage their consumption to achieve private goals, whether these are to lower energy bills, to gain financial rewards, to use home appliances more efficiently, or to reduce their carbon footprint. For example, with the investment of around A\$15000 for a solar and battery energy storage system, an average Australian family might in some circumstances be able to reduce their electricity bills to below A\$10 per month, instead of paying a A\$200-A\$300 monthly bill without this equipment installed (Mayoh, 2017). The family's carbon footprint will also be markedly reduced given the high emissions intensity of the present Australian electricity generation mix.

On the demand-side, products such as smart meters and home energy management equipment and systems (HEMS), as well as more energy efficient appliances, can all aid consumers in self-regulating their consumption in terms of both timing and overall consumption. More recently, the next generation of smart home energy management devices enabled by Internet of Things (IoT), cloud computing, data analytics, and advanced device interconnectivity, allows households and businesses to precisely control key energy equipment including air-conditioners, computers, television and

other appliances with advanced automated scheduling as well as ‘just in time’ responses, all enabled through their smartphones to realize real-time energy management.

Some key components and communication technology players at the forefront of the HEMS market at present include Aclara, Energate, Trilliant, Honeywell, Nest, Logitech, Energyhub, GE, Panasonic etc. (Market Research Future, 2018). According to Navigant Research, the HEMS market is projected to grow from \$2.3 billion in 2016 to \$7.8 billion by 2025 (Navigant Research, 2018).

The evolution of HEMS is moving away from HEMS1.0 technology mostly deployed by utilities through point solution devices such as direct load control and thermostat programs, to HEMS3.0 offering bundled residential services through holistic cloud-based platforms by blue chip and start-up service providers (Saadeh, 2015). As noted by GTM Research (Hill, 2015),

“Blue chip vendors, such as Apple, ADT, Google (after its acquisition of Nest), Samsung, Verizon, and Wal-Mart are all “partnering with incumbent hardware and software providers to develop home internet-of-things ecosystems to usher in a new phase of home energy management solutions.”

“Venture-backed start-ups are positioning themselves to take advantage of the new and competitive era of energy management in the connected home that is driven by the proliferation of consumer interest in smart devices and increasing efforts to reduce home energy bills”, “market growth is creating opportunities for companies on both sides of the meter.”

2.2 “Value-added” services

The second and third groups are services that can be supplied by both utilities and third-party providers as “value-added services”, that can be defined as *“energy services beyond electricity supply and energy grid services that may include customized or bespoke energy products/services that meet customer demand for renewable energy, integrated energy management solutions, energy storage, microgrids, electric vehicle charging, private or community solar, energy efficiency, or other services”* (Blansfield et al., 2017).

Many of these services require specialized support systems, dedicated infrastructure, and large investments, and are therefore primarily provider-dependent, with mostly voluntary participation by interested consumers. They allow joint value creation to increase utilization of assets and exchange of services, while offering secondary economic, environmental and societal value to households and communities (Gui et al., 2017). Key categories of value-added services and their rationale are listed in Sioshansi’s Introduction for this book, including cost-reflective tariffs, demand response, energy efficiency, VPPs, P2P, community microgrids and community-scale energy projects.

There is still debate on whether the incumbent utilities should be restricted in the provision of such value-added services. After all, they have the advantages of an established customer base, technical capability in network design, grid operation and management, and often ample financial resources. Nonetheless, many of them are facing competition from numerous niche providers, that can offer specialized and customized services for residential customers and communities, such as residential demand response (DR), P2P trading, VPP and community microgrids.

Benefiting from a new generation of distributed technologies and home energy products, and the plethora of energy data and communication options for devices and customer messaging, these new businesses can quickly emerge to fill needs in the residential sector that are traditionally underserved by utilities, often due to lack of enabling technologies and the traditionally large transaction costs related to serving a large number of small customers. For instance, the residential DR market is rapidly developing with the aid of new hardware and software offerings by many startup companies such as Whisker Labs, EnergyHub, AutoGrid and Nest (Wokutch, 2011). As noted above, P2P trading, VPP and community microgrids are discussed in depth in a number of Chapters in this book.

Further, non-utility service providers can now interact directly with consumers by bypassing a consumer's electric utility and providing smart grid products and services directly to the consumers. Their services can assist consumers in managing their electricity activities on a real-time basis, using electric efficiency analysis and energy management Interfaces via advanced metering devices, Web portals, software, and home area networks (Blansfield et al., 2017).

Meanwhile, for many incumbent utilities, the development of new service offerings is seen as a way to recoup eroded revenue base as a result of more energy efficient and self-sufficient consumers, or simply to stay relevant. As noted in the chapter by Woodhouse and colleagues, many new innovations are expected to come from outside the industry not from within. Unsurprisingly, the PwC's 13th global utilities CEO survey result indicates that more than a quarter of respondents agreed that the biggest competitive threat could come from companies with strong brands outside the sector (PwC, 2014).

3. Consumer decision making process

The proliferation of energy products and services brought about by the distributed and smart home technology advancements creates new opportunities yet challenges for consumers. As note earlier, many consumers may not wish to engage, and arrangements must continue to work for them. For those consumers ready, willing and able to engage, it does require them to make important, yet complex decisions regarding their energy service provision, including:

- What new electric appliances to purchase, and with what features?
- Whether to deploy smart metering, monitoring and load management
- Whether to install solar rooftop PV panels and battery energy storage?
- Which electricity retailer and type of tariff plan to select?
- What other possible service providers might they engage with, for which services?
- Whether to participate in a community energy project?
- To stay on-grid or off-the-grid?

These individual consumer decisions not only affect their own energy situation, but also influence the market development of new technologies, products and services as well as, in aggregate, potentially driving broader energy industry changes. Thus, understanding the consumer decision-making process, is indispensable for utilities and other product and service providers for effective long-term engagement of their customers.

