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# Prosumers: New actors in EU energy security

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**Abstract**

This paper critically analyses the new challenges and opportunities that prosumers, as new energy actors, bring to achieving energy security goals in the context of the European Union (EU). Following trends in the EU towards new levels of cooperation in energy governance, decentralization, and the emergence of a gig economy, the energy sector is currently undergoing a large-scale transition. One of its core aspects is the progressive top-down diffusion of potential, competences, and leverage across the energy value chain from states and corporate actors towards prosumers. While this trend creates ample potential for facilitating and improving the EU's security of supply, as well as fulfilling its climate change targets, several caveats exist. These caveats are not confined within energy security prerogatives; they also extend to the critical management of digital security, which the digitalization of energy services brings to the fore. Private and public finance should be effectively attracted and directed to infrastructure schemes that will enable a transition from the traditional centralized power network to the decentralized nexus of smart grids. Technology will play a crucial role in facilitating the role of prosumers in the new market-in-the-making.

**Keywords:** prosumers, gig economy, decentralisation, climate change, renewable energy, security, European Union

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## 1. Introduction

The increasing role of new actors in law-making has received attention since the 1990s.[1] Developments in climate change and environmental law in this era have catalysed innovative governance approaches by non-state actors and international organisations. These developments have created new legal challenges, both public and private, in a global multilevel governance context. New actors are not solely involved in contributing to thematic law and policy agenda setting, developing solutions and providing oversight capacity; they are also becoming important players in delivering services. Opportunities to deliver services are growing as the global economy reconfigures around advancing information and communications technologies illustrated by the rapidly emerging 'gig' economy.[2]

In this new setting, ample space is created for the emergence of new energy actors, a principal one being prosumers, namely consumers who are also producers of (renewable) energy and

[1] See for instance Clapham, A. "Non-state Actors," in Vincent Chetail (ed.) *Post-Conflict Peacebuilding: A Lexicon*, pp. 200–212, New York: Oxford University Press, 2009; Halliday, F. "The Romance of Non-state Actors," in Daphné Josselin and William Wallace (eds.), *Non-state Actors in World Politics*, pp. 21–40, New York: Palgrave, 2001; Josselin, Daphné, and William Wallace "Non-state Actors in World Politics: A Framework," in Daphné Josselin and William Wallace (eds.), *Non-state Actors in World Politics*, pp. 1–20, New York: Palgrave, 2001.

[2] 'A gig economy is an environment in which temporary positions are common and organizations contract with independent workers for short-term engagements.' See http://whatis.techtarget.com/definition/gig-economy.

who use energy in a smarter and more efficient manner. Energy prosumers is an umbrella term referring to self-generating energy providers, whether households or energy communities. Individuals contribute to the energy supply in their vicinity via their own installed renewable energy capacity, more often than not solar roofing, wind energy or combined heat and power.[3]

This paper critically analyses the new challenges and opportunities that prosumers bring to achieving energy security goals in the European Union (EU). The EU, along with the US, is a pioneer in engineering a hybrid electricity market model, where traditional power plants will be supplemented by virtual power plants, a plethora of small, individual energy producers and a corresponding new set of mechanisms to cater for the new market. That said, the adoption and customization of (elements of) this new energy architecture by other countries will hinge upon the degree of its success within European soil. This paper contributes to this volume in two specific ways. First of all, it critically discusses an emerging new actor in the EU's energy security that we refer to as prosumers. Second, it illustrates in broad terms the ways in which this new actor will cooperate with other actors in the EU energy market and contribute to the European Union's energy goals.

In this context, side by side with traditional threats and challenges, new risks, but also opportunities, arise for the ensuring energy security.[4] The energy sector is undergoing a large-scale low-carbon transition. What is underemphasized in this transition is that it involves a major paradigm shift from a supply-driven to a demand-side energy policy. Driven by a mix of geopolitical, economic, climate and technological considerations, the energy sector is moving towards a new architecture, the principal pillars of which are progressive electrification, a cleaner energy mix, renewable indigenous energy production, increased energy efficiency and the development of new markets to produce, transmit and, crucially, manage energy.[5] The key to this overhaul is the slow, but already underway, development of prosumer markets.

After this introduction, Section 2 outlines the key drivers of change behind energy service provision, identified as energy security, climate change and sustainability. The paper also

[3] Josh Roberts, Prosumer Rights: Options for a legal framework post-2020, (2016) ClientEarth, London.
[4] R. Leal-Arcas, J. Alemany Rios, and C. Grasso "The European Union and its energy security challenges," *Journal of World Energy Law and Business*, Vol. 8, Issue 4, pp. 291-336, 2015, Oxford University Press.
[5] For an overview of the current legal and policy situation in EU energy, see Leal-Arcas, R. and Wouters, J. (eds.) *Research Handbook on EU energy law and policy*, Edward Elgar Publishing, 2017.

examines the emerging ‘gig’ economy, facilitated by new information and communications technologies. Section 3 provides an overview of EU energy law reforms which have opened up space for new actors in pursuit of decentralised low-carbon energy generation and transmission. Section 4 explores in greater detail the changing roles for old actors and the emerging roles for new actors within a decentralised energy system that incorporates new digital technologies in the form of smart grids. Section 5, before the conclusion and recommendations, considers the impacts, both positive and negative, that a specific group of new actors may have on EU energy security for various EU Member States and the EU as a whole.

## 2. Drivers of change

The global governance landscape is rapidly transforming. This is particularly evident in the energy sector. The energy sector’s global transformation is being driven, directly and indirectly, by a changing geopolitical landscape, the urgent need to pursue low-carbon development to abate climate change, commitments to achieve integrated sustainable development,[6] innovative new digital information and communication technology, and transformations in economics. This section highlights the fact that these drivers are creating new spaces for both old and new actors to contribute to the transformation to a low-carbon world.

### 2.1. Energy security challenges

Driven by energy security concerns, energy actors, both state (governments, regulatory authorities and public-owned or controlled utilities) and non-state (private energy companies), are adapting the sourcing, use, and distribution of energy.[7] Diversifying energy supplies has opened opportunities for new actors to become involved in energy markets. The establishment of the International Renewable Energy Agency in 2009 to help countries transition to a sustainable energy future is an excellent example. The EU is faced with traditional energy challenges, the most important of which revolves around dependence on single suppliers with high market shares and problematic relations (namely Russia).[8] Other challenges include dependence on increasing oil imports and fluctuating energy prices. The designated European

[6] See generally Leal-Arcas, R. “Sustainability, common concern and public goods,” *The George Washington International Law Review*, Vol. 49, Issue 4, 2017.
[7] See for instance Leal-Arcas, R., Grasso, C. and Alemany Rios, J. *Energy security, trade and the EU: Regional and international perspectives*, Edward Elgar Publishing, 2016.
[8] Leal-Arcas, R. “The EU and Russia as Energy Trading Partners: Friends or Foes?” *European Foreign Affairs Review*, Vol. 14, Issue 3, pp. 337-366, 2009.

