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Alessandro Rubino, Angelo Facchini, Michael Fell, Monica Giulietti & Andrea Morone

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EDITORIAL

New energy downstream. Emerging business models and innovative best practices: an economic, institutional, and behavioral focus

Thanks to policy pressure and technological progress, modern energy systems are going through an increasing decentralization and decarbonization process. Digitalization and decarbonization, in this context, represent key enablers, as they unlock new opportunities of actors across the value chain (i.e., consumers, prosumers, retailers, traders, producers, network operators, and policy makers), providing them with new solutions. The combination of digital technologies and renewable energy solutions is already playing a pivotal role in the energy sector. The increasing attention toward clean energy sources, Internet of Things, Artificial Intelligence, Big Data, Cloud, 5 G, and Blockchain technologies are influencing changes both in energy companies' value creation strategies and in customer behavior as well as in policy and regulatory frameworks. This transition will define the economic and legal environment able to accommodate an ever-increasing number and variety of alternative business models and new solutions. All these new aspects are expected to have an impact on long-time established roles, particularly by creating trust and empowering consumers on one side, and by disrupting traditional business models on the other. Ideally, this transformative process should be able to set out cost-effective and economically productive pathway, resulting in a clean, dynamic, and resilient energy economy dominated by renewables – while ensuring stable and affordable energy supplies, providing universal energy access, and enabling robust economic growth.

Energy systems are therefore entering into unknown territories, and while statistical models and scenarios can identify possible ending points of these trajectories, the analysis and careful exploration of the most innovative business practice and new approach to energy supply can shed a light on the potential of these disruptive solutions. Peer-to-peer developments in the household and transport sectors, and the societal changes shaped by information technologies are turning traditional business models inside-out in ways that few were prepared for. Energy systems in the (near) future will be very different to those of today. The prelude to these radical changes is already visible in innovative business practice. It is emerging clearly that the role of consumers, the ability to handle large amounts of data, together with the emergence of bilateral trade arrangements and the deployment and use of new storage facilities will all contribute to shape the future energy systems. While we cannot be certain what tomorrow's system will look like, it is important to understand what is driving system change, the likely impacts on consumers and the implications for the economics of future energy systems.

The ways in which the sectors will change within these constraints are very uncertain however continued technological change is expected to affect both how energy is produced and used and how supply and demand are balanced through the grid and ancillary services. Substantial investment will be needed putting pressure on consumers' bills. But market forces will reduce other costs, perhaps very materially, as has been witnessed with the cost of renewable energy and storage.

Despite the uncertainty about what the future will look like, some key changes seem likely, including the development of smarter and more flexible system; increased decentralization of the energy sector (with more distributed generation and more suppliers operating locally rather than centrally); increasing interdependence of services, with greater utilization of consumers' and system data; a more diverse commercial environment; better services and opportunities for consumers enabled by new and smarter technologies. These changes have begun to blur the boundaries of the energy system as we know it and challenge the traditional business model around which the energy industry has been organized for many decades.

A greater effort is therefore now required to define more clearly what are the likely new institutional frameworks, the nature of the relationship among the new and incumbent energy players, and the role and perimeter of future regulation in this changing environment. Given these challenges, the present special issue has engaged the academic community in the analysis of the emerging trends to help practitioners, policymakers and the business environment, as well as fellow researcher – to identify and understand these critical issues.

This special issue has extensively explored these emerging trends in the new energy paradigm from a multidisciplinary point of view to provide a better understanding of their main economic, policy, and regulatory implications.

1. The special issue

The Special issue "New Energy Downstream. Emerging business models and innovative best practices: an economic, institutional and behavioural focus," explores the origin, cause, and consequences that the low carbon transition is producing, at various level, in the energy systems.