3.1 Five stages of consumer decision making

A five-stage consumer decision making process (Dudovskiy, 2013) for a household facing energy-related decisions might involve the following steps (Figure 1):

- needs recognition,
- search for information,
- evaluation of alternatives,
- purchase, and
- post purchase evaluation.

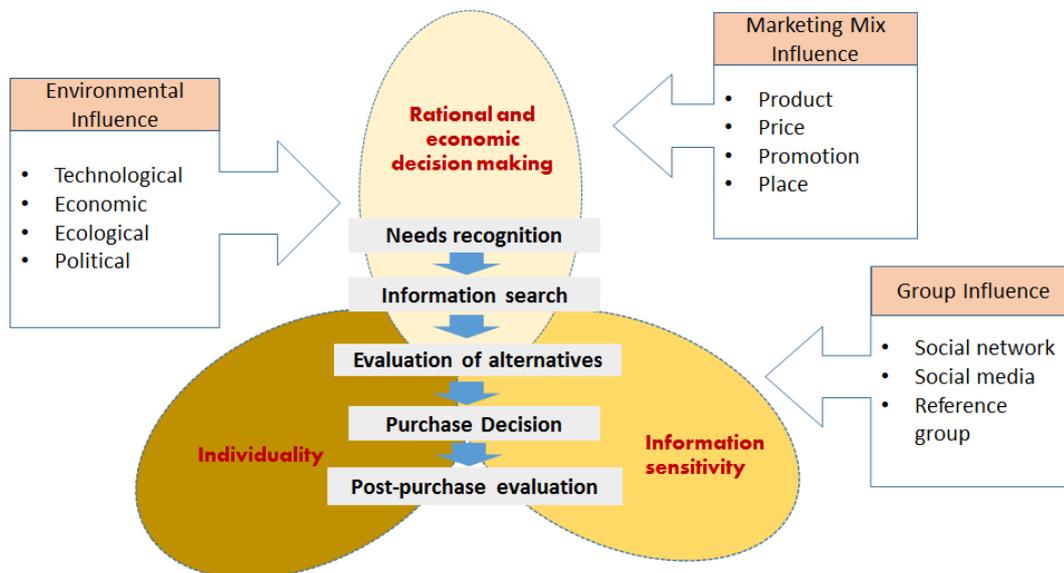
As many energy-related consumer decisions are complex, technical, unfamiliar, and novel, only a small number of sophisticated consumers may be able to gather and process all required information and perform a reasonably rational decisions. Worse, many separate but interrelated decisions need to be made progressively over an extended period of time while one decision can affect subsequent decisions. Therefore, the process of evaluation of alternatives can be difficult, time consuming and potentially pressured (Ha et al., 2010) even for an energy expert, let alone an average 'mum and dad' consumer.

Considerable upfront capital requirements and long replacement life cycles for many of these products and services add additional complexity and the decision making often require professional knowledge and skills. For example, working with a budget of \$5000 and desire to lower heating and cooling bills, a household may consider to either purchase a reverse cycle air conditioner, or install a 2.5 kW solar system. Although both can arrive at a lower heating and cooling bill, the choice is not readily straightforward, particularly given future uncertainties.

The adaptation of energy behaviors and solutions are often necessary post acquisition of energy products and services in order to achieve best outcomes. For instance, a case study in the Netherlands on TOU pricing and home energy management systems found that changed customer behavior to achieve savings may be maintained for only a short period, after which the rebound effect takes hold and benefits are not sustained for the long term as a significant number of customers revert to their traditional patterns of electricity consumption (Hu et al., 2015).

The decision-making process is further complicated by consumer behavioral processes bounded by information sensitivity, individuality, and rational and economic decision making, and influenced by environmental, marketing and group influences, and particularly external stimuli, as illustrated in Figure 2.

Figure 2. Consumer decision process, external influences and behavioral factors (Kanagal, 2016; Kotler, 1997).



Source: Adapted from Kanagal, N.B. 2016, Kotler, P. 1997

3.2 External Stimuli

The consumer decision making process may be influenced by external stimuli (Engel et al., 1995), including environmental influences, such as economic, technological, political, and social/culture aspects, marketing influences, such as product, price, promotion, and place, and group influences, such as ‘word-of-mouth’ and peer groups.

As widely acknowledged, technological, political, and social environments are particularly significant in the context of energy market and climate change, as consumers’ choices of products and services are primarily driven by technological advancements, and consumer decisions largely respond to policy incentives yet also broader market and social settings. The marketing and group influences on the consumer decision making process are clearly worthy of further consideration. They are discussed in more details respectively below.

Marketing influences:

In a competitive marketing environment, home energy products are evaluated and selected based on price, promotion, and a varied set of product parameters such as quality, functionality, design, and energy efficiency. Some innovative products have been introduced to Australian households and consumers to support more efficient use of electricity and better experiences, for example, Redback Hybrid System, offering intelligent technology that can store, monitor and manage solar energy around consumers’ home in a compact and elegant unit, controlled from your smartphone (RedBackTech, 2018). To help reduce barriers to adoption, including high upfront costs and uncertainty regarding product performance for some home energy products, many innovative financing schemes such as leasing options and zero interest loans are being offered by providers. As one recent example, an innovative start-up ShineHub has released a “fixed rate, free access” product in Australia to get solar panels and battery energy storage installed without any upfront costs. Households also get free hardware, free installation, a reduced electricity tariff, and can save between 14-50% on their electricity bill (Chang, 2018).