Energy Union[9] reflects these concerns and endeavours to place the Union on a low-carbon trajectory.[10]

A number of forces are creating a shifting terrain, including the globalization of gas markets, the advent of liquefied natural gas, the development of fracking technology, the decarbonizing of natural gas and shale oil and gas exploration, and further market integration. A new energy architecture is emerging as a result, involving demand-side policies, new business models—which go hand-in-hand with digitalization—and new actors in the energy sector. In particular, disentangling the EU from overt dependence on energy exports and fossil energy, while increasing energy efficiency and renewable energy generation, will fundamentally reshape the energy scene in the dual direction of demand-side policies and will create a plethora of new, dispersed, small-scale energy producers. Increasing domestic energy generation through renewable sources is integral to achieving greater energy security for Europe's member states. The diversification of energy generation required will result in new energy actors, such as large-scale investors in renewable energy generation, prosumers, and energy communities. This is a situation mirrored in other countries adopting the same energy diversification strategies, for example the US, China and South Africa. In this landscape, the role of prosumers seems central.

### 2.2. Climate change and sustainable development

Increasingly, a range of new actors that we refer to here as prosumers are actively contributing to initiatives to drive a transition to a low-carbon global economy.[11] The expanding environmental crisis[12] faced globally has resulted in new opportunities in governance. This has increasingly been recognised at the international level, where outcomes have recognised the value of non-state actors to achieving transformation and resolving the crisis. International

[9] The European Energy Union could well be the flagship of a new outset towards a more prosperous, energy-secure and unified Europe, bearing in mind that EU Member States wish to guard their sovereignty over national energy systems. The aim is to make it easier to trade energy inside the EU. In the past, there have been divisions between EU Member States when trying to draft a unified energy policy. The European Energy Union tries to rectify this deficiency. For an analysis of the European Energy Union, see Leal-Arcas, R. *The European Energy Union: The quest for secure, affordable and sustainable energy*, Claeys & Casteels Publishing, 2016, p. 12.

[10] Kapcer Szulecki, Severin Fischer, Anne Therese Gullberg and Oliver Sartor, 'Shaping the "Energy Union": Between National Positions and Governance Innovation in EU Energy and Climate policy' (2016) *Climate Policy* 16, 1.

[11] See generally Leal-Arcas, R., Filis, A. and Abu Gosh, E. *International Energy Governance: Selected Legal Issues*, Edward Elgar Publishing, 2014; "Better growth, better climate," The New Climate Economy, available at http://newclimateeconomy.report/2014/.

[12] One shocking environmental fact is that, in 2017, it rained in the Antarctica. See Potenza, A. "Unusual weather in Antarctica leads to rain and a Texas-sized melt," *The Verge*, 15 June 2017, available at https://www.theverge.com/2017/6/15/15811214/west-antarctica-ross-ice-shelf-melting-rain-el-nino.

multilateral conferences, including the 2002 Johannesburg UN Conference on Environment and Development, 2012 Rio+20 Conference, the UN General Assembly adoption of the 2015 Sustainable Development Goals (SDGs), and the UN climate change negotiations in 2015, increasingly emphasise the role that new actors beyond the state can play in making the transformation take place.[13] As a consequence, many new fora are emerging to tackle entrenched problems within a range of sectors such as water, forests, and the urban environment, creating new spaces and fostering new participatory approaches. Increasingly, the interconnections between different sectors are being recognised when developing law and policy interventions to produce co-benefits.[14]

This is particularly evident in relation to the international climate change regime, which has actively engaged non-state actors to contribute towards delivering mitigation and adaptation projects and investments. In fact, since the COP 21 in Paris in 2015, the joining of international negotiations and non-state actors is shaping new global climate change governance, which means that there is a connection between global and local processes. Moreover, the global climate change governance regime is constituted by a broad array of public, private and hybrid associations and mechanisms that have developed within and alongside the UNFCCC itself.[15] Alongside the UN Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) 20 as part of the Lima-Paris Action Agenda in 2014, a Non-State Actor Zone for Climate Action (NAZCA) was launched by the Peruvian Presidency to track initiatives that increase climate change mitigation and adaptation. Commitments on the NAZCA platform illustrate the range of actors being involved across sectors, especially energy.[16] Initiatives undertaken to abate climate change now need to be integrated with all the goals outlined in the

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[13] See for instance Sustainable Development Goal number 7, available at http://www.un.org/sustainabledevelopment/energy/.

[14] See for instance the Sustainable Development Goals Knowledge Platform, available at https://sustainabledevelopment.un.org/sdgs. See also Northrop, E. *et al*., "Examining the alignment between the intended nationally determined contributions and sustainable development goals," World Resources Institute, 2016; Hufbauer, G. and Suominen, K. *Globalization at Risk: Challenges to Finance and Trade*, Yale University Press, 2010; Victor, D. *Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet*, Cambridge University Press, 2011; Sachs, J. *The Age of Sustainable Development*, Columbia University Press, 2015; Sachs, J. *Building the New American Economy: Smart, fair, and sustainable*, Columbia University Press, 2017; Matsushita, M. and Schoenbaum, T. (eds.) *Emerging Issues in Sustainable Development: International trade law and policy relating to natural resources, energy, and the environment*: Springer, 2016; Hufbauer, G., Melendez-Ortiz, R. and Samans, R., *The Law and Economics of a Sustainable Energy Trade Agreement*, Cambridge University Press, 2016.

[15] H. Van Asselt, 'Alongside the UNFCCC: Complementary Venues for Climate Action' (Centre for Climate and Energy Solutions, May 2014); Lorraine Elliott, 'Climate Diplomacy' in Andrew F Cooper, Jorge Heine and Ramsh Thakur (eds), The Oxford Handbook of Modern Diplomacy (Oxford University Press, 2013).

[16] See UNFCCC Nazca Platform at http://climateaction.unfccc.int/.

UN SDGs. This extra dimension provides greater opportunities for innovative solutions from multiple actors.