This analysis starts by exploring the interplay between the energy-intensive economic activities and the citizen pro-environmental response that, in turn, is reflected in different claims for green energy policies. Caferra, Colasante, and Morone (2021) combine real economic statistics with behavioral data to establish that a potential causal relationship exists between the (macro-)economic and the behavioral (micro)-spheres. The study shows that countries with a greater fraction of energy-intensive production systems feature more citizen worried about the consequences of climate change, claiming for more green policies. The study highlights that economic growth obtained "at any cost" and at the expenses of a sustainable environmental conditions is no longer a viable option for concerned citizens, and a more sustainable-oriented societies pressure the government to direct their policy agenda toward greater effort in the environmental cause.

While the energy intensive production sector is one of the determinants explored in Caferra, Colasante, and Morone (2021), the attitude of EU firms toward energy-efficient and renewable energy innovations is explored to determine the triggers for the introduction of energy innovations.

Capozza, Divella, and Rubino (2021) provide empirical evidence on the main drivers for energy-specific innovations. EU firms result particularly responsive to direct economic incentives, such as subsidies and green public procurement standards. Also, demand-pull factors, and in particular the greater role that consumers place on sustainable consumption and on environmental-friendly business conduct, provide significant motivations for firms to introduce energy-efficient and renewable energy innovations.

Once the preferences of consumers and those of firms in the EU toward green production and low carbon services has been established, the special issue explores both the supply and demand side of energy products and services.

Magazzino et al. (2021) identify, using a range of statistical tools that allow to determine cross sectional dependence, a unidirectional causal link among ICT, electricity consumption, economic growth, and environmental pollution in a panel of 16 EU countries. The authors establish that Internet penetration significantly contributes to determine electricity consumption, that impacts on economic growth. The latter is also a significant factor affecting the degree of urbanization.

Surmonte et al. (2021) introduce a method to estimate the portfolio generation based on real geographic and meteorological data to evaluate the impact of the geographical dispersion of RES plants in Tuscany (Italy) in terms of the generation units by looking at their generation patterns. The study shows that by refurbishing the existing generation plants (Expansion Strategy) an investor can achieve an increase in the total annual production of about 1 GWh for wind and 1.6 GWh for solar (respectively, 0.76 and 1.1% of the total production), whereas a Green Field Strategy can increase the total production by 3.2 GWh of wind and 4 GWh of solar (representing a 2.43 and 2.89% of the total

production, respectively). The analysis, while region-specific, shows that RES potential location should be carefully considered when planning investments in new generation capacity and provides useful indications for the coordination role that energy regulators might play in future energy scenarios.

Pursuing integrated research and decision-making to advance action on the sustainable development goals (SDGs) fundamentally depends on understanding interactions between the various stakeholder, and the paper by Sareen and Nordholm (2021) goes in this direction. The analysis shows that solar PV transitions in Portugal affected energy governance and the role of the user. Governance in Portugal has primarily favored large-scale solar rollout at the cost of small-scale, community, and individual solar rollout. The study finds out that a self-selected group of consumers has transformed their role from end-users into energy citizens through the voluntary investment in small-scale solar. The analysis offers an early insight on motivation and mobilization by small-scale solar enthusiasts in a financially constrained economic context.

In the contest of low-carbon energy services, the provision of heat, as a new specific service and/or complementary service to electricity generation, is emerging as an efficient solution in several geographies. Two papers of this special issues explore this emerging technology by analyzing the general framework for heat services deployment and with an analysis applied to Germany.

Britton et al. (2021) explore the concept of heat-as-a-service, a model which is garnering increasing interest as a way of fostering greater uptake of low-carbon heating technologies. The authors draw on an expert workshop to identify the key barriers the model faces and propose areas where more research is needed on how these barriers can be addressed. This takes in a wide variety of topics including behavioral and consumer issues, policy and regulation, technology and data, and business models and financing.

Wesche et al. (2021), instead, focus on the development on non-urban district heating in Germany as configurational technological innovation systems. Here, the emphasis is placed on the prominent role of local context in determining the outcomes of projects to develop and operate such systems. In particular, the study recognizes the importance of know-how amongst local actors and suggests that national policy should do more to foster vertical and horizontal (i.e., with other actors in similar local contexts) knowledge exchange, such as by creating dedicated intermediaries.