Research on European and US consumer preferences for energy efficient products highlights that the final consumer buying decision is strongly influenced by point-of-purchase promotions and information from all channels including state efficiency programs. These decisions are indirectly affected by the availability of efficient products as determined by the manufacturer and the stocking practices of the retailers since customers cannot buy what is not offered in the market (Attali et al., 2009; McNary, 2008). Governments can also play a direct role in promoting products and services, through targeted government programs and information portals. For example, the Victorian government in Australia offers a A\$50 cash incentive for each household which visits an energy comparison website during a specified period to encourage people to find better power deals. It is claimed that the website has clear impacts on consumer decisions and can result in savings of \$330 on energy bills of a typical household in the first year alone (Edwards, 2018). The challenges of comparison shopping in the Victorian retail electricity market within the Australian NEM are discussed at length in the chapter by Bruce Mountain.

Group influences:

Consumers acquire their knowledge and experience through a process of learning and usage of the products and services under consideration, which is heavily influenced by the group and business environment around the consumer. This environment is, of course, impacted in the longer-term by the aggregate outcomes of consumer decision making processes. Informal and formal discussion groups and forums on Facebook, Twitter etc., including more professional channels and moderated sites by expert organizations, such as the Alternative Technology Association and Consumer advocates Choice in Australia, can be set up to engage targeted groups to share knowledge and experiences. Some, such as 'My Efficient Electric Home' discussion forums created by Melbourne Energy Institute, provide a platform not only for information sharing, but also for members to lobby governments toward more progressive policies and regulations removing disincentives for certain products and technologies, for example heat pumps. It is estimated that the discussions on this particular platform may have influenced more than A\$400,000 worth of member purchases to date (Forcey, 2017).

Social influences, such as 'word of mouth', reference groups, and interaction in mass-media that allow for social interactions, can all have spill over effects on energy consumer decision processes, and encourage behavior change. This has proven to be so effective that part of Sonnen's sales strategy for their solar and battery energy storage product hinges on the 'cluster' or 'contagion' effect - people who buy cutting edge 'cool' products, such as solar battery, solar panels, electric vehicles, like to tell their neighbors and peers about it, some then follow suit, and further spread the message (Kelly-Detwiler, 2017).

These groups thus can play an important intermediary role as knowledge brokers to foster social learning and innovation by recombining and transferring knowledge among members and communities. These intermediaries not only facilitate exchanges of knowledge and ideas, among close-knit communities, but also geographically dispersed communities, with some also offering commercial, technical and financial advice, policy advocacy and policy support. In community based projects, their role is even more prominent through linking individual project and isolated initiatives and discussing common pathways for development, through to sharing an increasingly coherent identity and more networked activities (Smith et al., 2016). This experience generates important social and technical know-how, and hopefully supports the more

complex energy activities required in community based initiatives, such as applying for grants, seeking loans, raising money, planning and building permissions, insurance and marketing strategies (Hargreaves et al., 2013) .

3.3 Behavioral process

In theory at least, energy related consumer decisions are made through choices for customized electricity products and solutions best attending to individual preferences (time and trust), behavior (knowledge and information, convenience) and economic circumstances (financial). These mostly relate to consumers allocating resources as they see fit, among the options that are available to them, to acquire their 'choice of products', 'choice of services', or 'choice of investments'. It is, however, a bounded exercise for reasons including those outlined here, specifically information sensitivity, individuality, and rational and economic decision making (Kanagal, 2016).

- *Information sensitivity:* Nowadays, there exist numerous information outlets, providing information on relevant government initiatives and incentives, smart homes and home automation, home energy ratings, advice on how to choose solar products and energy efficient appliances, as well as on how to adjust consumption patterns for more efficient use of consumers' solar systems and other technologies. These often require consumers to possess certain degree of proficiency to understand adequately the products and services they require, administering technologies involved, market and policy information, and their combined effects. Or else, consumers can make economically disadvantageous decisions. From this perspective, appropriate communication strategies from 'expert advisors' such as policy makers, utilities, and other providers, through education, marketing, advertising, and regulation will help overcome inertia or information barriers, and facilitate appropriate consumer choices and thus more efficient marketplace outcomes.

As one example of efforts to induce consumers to make better informed decisions, the energy regulator in the UK has recently trialed an auction process in an attempt to find better energy deals for 'sticky' customers who failed to shop around in the last three years. The customers can decline the chance to opt-in to the switch. In this case, government intervention acts as a 'nudge'¹ (Thaler and Sunstein, 2008), which is carefully selected and helps to minimize the decision costs and individual error costs. The results are yet to be seen in overcoming the inertia of not acting, thus leading to more satisfied consumers and improved consumer welfare.

- *Individuality:* In at least part, self-interest drives people to consider different energy plans and options for economic optimization or personal satisfaction. Consumer decision making is often closely related to their willingness-to-pay, that is not only exhibited in economic terms, but also in people's perception of satisfaction such as comforts and habits, and time value. Some research highlights that energy behaviour is strongly linked to households' financial situation (Pongiglione, 2011). For example, people with low incomes may be more willing to make life style changes such as taking up time-of-use tariffs or forgoing air conditioning at peak demand times. People with higher incomes can be more willing to pay extra for low energy electrical appliances, and new technology products such as solar PV, battery storage and electric vehicles. They are however more reluctant to constrain their personal freedom and give up habits

¹ A nudge alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives.

and lifestyle, therefore less incline to participate in recycling programs (Huhtala, 2010), and are more willing to drive than taking public transport.