As will be analysed in Section 4, old and new actors alike are seeking new alliances to achieve integrated outcomes. This is visible for instance with multinational enterprises in their efforts to design sustainability commodity supply chains standards, such as the Roundtable on Sustainable Palm Oil, which includes different stakeholders, including the Forest People's Programme, a non-governmental organisation run by indigenous people.[17] The effectiveness and impacts, especially socially and environmentally, of the outsourcing of governance is much debated.[18] Despite concerns, however, the trend continues apace. It is a trend that provides opportunities that policymakers and regulators, as well as entrepreneurs at all levels, are looking to exploit for a variety of reasons. New technologies are providing platforms for innovative approaches by all actors seeking to contribute to the low-carbon global energy transition.

### 2.3. The 'gig' economy and new technologies

The emergence of the gig economy implies the introduction of new actors. The increase in service provisions such as AirBnB, contracting, free-lancing, self-employment and on-demand web-based platforms such as Uber are challenging traditionally regulated economic relations. It is not possible to isolate the gig economy per se. Various terms are used, mostly interchangeably, to describe these new economic phenomena including the 'gig' economy, the 'sharing' economy, the 'collaborative' economy, the 'peer-to-peer (P2P)' economy, and the 'access' economy, amongst others. It is arguable whether these notions reflect the same economic model, especially given the plurality and diversity of the activities and the various forms that the "sharing" scheme may take.[19] Yet, overall the concept itself appears to be simple and has a certain dynamism that fits within the broader context "[t]he advent of the collaborative economy, in combination with artificial intelligence, big data and 3D printing".[20]

[17] Marcus Colchester, Do commodity certification systems uphold indigenous peoples' rights? Lessons from the Roundtable on Sustainable Palm Oil and Forest Stewardship Council, *Policy Matters* 21 (2016): 150-165.
[18] Dara O'Rourke, 'Outsourcing Regulation: Analyzing Nongovernmental Systems of Labor Standards and Monitoring' (2003) 31 Policy Studies Journal; Nils Brunsson and Bengt Jacobsson (eds.), A World of Standards (OUP 2000).
[19] Vassilis Hatzopoulos, and Sofia Roma. Caring for sharing? The collaborative economy under EU law, (2017) *Common Market Law Review* 54, no. 1, 81-127.
[20] Schwab, The Fourth Industrial Revolution: What it means and how to respond", *Foreign Affairs* (12 Dec. 2015).

To economists, the gig economy represents what is termed as a "disruptive innovation."[21] The gig economy offers opportunities for existing and new market players to engage in new forms of economic exchanges. However, it also has negative impacts on current relations between market participants, policymakers and regulatory authorities. It remains to be seen how this new economy alters the mechanisms of traditional economic schemes.

The growth of the gig economy is intrinsically linked with new technologies. Many innovations depend on access to data at reduced costs. Arguably, there is a chance to maximize economic growth if we have more openly shared data under proper ethical structures, instead of competing data silos.[22] Data become "most valuable when open and shared."[23] In the EU, for instance, economic security and growth is associated with the provision of cloud computing. Special Rapporteur Hans Graux claims:

> allowing easy on-demand access to information technology services, cloud computing can significantly reduce capital expenditure, as cloud users only pay for what they actually use. … [and that] this will foster innovative business models and services across all industries, generating new advantages for customers and companies alike …. Small businesses (SMEs) in particular can benefit from the cloud, as they can get access to high-performance IT solutions, which will help them to adapt quickly to new market developments and to innovate and grow their businesses faster.[24]

Given this perspective, the cloud has an enormous part to play in decentralised energy provision in the EU energy generation, as it will open up opportunities for new small- and medium-scale actors. To achieve this, Graux envisages a sharing economy that is not held back by regulation and barriers to market access.[25]

In the context of a decentralized energy system—a system that places the consumer at the centre of action, empowers the consumer and therefore democratizes the energy system[26]—it is important to talk about smart grids. The term "smart grids" can be defined in a variety of ways. The following definition is used by the European Regulators' Group for Electricity and Gas (ERGEG), the Council of European Energy Regulators (CEER) and the European Commission in a number of documents:

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[21] Vassilis Hatzopoulos, and Sofia Roma. Caring for sharing? The collaborative economy under EU law, (2017) *Common Market Law Review* 54, no. 1, 81-127.
[22] See the views expressed by Mark Parsons, secretary-general of Research Data Alliance, in *The Economist*, 27th May 2017, p. 20.
[23] Idem.
[24] Hans Graux, Special Rapporteur, Establishing a Trusted Cloud for Europe, (European Commission's European Cloud Partnership Steering Board, 2014).
[25] Ibid.
[26] See 7th Citizens' Energy Forum Conclusions, 12-13 March 2015, available at https://ec.europa.eu/energy/sites/ener/files/documents/2015_03_13_LF_conclusions.pdf.

> ‘A smart grid is an electricity network that can cost-efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power systems with low losses and high levels of quality and security of supply and safety.’[27]

Smart grids are integrated systems that include technologies, information (availability, accessibility, utility), human and social influences, organizational and managerial supporting arrangements, and political (policy) constraints as well as facilitation (including law) considerations.[28] Smart metering systems are a stepping stone towards smart grids empowering consumers to actively participate in the energy market. Smart metering systems and smart grids foreshadow the impending ‘Internet of Things,’ and the potential risks associated with the collection of detailed consumption data are likely to increase in the future when combined with data from other sources, such as geo-location data, tracking and profiling on the internet, video surveillance systems, and radio frequency identification systems.[29]

Across the EU, decentralisation, as well as the development of smart grids and smart metering installation, is occurring at differing rates, with the purpose of reducing greenhouse gas emissions. In 2014, approximately 42 per cent of European countries already had a strategic roadmap in place for the implementation of smart grids, while 58 per cent did not.[30] Enabling the necessary regulatory reforms across the spectrum of issues will require innovative approaches to law and regulatory design. The implications of smart grids, like the gig economy itself for law, regulation and policymaking are only beginning to be considered.[31] Gig-based

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[27] See “Position Paper on Smart Grids – An ERGEG Public Consultation Paper,” E09- EQS-30-04, 10 December 2009, p. 12; “Position Paper on Smart Grids – An ERGEG Public Conclusions Paper”. E10- EQS-38-05, 10 June 2010; European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “Smart Grids: from innovation to deployment”, COM (2011) 202 final, Brussels, 12 April 2011; and CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions (“Smart Regulation”). C13-EQS-57-04, 18-Feb-2014.