The special issues move on to exploring the implication of the energy transition for the transportation sector. Tor et al. (2021) investigate the impacts of integrating electrical vehicles into distribution grids in Turkey. The analysis shows that the current distribution grid configurations in four different DSOs allows sufficient capacity to integrate almost 10% of electrical vehicles in the vehicle stock by 2030. However, the adaptation of the systems to these emerging technologies requires electricity tariff design, smart technology roll-out, and optimized planning for the location of charging points to be carefully planned for a smooth transition process, to minimize stress on the grid and to encourage efficient utilization of the infrastructure.

The opportunities and the challenges related to the low-carbon transition and the digitalization of the energy services have been explored in the article discussed above, however the transition process also implies the assessment of the unanticipated impact that new business models might have on consumers.

Fjellså, Ryghaug, and Skjølsvold (2021) explore the concept of end-user flexibility in an energy justice perspective. The authors study electricity consumption and end-user flexibility in daily life for a group of students in Norway, where it is common for students to live with others, such as partners, children, and peers, in student homes and diverse forms of shared housing. The authors draw on 75 illustrations and 17 written statements from 75 students, collected in 2018. The researchers identify three different types of energy-related activities. The first group of activities are shaped by societal structures, such as lectures and working hours. The second category depends on the materiality of their habitat, such as the standard of their housing, its design, and its facilities. The third category consists of activities shaped by personal needs and comfort, such as cooking, cleaning, and leisure. The analysis shows that these categories have different degrees of flexibility. The study demonstrate that the students' flexibility potential was limited due to socio-material factors, such as housing, life situation,

and limited flexibility capital and therefore it highlights that, notwithstanding the intention to be flexible, vulnerable groups might find themselves in a situation in which they systematically live their daily life in flexibility poverty. As a consequence, energy policies should carefully consider the implications of distributional bias in public support for energy efficiency measures.

Further on the potential unintended repercussion of energy transition for consumers, Decker (2022) explores whether the risks of digitized and multi-source energy systems can be addressed under existing energy consumer protection frameworks. Decker identifies two main challenges related to modern energy systems: firstly, consumer protection obligations may not easily accommodate new energy products, business models or supply arrangements, and secondly, current frameworks remain quite rigid in terms of precisely defined product and services and might fail to adapt to the rapid changes occurring in energy markets. Based on case studies applied to Britain, USA, and Australia, the author proposes a twofold approach to adapt consumer protection framework to the evolving circumstances in the energy sector: on the one hand, regulators should define a minimalist set of basic rights which apply to all consumers irrespective of how they source, manage, or consume energy; on the other hand, the consumer protection framework should place greater reliance on co-regulation to develop, monitor, and enforce a series of codes that apply to new products and services as they arise.

2. Conclusions

The special issue has clearly shown that different business models and a different configuration of the energy system are certainly possible thanks to the impactful role played by decarbonization and digitalization. The smart energy transition is underway, and it can bring about important advantages for consumers and energy and service providers alike. However, a careful consideration of the fundamentals of this evolving sector is required to be able to reap the multiple benefits connected to the low carbon transition in the energy sector. This special issue aims to provide an initial guidance to navigate the unpredictable directions that this journey might define in the years to come.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Alessandro Rubino
Ionian Department of Law, Economics and Environment, University of Bari Aldo Moro, Bari, Italy
alessandro.rubino@uniba.it http://orcid.org/0000-0002-2737-9052

Angelo Facchini
IMT Alti Studi Lucca, Italy
http://orcid.org/0000-0003-2652-5238

Michael Fell
Bartlett School Environment, Energy & Resources Faculty of the Built Environment, University College London, London, UK
http://orcid.org/0000-0003-2764-7464

Monica Giulietti
School of Business and Economics, Loughborough University, UK

Andrea Morone
Department of Economics, Management and Business Law, University of Bari Aldo Moro, Bari, Italy