The trust and credibility of service providers is also an important determinant of residential energy related choices and behavior, as well as acceptance of energy innovation and technology. Distrust reduces the likelihood of consumers to take up products and services offered by utilities. Evidently, electricity bill shocks and lack of trust in Australian electricity retailers are pushing householders increasingly towards generating their own power on their rooftops (Orchison, 2018). In another instance, when a distribution network company in Victoria asked its customers who should pay for investments for network reliability due to the increased uptake of rooftop solar on its networks: a) All customers b) Customers with solar panels who export, the unanimous response was clear (Vorrath, 2018):

“None of the above!! ... Power company invest own money so to get returns..”,

“we have paid over and over for your infrastructure, it’s part of your expense, it’s the solar panel owners who are supplementing your grid thus avoiding upgrades we are told”,

“If you start charging me more, SIMPLE I will just disconnect and install batteries.”

- *Rational and economic decision making*: serves to maximize utility for the consumption basket at the least cost, given budget constraints. In order to behave rationally in the economic sense, as this approach suggests, a consumer would have to be aware of all the available consumption options, be capable of correctly rating each alternative and be available to select the optimum course of action (Schiffman and Kanuk, 2007). Many product providers facilitate this process by offering online evaluation tools or quotes, tips and product/service comparisons to facilitate consumers decision making, for example, solar calculators/estimators to determine how many solar panels a household needs, payback periods, based on roof space, household appliances, products and more. The complexity of the decision making process increases significantly for value-added services categories as most require active management that involve an exchange of personal comfort and convenience for economic benefits. For solution-based services, such as microgrids, community-scale energy projects, rational and economic decision making will require even more complex and professional planning, ideally treated as ‘investment’ decisions. These often imply opportunity costs in decision-making, as consumers need to decide how to allocate their limited budget to energy assets and options that often have much longer replacement life cycles.

3.4 Decision making biases

In practice, a consumer’s actual decision is often not made rationally by assessing their individual situation for the best long-term benefits. Instead, household decision makers are prone to systematic errors in judging the benefits and costs of their energy choices. Sometimes consumers choose one option over another because they misestimate its value to them. For example, research shows that despite the push from the government and utilities towards the time-of-use (TOU) electricity tariff, NSW families who have moved from a single rate to a TOU electricity plan in an effort to cut costs may actually end up paying \$370 more each year if their demand cannot be reduced in the peak pricing period² (Han, 2017).

² The peak period in this context, typically refers to be between 2pm and 8pm on weekdays.

Some may be incapable or unwilling to choose for various reasons, referred to as 'nonsumers' by Ben-David in the preface of this book. The Chapter by Bruce Mountain also discusses why consumers in Victoria, Australia have shunned away from electricity tariffs with demand charges for reasons including the difficulties in accessing potential benefits, and lack of product information and promotion from retailers.

Some consumers may delay choice due to 'status quo bias'³ or 'inertia'. For instance, it is observed that switching energy provider to a more efficient one or substituting old household appliances with more energy efficient ones are not the easy and linear decision that one could expect (McNamara and Grubb, 2011; Pongiglione, 2011). As a result, many consumers may prefer simple rather than complicated alternatives, and be open to default options.

Human beings also discount future benefits by, are therefore inclined to shy away from more capital intensive upfront investment solutions even though they may yield medium/long term savings as the cash flow from these investments will be more uncertain and difficult to forecast. This aspect has created a major barrier for the commercial development of community-based long-term energy solutions, such as community microgrids, and integrated community energy systems (Gui et al., 2017). When visible immediate benefits are not achieved, this can also lead to limited incentives to adopt more efficient energy products and services, or change individual behavior.

In summary, energy consumers' decisions are mostly limited by accessibility of information, marketing and promotion activities, and significantly impacted by common cognitive and psychological factors, including individual knowledge and network effects. All these aspects of consumer decision making present huge challenges to providers in customer acquisition and retention, yet present opportunities for innovative providers to gain a foothold in a traditionally utility-dominated business environment.

4. Customer engagement as a key focus for utilities

As noted above, electricity utilities around the world are facing ever more demanding customers, stagnant on-grid load demand, and competition from non-utility providers to deliver value-added services. Consequently, utility partnerships and cooperation with innovative non-utility providers have become increasingly common. As an example, Greensync, an Australia's home grown demand-side management (DSM) provider, provides a range of products and interfaces to help manage virtual power plant, demand side resources, and network constraints, for utilities, retailers, energy markets, commercial and industrial businesses. It also offers a decentralized energy exchange (deX) platform that creates open market places for local energy to be generated, controlled or stored, and then traded between households, businesses, utilities and the larger market operators (GreenSync, 2018).