[28] Polinpapilinho F. et al A Criticality-based Approach for the Analysis of Smart Grids, Technology Economy Smart Grids Sustain Energy (Springer 2016).

[29] Data Protection Working Party, Opinion 04/2013 on the Data Protection Impact Assessment Template for Smart Grid and Smart Metering Systems (‘DPIA Template’) para 29 prepared by Expert Group 2 of the Commission's Smart Grid Task Force, 00678/13/EN, WP205, 22 April 2013; Recommendation CM/Rec(2010)13 of 23 November 2010 of the Council of Europe Committee of Ministers to Member States on the protection of individuals with regard to automatic processing of personal data in the context of profiling.

[30] CEER, “CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions (“Smart Regulation”),” C13-EQS-57-04, 18-Feb-2014, available at http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Electricity/Tab3/C13-EQS-57-04_Regulatory%20Approaches%20to%20Smart%20Grids_21-Jan-2014-2.pdf.

[31] Rauch and Schleicher, Like Uber, but for local governmental policy: The future of local regulation of the ‘sharing economy’, George Mason University Law & Economics, Research Paper No. 15-01 (2015); Koopman, Mitchell and Thierer, The sharing economy and consumer protection regulation: The case for policy change, 8 Journal of Business, Entrepreneurship & the Law (2015); Katz, “Regulating the sharing economy”, 30 *Berkeley Technology Law Journal* (2015), 1068–1125.

economic activity often raises issues with regard to the application of existing legal frameworks and blurs established lines between consumer and provider, employee and self-employed, or the professional and non-professional provision of services.

All of this can result in uncertainty over applicable rules, especially when combined with regulatory fragmentation stemming from divergent regulatory approaches at the national or local level. When it comes to energy, fragmentation of policies, regulations and cooperation platforms are a constant problem in utilization and trade, creating barriers to communication and effective solutions.[32] It remains to be seen whether the impact of such disintegration may slow down the spread of smart grids or, on the contrary, whether it will have the potential to boost it in the future. The EU Commission has noted that there is a risk that regulatory grey zones are being exploited to circumvent rules designed to preserve the public interest.[33] In reality, the gig economy is merely adding to a pattern of decentring governance and the emergence of a "post-regulatory" world.[34]

## 3. EU energy law reform: Decentralisation

To understand the increasing role of prosumers in a decentralized energy system and to make access to energy more democratic,[35] it is relevant to say a few words about EU energy law reform. A new energy ecosystem, one that increasingly harnesses renewable energies via decentralised providers, is evolving in EU member states. Driving this change is EU regulation, which needs to be clear for investment to be predictable. The linking of energy with climate-related issues is relatively new within the EU. Energy issues have always been at the heart of European integration, but energy-related topics (such as climate change policy,[36] renewable energies,[37] energy planning, security of energy supply[38]) have only gained importance in the EU's policy and regulation agenda following an environmentalism of energy law under the

[32] Leal-Arcas, R. and A. Filis, "The Fragmented Governance of the Global Energy Economy: A Legal-Institutional Analysis," *Journal of World Energy Law and Business*, Vol. 6, Issue 4, pp. 348-405, 2013.

[33] Communication from The Commission to the European Parliament, The Council, The European Economic and Social Committee and The Committee of the Regions A European Agenda for the Collaborative Economy (2016) 184 final - Brussels, 2.6.2016 COM(2016) 356 final.

[34] Julia Black, 'Decentring regulation: understanding the role of regulation and self-regulation in a "post-regulatory" world' (2001) 54 *Current Legal Problems*.

[35] In terms broader than energy access, a quote attributed to Thomas Jefferson seems pertinent here: "That government is best which governs the least."

[36] See generally Leal-Arcas, R. *Climate Change and International Trade*, Edward Elgar Publishing, 2013.

[37] Leal-Arcas, R. and S. Minas, "Mapping the international and European governance of renewable energy," *Oxford Yearbook of European Law*, Vol. 35, No. 1, pp. 621-666, 2016.

[38] R. Leal-Arcas, J. Alemany Rios, and C. Grasso "The European Union and its energy security challenges," *Journal of World Energy Law and Business*, Vol. 8, Issue 4, pp. 291-336, 2015, Oxford University Press.

auspices of sustainability.[39] Arguably, today energy and environmental regulation are two sides of the same coin.[40]

The European Union has prioritized the goal of securing affordable and low-carbon energy as the basis for a green economy. It has set aspirational goals and associated targets to launch an Energy Union beyond 2020.[41] To encourage this transition to a more secure, affordable and decarbonized energy system,[42] the EU adopted climate and energy targets for 2020 and 2030 along with a long-term goal to reduce EU-wide greenhouse gas emissions by 80–95 per cent below 1990 levels by 2050.[43] In 2014, the EU set the target to reduce greenhouse gas emissions by at least 40 per cent by 2030 from 1990 levels.[44]

Under Directive 2009/72/EC of the European Parliament and of the Council and Directive 2009/73/EC of the European Parliament and of the Council, EU Member States are required to ensure the implementation of smart metering systems that assist the active participation of consumers in the electricity and gas supply markets.[45] This is part of a broader goal to increase energy efficiency through developing the demand response market.[46] The European Commission explicitly acknowledged in its Energy Union strategy that "citizens should be at its core, where they take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected."[47] One way to increase participation is through the promotion of demand response measures amongst consumers. Demand response

> is a tariff or programme established to incentivise changes in electric consumption patterns by end-use consumers from their normal consumption patterns in response to changes in

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[39] I. Solorio, Mischa Bechberger, Lucia Popartan, "The European Energy Policy and its `Green Dimension': Discursive Hegemony and Policy Variations in the Greening of Energy Policy," in, P. Barnes and T. Hoerber (eds), *Sustainable development and Governance in Europe*, Routledge (2013) cited in Maria Dolores Sanchez Galera, "The Integration of Energy and Environment under the Paradigm of Sustainability threatened by the Hurdles of the Internal Energy Market," (2017) *European Energy and Environmental Law Review* 13.

[40] E. Orlando, "The Evolution of EU Policy and law in the Environmental field: Achievements and Current Challenges," in Bakker, C. and Francioni, F. (eds.) *The EU, The US and Global Climate Governance*, Routledge, 2014, p. 74.

[41] Noriko Fujiwara, 'Overview of the EU Climate Policy Based on the 2030 Framework', in Raphael Heffron and Gavin Little (eds.) *Delivering Energy Law and Policy in the EU and the US: A Reader* (Edinburgh University Press 2016).