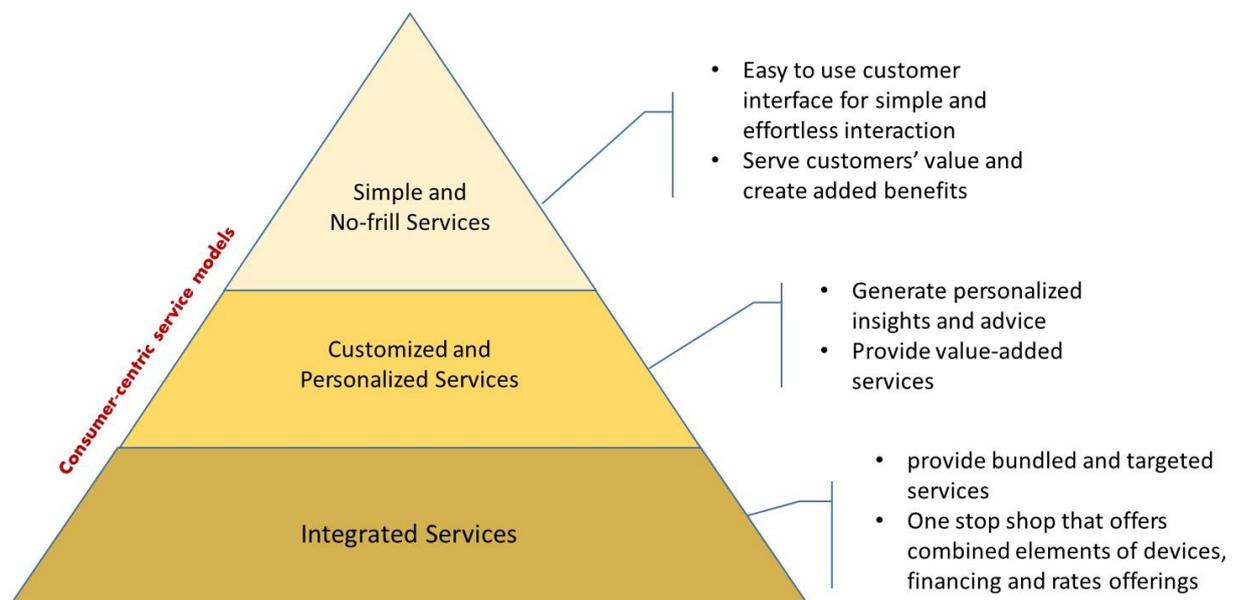
The growing pressure for better utility services from customers, competitors, and the broader marketplace requires a shift of business strategy from performance-based to customer-centric models, and the increase of offerings from the universal provision of standardized and undifferentiated products to the provision of personalized and customized solutions. These new products and services can help to engage and retain customers, and establish new revenue streams and areas for growth for utilities or, if they fail to do so, new competitors.

³ That is, consumers tend to resist change, and often reluctant to alter their habits and comforts, and instead favour the status quo or 'default' setting.

On the other hand, individual traits and characteristics of consumer decision making and behavior allow them to self-select into different energy options and solutions, which provides information for providers to design more targeted services. To better satisfy customers' needs, these additional programs and services should aim to help remove key constraints and hindrances in the consumer decision process, such as time, money, information barriers and decision complexity.

Deepening customer engagements demands providers and utilities better understand the science and art of consumer decision making and behavior, and embrace value-added services and solutions that are simple and easy-to-use, customized to individual needs, and integrated services to cater for multiple needs. In this section, we review three key consumer-centric service models working with utilities or employed by utilities; simple and fast services, personalized and customized services, and integrated utility services, as illustrated in Figure 3. These are drawn from around the world and only represent a small part of the growing activities being seen in the electricity sector.

Figure 3. Three key categories of consumer-centric service models.



Source: Authors own illustration

4.1 Simple and fast services – Ohmconnect

Ohmconnect is a start-up based in California that claims to be the first to help residential consumers to save energy and get paid for it. It covers the area in between from San Diego to Buffalo serving 300,000 small customers, and reports to have helped its customers save around \$4 million to date (Ohmconnect, 2018). Customers typically earn between \$50-150 per year, depending on how much electricity they typically use.

It works in three simple steps for customers:

1. Connect - customers first sign up for *Ohmconnect* and authorize the company to access their homes' smart meter and any supported internet-connected devices.
2. Save - the company will alert customers to energy spikes a few times a week, and ask them to cut back power consumption for the periods.
3. Cash out - The customer then get paid for the energy they don't use.

It is even simpler for customers who have the right thermostat, smart switches, or a *Tesla* electric vehicle since *Ohmconnect* can automatically manage their power consumption on behalf of the customers. The service includes an interactive map of where the electricity is coming from, to help customers better appreciate the emissions they reduced by using less electricity. After the designated hour is over, the company compares how much customers used with what they usually use to determine the payments to customers (Finley, 2015).

Ohmconnect provides added value to small customers by helping them to extract more value from their electricity usage, and to utilities better connecting to their customers. Further, its appeal to customers also lies in its easy to use interface and fast interaction with them. Therefore, the company can help significantly lower transaction costs for a large number of residential customers to participate in the wholesale market as a bundle.

A big challenge to the company, however, is how to effectively grow its customer base with minimum customer acquisition costs (EEI, 2018), and encourage greater customer participation. Given the small savings it generally offers, its revenue generation currently relies heavily on voluntary demand response (VDR)⁴ behavior (Gyamfi and Krumdieck, 2011) or pro-environmental charitable contributions by customers. For the long term sustainability and growth of the business, the company needs to expand its customer base and revenue streams, for example to more effectively identify and raise awareness among potential customers, to target customers with right equipment, or joint promotion of its services through utilities and equipment retailers. All this requires deeper understanding of potential customers behavior and decision making process.

4.2 Personalized and customized services – Wattcost, Opower, Bidgely

The digital transformation of the electricity system now makes personalized and customized services to households a real prospect, when these services have not been considered as economically viable for residential customers to date due to technology and transaction costs.

Wattcost, an Australian start-up, offers a smart product with a wireless sensor that listens to every appliance from electricity meter and captures real-time energy use to create personal intelligent home. It also help to identify potential electricity cost savings, reveal the lowest cost electricity plans to match customer's actual home energy use, and even send real-time alerts for appliance and home protection, and offer features for experience sharing with communities (Wattcost, 2017).

Opower, now part of Oracle, provides cloud-based software to the utility industry. Its software uses statistical algorithms to perform pattern recognition analysis from

⁴ It is defined as external signals or information changing normal electricity usage patterns for a certain period of time.

energy data and presents personalized insights to consumers in order to motivate reductions in energy consumption. Without any devices installed in the home, the platform can perform usage-disaggregation analysis, to generate recommendations about specific types of energy use such as heating or cooling usage, and to present marketplace suite, a utility-branded product recommendation engine, which enables the customer to search and sort products based on personalized estimates. It is reported that the average customer receiving the *Opower* platform has cut energy usage by more than 2.5 percent (Leuschner, 2017).

Bidgely (Bidgely, 2018), offers a white-label platform to utilities called HomeBeat Energy monitor that uses customer data to disaggregate energy use among household devices to help utility customers prioritize energy-savings efforts. The platform includes a mobile app and web portal that has features for personalised energy-saving insights, neighborhood comparisons, alerts and notifications, and social media channels.

The huge market potential in smart home space, unsurprisingly also invites entries from tech giants, such as Google, Apple, Amazon, who can easily leverage their existing relationship with customers, their connectivity, data and analytics capacity to lead the market development, as alluded by Woodhouse et al. All three companies have launched to market their smart home hub services - Google Home, Apple HomeKit and Amazon Alexa, enabling customers connect and automate control of various smart home devices and set pre-programmed actions, from switching on and off lights, regulating room temperature through thermostats, to locking doors.

These technologies may well provide these tech giants with far greater insights about customer homes and their energy consumption behavior than the utilities that actually provide them electricity. These companies can exploit their direct close relationship with their customers in a number of ways:

- offering customized and personalized home energy solutions by understanding their needs around customers' homes through data aggregation, data-mining and AI;
- leveraging data from customers' online searches, purchases, social media likes and shares, to suggest services based on their previous behaviour with least information search costs, thus offering a range of new services such as more efficient devices, equipment such as solar cells, battery storage, rainwater tanks;
- offering retail services through digital metering, advanced communications and big data analytics, to reduce peak demand and prices through timely feedback of data and appliance control;
- offering more itemized customer data to utilities so to better optimize electricity grids.

4.3 Integrated utility services – Powershop, Green Mountain Power (GMP)

Powershop is an online electricity retailer in Australia, New Zealand and UK that seeks to differentiate itself from the conventional retailers, focusing on customer experience improvement, care for environment, and support for renewable energy. *Powershop* offers innovative yet integrated products and services that help to make electricity usage and bills more transparent, to help customers save, and options to participate in community energy. The company provides a mobile app to help customers control and understand their electricity account, to pay for power on the go, monitor their electricity usage and to get credit by providing referrals (Powershop, 2018).

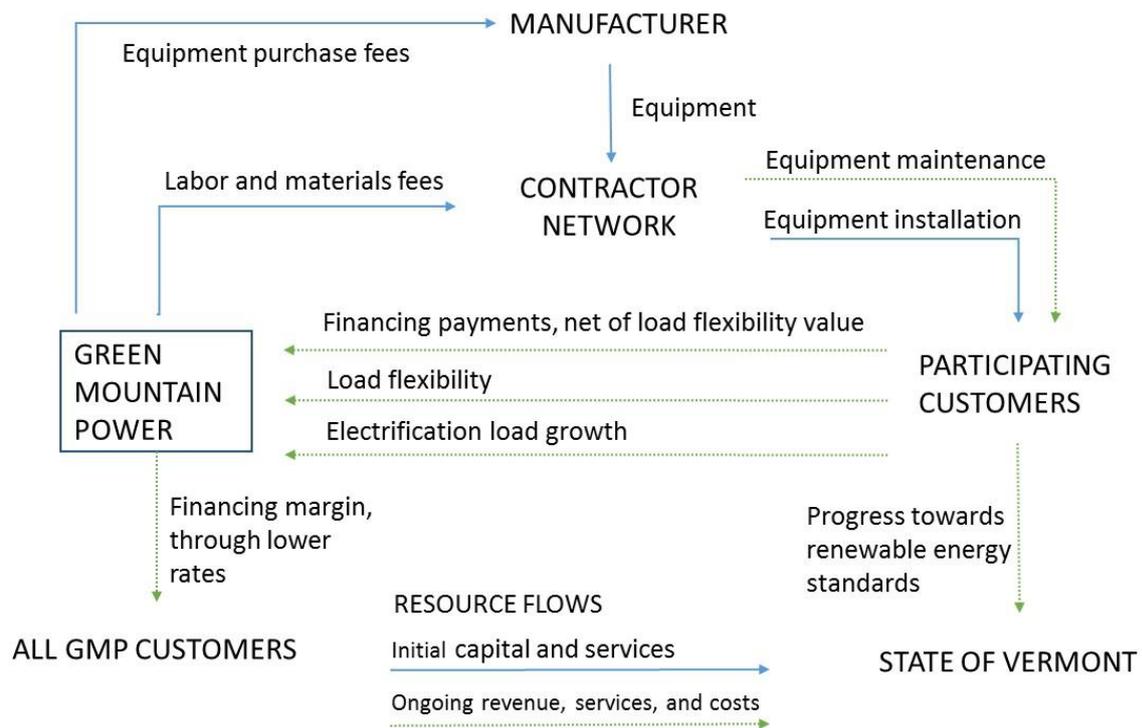
Green Mountain Power (GMP) is an investor-owned utility in Vermont, serving approximately 265,000 residential and customers (Green Mountain Power, 2018). In the face of disruptive DER technologies and declining energy sales, GMP is going through the business transformation, focusing on a new way of doing business to meet the needs of customers with integrated energy services that help people use less energy and save money, while continuing to generate clean, cost-effective and reliable power. As stated by *GMP* CEO Mary Powell, “*This is so important as we partner with customers on a new energy future that is home-, business-, and community-based and leverages the latest innovations in grid modernization to drive down costs and provide value for all customers.*”

GMP offers customers a suite of new products to meet their energy needs with new and efficient technologies, and financing options to reduce or eliminate up-front costs to the *customer*.