[42] Leal-Arcas, R. "The transition towards decarbonization: A legal and policy exploration of the European Union," *Queen Mary School of Law Legal Studies Research Paper 222/2016*, pp. 1-31.

[43] European Commission, 'Energy Roadmap 2050' COM (2011) 885 final (15 December 2011).

[44] Conclusions on 2030 Climate and Energy Policy Framework, SN79/14 (23 October 2014).

[45] Commission Recommendation of 10 October 2014 on the Data Protection Impact Assessment Template for Smart Grid and Smart Metering Systems (2014/724/EU) S2.

[46] Energy Efficiency Directive (2012/27/EU)

[47] European Commission, A Framework Strategy for a Resilient Energy Union with a Forward - Looking Climate Change Policy, COM (2015)080 final.

> the price of electricity over time, or to incentivise payments designed to induce lower electricity use at times of high market prices or when system reliability is jeopardised.[48]

The 2012 Energy Efficiency Directive constitutes a major step towards the development of demand response in Europe.[49] The Directive requires EU Member States to promote participation in and access to Demand Response.[50] It also requires them to define technical modalities for participation in these markets.[51] In this regard, there remains much work to be done by EU Member States.

In terms of barriers to demand response, there are barriers to implicit demand response and barriers to explicit demand response. Regarding implicit demand response, where consumers react to price signals that they receive, barriers can be lack of access to a dynamic pricing contract (where a consumer receives as close to real-time signals as possible), or lack of a smart meter with the correct functionalities to transmit signals and record the consumer's reactions.

As for explicit demand response, the barriers can be divided into legal barriers and logistical barriers.[52] In terms of legal barriers, in some countries, demand response is not allowed to participate in certain markets, or at all. In other countries, for example Spain, aggregation is illegal, which is a major barrier for demand response. Regarding logistical barriers, these are where technical demand response and aggregation are legal, but market requirements, such as product definitions and minimum bid sizes are very high (for instance in Sweden), or where there are limitations on aggregation.

At a technical level, there is a critical need for standardised regulation at the European level, including clarified roles and responsibilities, to help to realise expanded demand response provision within a decentralised energy system.[53] Information and communication technologies, especially new digital applications for smart girds, play a central role in enabling new renewable energy providers to monitor and process data generated across distributed

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[48] Smart Energy Demand Coalition (SEDC) *Mapping Demand Response in Europe Today – 2015*, p.20; Balijepalli, M. and Pradhan, K. (2011) "Review of Demand Response under Smart Grid Paradigm". *IEEE PES Innovative Smart Grid Technologies*.

[49] Directive 2012/27/EU, on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, 25 October 2012.

[50] Article 15.8 Directive 2012/27/EU, on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, 25 October 2012.

[51] Ibid.

[52] For further details on the barriers to explicit demand response, see Smart Energy Demand Coalition, "Explicit Demand Response in Europe: Mapping the Markets 2017," available at http://www.smartenergydemand.eu/wp-content/uploads/2017/04/SEDC-Explicit-Demand-Response-in-Europe-Mapping-the-Markets-2017.pdf.

[53] Smart Energy Demand Coalition (SEDC) *Mapping Demand Response in Europe Today – 2015*.

infrastructure and create opportunities to meet the various EU energy policy goals including efficiency, security and sustainability.[54] These opportunities are enabling the emergence of so-called 'energy prosumers,' i.e., new, flexible market actors – whether individual households or cooperatives – that generate and sell energy to the grid via Distribution System Operators (DSOs). The opportunities across the EU for consumers to become prosumers are, however, mixed, due to Member States being slow at introducing relevant regulation. There are exceptions to this situation, though, as explained below.

In terms of smart metering, Italy represents a forerunner in the EU.[55] Smart metering implementation has been completed, covering 99% of electronic metering points. The DSO is the owner and responsible party for implementing the smart grid and for guaranteeing power quality.[56] Since the lifetime of the low voltage, remote control meter is fifteen years old and the first replacement campaign was launched in 2001.

In 2016, the first generation (1G) meters reached their end-of-life and some companies have started installing 2G meters. Italian law laid down functional specifications for 2G meters and identifies some crucial criteria: 2G meters, once installed, shall remain in operation, presumably, for another 15 years; over this period, they must be able to support every electric system transformation, such as the new distributed production paradigm and the changes of the electricity market.[57] Other countries, such as Spain, have not developed an implementation plan for smart grids. Yet, the roll-out of smart meters is ongoing, with completion planned for 2018.

With respect to regulatory incentives to promote the development of smart grids, according to the CEER 79 per cent of Member States use tools for price regulation and 63 per cent use performance indicators. In contrast, tools to regulate the provision of information, charges and licensing are used significantly less. In 76 per cent of EU Member States, regulatory instruments will need to be adapted in order to facilitate the deployment of smart grids.[58] In particular, in Belgium there is an ongoing discussion about a capacity tariff versus a traditional

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[54] See A. Moreno-Munoza, F.J. Bellido-Outeirinoa, P. Sianob, M.A. Gomez-Nietoc, "Mobile social media for smart grids customer engagement: Emerging trends and challenges," *Renewable and Sustainable Energy Reviews*, Volume 53, January 2016, Pages 1611–1616.

[55] "Europe to follow Italy's lead on smart meters," *Reuters*, available at http://www.reuters.com/article/energy-efficiency-smartmeters-italy-idUSL5N0EA3HL20130530.

[56] The metering activity in Italy is regulated by the Regulation ARG/elt 199/11 (TIT).

[57] See the Italian legislative decree 102/2014; and http://www.autorita.energia.it/it/docs/dc/15/416-15.jsp.

[58] CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions ("Smart Regulation"). C13-EQS-57-04, 18-Feb-2014, p.14.

consumption-based tariff. From 2018 onwards, Atrias[59] will provide a new clearing house with new MIG6 market protocol implementation. This means that, from 2018 onwards, new market models for prosumers with PV<10 kW peak will be established, making dynamic tariffs and sale of injection possible.[60]

In the UK, the value of demand-side flexibility for the electricity system will have to be reflected in the incentives to invest in smart grids.[61] In Lithuania, reaping the benefits of smart grids and managing related data privacy issues will require amendments to the current regulatory framework.[62] In Italy, "input-based" type of incentive regulation has been used for the transmission network as well as to support smart grid pilot projects in distribution networks.[63] In Poland, in order to assess the benefits for consumers of smart metering, two new performance indicators were introduced.[64] In Spain, the deployment of smart meters is viewed as a necessary step towards the development of smart grids. A proposal to change the low voltage code has been established, as well as a new discriminatory tariff that, thanks to smart meters, promotes the charging of EV at times of lower demand and prices.