- Its eHome program offers free smart control to manage electric water heaters and heat pump from customer’s smart phone. for a home energy management and energy efficiency overhaul.
- Customers can upgrade their space and water heating with efficient electric heat pumps while also enrolling these devices in demand response to support the grid.
- *GMP* offers free home electric-vehicle chargers and discounted off-peak charging.
- Customers can install a *Tesla* Powerwall battery system for backup energy at reduced cost in return for enabling *GMP* to dispatch the battery to lower grid costs.
- Its new “Bring Your Own Device” program allows home battery storage owners to share their surplus power to reduce energy costs for all customers.
- Rural customers wishing to go off-grid can get *GMP*’s support to plan and manage their very own independent energy system.

Its new financing business model as illustrated in Figure 4, works as follows: *GMP* provides finance and procures the heat pumps to replace fossil-fuel heating systems for participating customers. Local contractors are responsible for installation. The up-front cost of the heat pumps is captured in *GMP*’s rate base alongside other utility investments. The financing payments from participants return to the broader customer base by offsetting a portion of *GMP*’s annual revenue requirement. These payments are structured to return a net benefit to nonparticipating customers. These new energy sales can help spread the fixed costs of the grid and keep bills affordable, particularly when the devices are managed to shift load to low-cost times of day.

Figure 4. Illustration of resources flow in GMP's innovative pilots (RMI, 2018)



Source: Adapted from Customer-Centric Energy transformation: A Case Study of the Opportunity with Green Mountain Power. Rocky Mountain Institute (RMI), 2018

GMP argues that it can deepen its business transformation through more bundled and targeted programs, combining elements of devices, financing and rates offerings to encourage active energy management and demand flexibility, adopt renewable energy and energy efficiency products, and fuel switching from fossil-fuel based to electric products. The success in this transformation will be rooted in its ability to understand customer needs so to provide added value to its customers.

Looking beyond Vermont, the role of future utilities will inarguably be all of these:

- As an 'energy conductor' to help create a more efficient and optimized electric system, leveraging customer-sited resources to the benefit of all customers (Blansfield et al., 2017).
- As an Energy-as-a-Service company that applies innovative technology and data management in ways that give customers more control of electricity consumption through customizable pricing and cutting-edge energy management options (Warwick, 2017).
- As an 'energy enabler' that enables 'energy solutions' and in many cases 'home solutions' – enable customers to optimise their energy positions (PwC, 2014)
- As a combination of supplier, integrator, enabler, and optimizer, to address customers' needs through proactive engagement and integrated products and services.

Table 1 lists the key value proposition, customer benefits, opportunities and barriers to the adoption of these models.

Table 1. Value proposition, customer benefits, opportunities and barriers to adoption of consumer-centric service models

	Simple and no frills eg. <i>OhmConnect</i>	Customised and personalized eg. <i>Wattcost, Opower, Bidgely</i>	Integrated services eg. <i>Powershop, GMP</i>
Value proposition	Simple and easy-to-use interface; fast services; Reduced transaction costs to serve a large number of small customers as a bundle; Engagement of customers and utilities as the co-creator of value	Personalized and customized services; Leverage with companies' other products and services; Insights into customer consumption behavior and even decision making process; Low customer acquisition costs	Integrated and hassle-free services; Bundled services combining home energy management, transport, rates and financing; Engagement of customers and utilities to co-create value; Reduce asset investment costs
Benefits to customers	Save electricity and earn; Contribution to reduce emission; Satisfaction from being responsible users	Full control of smart and automated homes; Personalized and customized services; More comfort and convenience	One-stop shop for financing, installation, maintenance; Bundled and integrated services
Opportunities	Considerable market potential to engage more energy consumers; replicate business model to expand to other regions	Leverage with existing user base and user data; Lock-in potential; potential multiple service offerings to customers and utilities	Leverage with existing customer base and user data; Increased revenue stream; Early mover in utility transformation
Barriers to adoption	Small savings to customers; Relying on voluntary participation	Costs to hardware and systems; lack of compatibility among providers	Competition from other providers; trial-and-error process

5. Conclusions

In a new era of choice and energy consumer engagement, this chapter set out to first summarise and classify the growing range of products and services available to consumers. It then presented some possible models for the process of consumer decision making towards improving their energy service provision, given these opportunities, yet also their complexities, uncertainties and hence risks. We also considered the challenges of decision making for those consumers who choose not to actively engage with the industry. We now see growing diversity across energy consumers, from professional consumers, prosumers, and prosumagers, and perhaps more, through to nosumers at the other end of the 'engagement' spectrum.

The consumer challenges presented have also inspired a new generation of service providers that strive to better facilitate consumer decision and choice making, and hence capture the value that such consumer engagement can create, than existing industry players have achieved to date. The provision of these products and services requires an intimate understanding of individual customer needs and their decision making process, to assist in acquiring information and resources, removing barriers, thus reaching a solution that is mutually beneficial. Those businesses who can innovate to offer value-added products and services that allow simple and fast interaction, personalized and customized services, and integrated solution for consumers seem best placed to succeed in an increasingly competitive distributed energy future.

To conclude, utilities, potential new product and service providers, and regulators and policy makers will all need to take into consideration the psychological and behavioural characteristics of consumers when establishing business strategies and policies to assist consumers to maximise their personal as well as larger social outcomes.