With regard to smart grids demonstration projects and how they are funded, 61 per cent of EU Member States use a combination of funding sources. Fifty-six per cent of EU Member States have been funding demonstration projects through industry funding, public funding institutions, the EU Commission and integrated municipal energy suppliers. In 61 per cent of EU Member States, governments are responsible for taking decisions about granting funds. For example, Finland passes costs through to consumers to a certain extent, but also adopts efficiency targets for companies. DSOs and research institutes are the main parties responsible. Italy uses a cost-benefit indicator to select projects. Austria finances demonstration projects through a combination of funding from industry, public institutions and the national budget. The Austrian federal government established the Climate and Energy Fund (Klima- und Energiefonds - KLIEN) to support the implementation of its climate strategy. KLIEN is responsible for most of the funds for demonstration projects. Remaining costs are audited and covered through network charges during the regulatory period, with the application of

[59] "Atrias wishes to develop together with the energy suppliers and the distribution grid operators a new market model and improved market processes." See http://www.atrias.be/UK/Pages/About.aspx.
[60] http://energy.sia-partners.com/20160701/atrias-and-mig60-towards-new-energy-market-model-belgium.
[61] CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions ("Smart Regulation"). C13-EQS-57-04, 18-Feb-2014, p.14.
[62] Ibid.
[63] Ibid.
[64] Ibid.

efficiency targets. The UK does not apply efficiency targets to demonstration projects. However, a key criterion for awarding funding is the project's value for consumers and its long-term efficiency.[65]

With respect to more general incentives to encourage DSOs to adopt smart-grid innovation projects, most EU Member States use a combination of regulatory mechanisms, national government initiatives, and European initiatives. Sixty-three per cent of EU Member States use general incentives not specific to smart grids to promote the development of smart grids. For example, Austria incentivizes cost reductions through efficiency targets which do not distinguish between traditional and smart grids. As a result, regulated companies favor smart solutions when they are more cost-efficient than the alternatives. Belgium still has to specifically define incentives, while Cyprus has currently no incentives in place. In 75 per cent of EU Member States, incentives for DSOs to innovate are funded through network charges. National and European funding is also used to a significant extent. Many EU Member States adopt a combination of funding sources. For instance, Austria, Finland, Italy and France use network charges, national funding, and European funding. The Netherlands, Poland and Norway (although not an EU country) use network charges as well as national funding. Lithuania and Slovenia use network charges and European funding. Spain uses European as well as national funding.[66]

Finally, with regard to the smart grids-related issues of data privacy and security, according to the CEER status review on European regulatory approaches enabling smart grids solutions, there is no clear consensus about whether national regulatory authorities (NRAs) for the energy sector will and should be responsible for data security regulation in relation to smart meter data. For example, in the UK, data aggregation plans will be proposed by the distribution network operator (DNO) and then approved by the NRA, and data privacy requirements will be regulated in the context of license conditions. In Slovenia, a cost-benefit analysis carried out by the NRA will also look at security issues. In Spain, access to data by actors other than customers will have be based on terms and conditions established by the NRA. In contrast, in the Czech Republic, it will be the Office for Personal Data Protection to be responsible for data security. Similarly, in France, there is a separate and dedicated agency with competence over data security. In Germany, this is the responsibility of the Federal Office for Information

[65] Ibid, pp.19-20.
[66] Ibid, p.21.

Security. Finally, in countries such as Belgium and the Netherlands, the NRA for the energy sector and the Data Protection Authority will work jointly on data security issues.[67]

The ERGEG Guidelines of Good Practice on regulatory aspects of smart metering recommend that "it is always the customer that chooses in what way metering data should be used and by whom, with the exception of metering data required to fulfil regulated duties and within the national market model. [Furthermore] Full transparency on existing customer data should be the general principle."[68] Table 1 shows that many EU Member States indeed provide customers with information about, and ensure control over, their metering data free of charge. However, the same table also shows that, in a number of EU Member States, customers are not given control over their own data.[69]

*Table 1: Data privacy and security regulation in European Member States*

| | In control and informed | In control and not informed | No control over data | Not available |
|---|---|---|---|---|
| Free | **AT, BE, DK, FI, FR, DE, GB, IE, IT, LU, NO, PL, NL** | | **CY, CZ, EE, IS, RO, SI, ES, SE** | **LT, PT** |
| Not free | | | | |

Source: CEER Status Review of Regulatory Aspects of Smart Metering. C13-RMF-54-05, 12 September 2013, p. 16.

The EU's legal reforms are thus leading to providing new opportunities for both existing actors and new ones, such as prosumers. Before specifically considering the potential implications of prosumers for energy security, the following section offers reflections on the opportunities emerging for all actors in the energy system.

[67] Ibid, pp.15-16.
[68] ERGEG "Final Guidelines of Good Practice on Regulatory Aspects of Smart Metering for Electricity and Gas". February 2011, E10-RMF-29-05, p.12.
[69] CEER Status Review of Regulatory Aspects of Smart Metering. C13-RMF-54-05, 12 September 2013, p.16.

## 4. Energy actors: Old and new

The transition to a low-carbon energy supply drawing on widely dispersed generation and supply can only result from new patterns of engagement.[70] In particular, a new market design is very much in demand, both differentiating the role of incumbents, as well as providing opportunities for the emergence of new actors.[71] In the context of the theme of the present Volume, it is important to note that differing needs and interests between old and new actors will influence the design of the regulatory landscape going forward in a rapidly changing economic context.

### 4.1. Old actors

The traditional energy market landscape is under large-scale transition. Traditionally, and since the application of the unbundling regulation as part of the process of the establishment of a fully liberalized single energy market, Transmission System Operators (TSOs) have been in charge of balancing the load at high voltage levels and transmitting it from large generation plants to DSOs. The changing nature of electricity generation, increasingly moving from large power plants to an exponentially growing number of decentralized generation premises, casts doubt on the exact role of TSOs in the coming years and decades. DSOs, to the contrary, find themselves at the heart of the energy transition. The European Commission's proposed internal electricity market directive suggests an upgraded role for DSOs, not least in managing and coordinating all the new decentralized sources. DSOs are expected to integrate different forms of power generation into their grids, and distribute electricity to households, offices and all establishments in general in a secure and efficient way. Their function, at the same time, is expected to enormously gain from digitalization.[72]

It is for these reasons, however, that DSOs also find themselves amidst competing actors for market share. For one, TSOs' marginalization may push them to ask for a redefined role in the changing energy market landscape. The precise division of labour between TSOs and DSOs

[70] Paul Upham, 'Public engagement and Low Carbon Energy Transitions: Rationales and Challenges' in Raphael Heffron and Gavin Little (eds.), *Delivering Energy Law and Policy in the EU and the US; A Reader* (Edinburgh University Press, 2016) 549.
[71] Yael Parag, Benjamin K. Sovacool, "Electricity Market Design for the Prosumer Era," *Nature Energy* 1, Article number: 16032 (2016).
[72] European Commission, Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal market for electricity (recast), Brussels, 30.11.2016 COM(2016) 861 final 2016/0379 (COD) 4-5; Pavol Szalai , 'Power grid operators expect their "Uber moment"', EU Observer, 29 September 2016, https://www.euractiv.com/section/energy/news/power-grid-operators-expect-their-uber-moment/.

remains murky for the time being. The rules of the game that will ensure their efficient cooperation within and across countries are yet to be defined.[73]

Moreover, energy policy and specific jurisdictions will define which actors are allocated which functions and in what ways. In general, one can discern between top-down (namely where governments dictate),[74] bottom-up (i.e., where non-state actors initiate), or a hybrid combination of both top-down and bottom-up energy policy, which would also determine the extent to which lower policy levels will have the leverage to manage the roll-out of smart-grids. One option is for some features of smart grids, such as smart meters, to be legally enforced. Contrary to this top-down approach, another option is to leave this in the discretion of utilities, DSOs and consumers. In practice, a hybridized approach is followed. The EU climate policy sets mandatory policy goals in a top-down form, while the roll-out of smart grids is left to lower level and market players, which are however incentivized to take this path for climate and efficiency reasons. This resonates with the principle of subsidiarity, which allows broad discretion to the various member-states to pursue different strategies.[75]

This having been said, the type of unbundling enforced pays a pivotal role in the structure of the market and the allocation of likely privileges. In the case of legal unbundling only, when the DSO is a separate legal entity from the generation company, links between the network and production companies can be maintained and this way likely benefits can be passed over to associated retailers. A level-playing field then is endangered, since investments on smart grids by DSOs can, in this case, implicitly favour other companies in the same holding, this way creating a competitive advantage *vis-à-vis* other market players. In the case of ownership unbundling, to the contrary, the DSO and the production are under the control of different

[73] Pavol Szalai , 'Power grid operators expect their "Uber moment"', EU Observer, 29 September 2016, https://www.euractiv.com/section/energy/news/power-grid-operators-expect-their-uber-moment/

[74] R. Leal-Arcas and C. Grasso "The Transatlantic Trade and Investment Partnership, energy and divestment," in Van de Graaf, T. *et al*. (eds.) *The Palgrave Handbook of the International Political Economy of Energy*, Palgrave, 2016, pp. 205-224; R. Leal-Arcas, "Mega-regionals and sustainable development: The Transatlantic Trade and Investment Partnership and the Trans-Pacific Partnership," *Renewable Energy Law and Policy Review*, Vol. 6(4), 2015, pp. 248-264; R. Leal-Arcas, Valentina Caruso and Raphaela Leupuscek, "Renewables, preferential trade agreements and EU energy security," *Laws*, Vol. 4, Issue 3, pp. 472-514; R. Leal-Arcas, Costantino Grasso and Juan Alemany Rios, "Multilateral, regional and bilateral energy trade governance" *Renewable Energy Law and Policy Review*, Vol. 6(1), pp. 38-87, 2015.

[75] Eid, Rudi Hakvoort and Martin de Jong, 'Global Trends in the Political Economy of Smart Grids: A Tailored Perspective on "Smart" for Grids in Transition' (2016) *UNU-WIDER Research Paper wp2016-022*. *World Institute for Development Economic Research* 10.

stakeholders. This should in theory lead to a more transparent and efficient allocation of smart grid benefits across market actors.[76]

Despite the strong grounds for the deployment of smart grids, market conditions raise barriers to their fast roll-out. For one, dominant market players across the value chain have little incentive to invest in new network infrastructure, as their main concern relates to retaining market share. The positive effects of rolling out smart grids are too uncertain to justify the costs associated with m reductions in market power. Taking into account that market players are one way or the other (legally, economically through competition, *et cetera*) forced to invest, it makes sense for DSOs to invest in advanced metering infrastructure. A market opening seems to exist for private investors investing in control boxes, downstream from the meter. The danger is that private investment could lead to captive customers (as these companies would necessitate long lead contractual times to recover investment costs), thus lessening competition in the nascent market. Such issues are critical and may hamper the operation of the market in the making. In particular, regulation must continually monitor abuse of market power. Scrutiny must also be paid to waiting games, with the understanding that incumbent market power ubiquitously functions as an incentive to over- or underinvest.[77]

### 4.2. New actors

The emergence of new actors on the energy market will influence the feasibility of fulfilling goals related to a more effective energy utilization. Prosumers have the potential of increasing energy efficiency and securing stable energy supplies for a wider range of consumers, including themselves. New opportunities arise for a new type of economic activity, that of energy aggregators, in what seems to be a much more variable business energy landscape. This role can be fulfilled by incumbent market players, as well as by new companies that will focus on encouraging their customers' efficient use of energy and contracting the surplus capacity, which they can sell in a "flexibility package" to the distributors and utilities. Small storage providers can also emerge in an evolving market that needs back-up capacity and last resort solutions to respond to energy supply and demand variability.

A high premium will be paid for such flexibility services, so the corporate rationale is evidently present. Importantly, there are strong grounds for such economic activity to take place at the community (or even at the district/neighbourhood) level, with co-operatives appearing as a

[76] Ibid., at 9.
[77] Cédric Clastres, 'Smart grids: Another Step Towards Competition, Energy Security and Climate Change Objectives' (2011) *Energy Policy* 39 19-21.

potent form of entrepreneurial type of organization.[78] The energy market increasingly calls for integrated energy services companies which will optimize both digital technology and electricity distribution by means of trading flexibility services.[79] There are reasons to be optimistic about the affordability of technology advancement for future prosumers: when smartphones came out, they were unaffordable; today, around 80 per cent of phones in the US are smartphones.[80] By analogy, the same effect should happen in energy technology.