References

- Attali, S., Bush, E., Michel, A., 2009. Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe, Market Transformation Programme. Defra.
- Bidgely, 2018. Bidgely Solutions to Attract and Retain Customers. 2018 BIDGELY, INC. .
- Blansfield, J., Wood, L., Katofsky, R., Stafford, B., Waggoner, D., Givens, S., Mork, R., 2017. Value-added electricity services: New roles for utilities and third-party providers, in: Schwartz, L. (Ed.), Future Electric Utility Regulation. Lawrence Berkeley National Laboratory.
- Chang, C., 2018. ShineHub offers 'fixed rate, free access' solar and battery plan, News.com.au.
- Dudovski, J., 2013. Consumer Decision Making Process: a detailed analysis.
- Edwards, J., 2018. Victorian government offers cash incentive to help households get better energy deal, ABC News. ABC.
- EEl, 2018. New business models at the grid's edge and beyond, EEnergy Informer. Fereidoon P. Sioshansi, PhD, Walnut Creek, CA, p. 18.
- Engel, J., Blackwell, Miniard, 1995. Consumer Behaviour, Fliruda: Dryden.
- Finley, K., 2015. The internet of anything: The system that pays you to use less electricity. Wired.
- Forcey, T., 2017. Can Facebook help you make your home more sustainable?, The Conversation. The Conversation.
- Green Mountain Power, 2018. Products to help you use less energy and save. Green Mountain Power.
- GreenSync, 2018. Creating markets through the decentralised energy exchange. 2018 GreenSync.
- Gui, E.M., Diesendorf, M., MacGill, I., 2017. Distributed Energy Infrastructure Paradigm: Community micogrids in a New Institutional Economics context. Renew. Sustain. Energy Rev. 72, 1355–1365.
- Gui, E.M., MacGill, I., 2018. Typology of future clean energy communities: An exploratory structure, opportunities, and challenges. Energy Res. Social Sci. 35, 94-107.
- Gyamfi, S., Krumdieck, S., 2011. Price, environment and security: Exploring multi-modal motivation in voluntary residential peak demand response. Energy Policy 39, 2993-3004.
- Ha, H., Janda, S., Muthaly, S., 2010. Development of brand equity: evaluation of four alternative models. Service Industries Journal 30, 911-928.
- Han, E., 2017. NSW families paying \$400 more under 'time of use' electricity plans, new research shows. The Sydney Morning Herald.

- Hargreaves, T., Hielscher, S., Seyfang, G., 2013. Grassroots innovations in community energy: The role of intermediaries in niche development. *Global Environmental Change* 23, 868-880.
- Hill, J.S., 2015. GTM Identifies 120 Major Home Energy Players. *Gleantechnica*.
- Hu, Z., Kim, J.-h., Wang, J., Byrne, J., 2015. Review of dynamic pricing programs in the U.S. and Europe: Status quo and policy recommendations. *Renew Sustain Energy Rev* 42, 743-751.
- Huhtala, A., 2010. Income effects and the inconvenience of private provision of public goods for bads: The case of recycling in Finland. *Ecological Econ.* 69, 1675-1681.
- Kanagal, N.B., 2016. An extended model of behavioral process in consumer decision making. *Int J Marketing Studies* 8, 87-93.
- Kelly-Detwiler, P., 2017. Sonnen: Changing the way we buy, store, and sell electricity. *Forbes*.
- Kotler, P., 1997. *Marketing Management: Analysis, Planning, Implementation and Control*. Prentice Hall, India.
- Leuschner, P., 2017. Utilities must proactively engage their customers-here's how, *Smart Energy International*. Spintelligent (PTY) Ltd.
- Market Research Future, 2018. *Smart Home Energy Management Device Market Research Report - Global Forecast 2023*. Market Research Future.
- Mayoh, L., 2017. Using solar power to reduce your electricity bill. *News corp*.
- McNamara, S., Grubb, M., 2011. The psychological underpinning of the consumer role in energy demand and carbon abatement. *Electricity Policy Research Group Working Paper 1110* Cambridge.
- McNary, B., 2008. Market penetration of ENERGY STAR qualified appliances: An analysis of various predictor variables, *ACEEE Summer Study on Energy Efficiency in Buildings*. D&R International.
- Navigant Research, 2018. *Home Energy Reports, Digital Tools, Standalone HEM, and Networked HEM, Market Data: Home Energy Management*. Navigant Research.
- Ohmconnect, 2018. Small changes add up to a big difference.
- Orchison, K., 2018. *Coolibah Commentary, Coolibah*. Coolibah.
- Parkinson, G., 2018. Zibelman: Old market rules make no sense. *RenewEconomy*.
- Pongiglione, F., 2011. Climate change and individual decision making: An examination of knowledge, risk perception, self-interest, and their interplay. *Universita di Bologna*.
- Powershop, 2018. *2018 Powershop Australia Pty Ltd*.
- PwC, 2014. *Utility of the future A customer-led shift in the electricity sector. An Australian context*. PwC.
- RedBackTech, 2018. *Powering your future. 2018 Redback Technologies*.
- RMI, 2018. *From Customer-Centric Energy Transformation: A Case Study of the Opportunity with Green Mountain Power*. Rocky Mountain Institute.
- Saadeh, O., 2015. *Energy in the Connected Home 2015: Technology evolution, landscape and distribution strategies*, Grid Edge. gtmresearch.

- Schiffman, L.G., Kanuk, L.L., 2007. *Consumer Behavior*, 9th ed, New Jersey: Prentice Hall.
- Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., Seyfang, G., 2016. Making the most of community energies: Three perspectives on grassroots innovation. *Environ. Plann. A*. 48, 407–432.
- Thaler, R.H., Sunstein, C.R., 2008. *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press, New Haven, CT.
- Vorrath, S., 2018. Victoria networks ask if solar households should pay for grid upgrades. This was the response.... *One Step Off the Grid*.
- Warwick, M., 2017. *Introduction as Energy as a Service (EaaS)*. Pacific Northwest National Laboratory, Tampa, Florida.
- Wattcost, 2017. New technology to make your home energy intelligent so you always pay less. 2017 Wattcost.
- Wokutch, A.S.V., 2011. The role of non-utility service providers in smart grid development. *J. Telecomm. & High Tech. L.* 9, 532-571.