There are many ways for citizens, small businesses and communities to contribute to the energy transition, actively participating in different aspects of the energy market to become true "energy citizens." Citizens are no longer resigned to the role of passive consumers, but have the potential to be energy producers, or "prosumers," particularly through self-generation of renewable energy, storage, energy conservation and participation in demand response.[81] From a legal point of view, prosumers are still considered individuals, rather than commercial actors. Their likely coming together though, in energy communities, will necessitate a more commercial legal status. In general, the future legal status of prosumers is one of the issues that remains unsettled and will have to be determined by the upcoming EU energy regulation.

Crucially, the new energy market creates ample opportunities for individuals and households to become energy traders.[82] Either directly *vis-à-vis* established utilities or indirectly through aggregators, prosumers are empowered to trade the energy they have conserved or produced, thus killing two birds with one stone by facilitating flexibility and network optimization, as well as raising extra revenues for themselves. Indeed, the emphasis of the undertaken energy overhaul lies in distributed energy resources (DER), which enhance local generation and flows into the network.[83]

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[78] Ye Cai, Tao Huang, Ettore Bompard, Yijia Cao, Yong Li, "Self-Sustainable Community of Electricity Prosumers in the Emerging Distribution System," 2016 IEEE Transactions on Smart Grid (Volume: PP, Issue: 99).

[79] Louis Boscán and Rahmatallah Poudineh, 'Flexibility-Enabling Contracts in Electricity Markets' (2016) *Oxford Energy Comment, The Oxford Institute for Energy Studies* 2.

[80] Pew Research Center, "Mobile Fact Sheet," available at http://www.pewinternet.org/fact-sheet/mobile/.

[81] Josh Roberts, "Prosumer Rights: Options for a legal framework post-2020," (2016) ClientEarth, London.

[82] This approach is quite in contrast to the typical top-down way of trading energy. See for instance Leal-Arcas, R. "How governing international trade in energy can enhance EU energy security," *Renewable Energy Law and Policy Review*, Vol. 6(3), pp. 202-219, 2015; Leal-Arcas, R, Costantino Grasso and Juan Alemany Rios, "Multilateral, regional and bilateral energy trade governance" *Renewable Energy Law and Policy Review*, Vol. 6(1), pp. 38-87, 2015.

[83] European Commission, 'Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast)', Brussels, 23.2.2017. COM(2016) 767 final/22016/0382(COD) CORRIGENDUM.

The establishment of a prosumers market is very much a work in progress. Smart grids are the hardware that will allow their full-fledged development, while relevant regulation will be its software. The Commission has taken a solid stance in its Winter Package on several key issues:

- First, it provided for consumers' right to consume the renewable electricity they generate without facing undue restrictions. This means that national jurisdictions that still forbid self-generation will be displaced by EU legislation. On top of this, consumers will be empowered to trade the energy they produce to energy companies, this way becoming active participants in the energy markets and pillars of their consolidated resilience.
- Second, a separate type of energy entity, namely energy communities, is explicitly recognized. Prosumers will be granted the right to group and function in the market collectively.
- Third, more information will be provided regarding energy performance and the sources of district heating and cooling systems. This is a key issue if prosumers and energy communities are to be in practice empowered to improve on their energy performance, this including both production and consumption, as well as trading. Added to the above, further scrutiny will be paid to improving the quality of information consumers will get. This calls for the further refinement of the Guarantees of Origin system with regard to energy resources.[84]

Placing prosumers at the centre of energy markets also requires widespread active demand participation by consumers. This boils down to the "corporatization," rationalization, and economization of consumer behaviour.[85] Demand response is all about consumers making use of the services digital technology provides to better adjust their energy use to their needs and at the same time adapt their energy usage to the most affordable energy price bands throughout each day. This can grant them significant benefits in terms of energy conservation, efficiency, savings and extra dividends. Critical information on the state of the grid and running prices enable consumers to turn down, for example, the heating system at peak times to save on energy. This way pressure to the grid is relaxed and the consumer is remunerated. On the other

[84] Ibid.

[85] A.J. Dinusha Rathnayaka, Vidyasagar M. Potdar, Tharam Dillon, Omar Hussain, Samitha Kuruppu, "Analysis of Energy Behaviour Profiles of Prosumers," 2012 *IEEE*, 236-241. For further analysis on the link between behavioral sciences and government, see Sunstein, C. *The Ethics of Influence: Government in the Age of Behavioral Science*, Cambridge University Press, 2016.

hand, making use of cheap energy (when, for example, solar panels and/or wind turbines generate ample energy) leads to valuable energy savings/surplus for trading.[86]

Smart applications and dynamic price contracts are different ways to achieve energy efficiency maximization. With regard to the former, instructing smart appliances, like the washing machine, to operate at the time of the lowest prices within a day is an energy saver. When it comes to the latter, consumers can take note of their consumption patterns and negotiate corresponding contracts with electricity suppliers. Such contracts should be increasingly on offer, and become increasingly more sophisticated and flexible, taking into account that competition is expected to mature and become consolidated. A number of pricing mechanisms can be utilized, such as real-time pricing, time-of-use pricing, critical-time pricing, tariff-of-use pricing, and time-variable pricing to reflect market fundamentals and substitute for traditional methods of dealing with supply-demand disequilibria, such as load-shedding and self-rationing.

Implementing dynamic pricing contracts, however, is more easily said than done. From the perspective of utilities and energy services companies in general, the variability, multi-dimensionality and heterogeneity of energy use renders the "representative agent" approach deficient in a demand response programme. While a one-size-fits-all program is hardly the solution, designating appropriate contracts for vastly different (and dynamic) consumer profiles is a daunting task. Efficient contracting is hence practically challenging, especially if one also takes into account the supply side. Suppliers themselves differ in the cost (disutility) they have to bear to draw on flexibility services to match demand each time and are naturally loathe to shoulder extra costs.[87]

A crucial parameter that will to a great extent determine the scale of optimization of smart grids will be the successful incorporation of storage capacity in the system in the form of batteries. This remains commercially challenging, with controversy over the efficiency gains lingering. The use of storage batteries will enable the optimal function of the network, not least since it

[86] European Commission, 'Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast)', Brussels, 23.2.2017. COM(2016) 767 final/22016/0382(COD) CORRIGENDUM.

[87] Louis Boscán and Rahmatallah Poudineh, 'Flexibility-Enabling Contracts in Electricity Markets' (2016) *Oxford Energy Comment, The Oxford Institute for Energy Studies* 10.

will reduce peak consumption, system-wide generation costs, losses, and network congestions. At the same time, it will lessen the need for further investments in network expansions.[88]

Whether electric vehicles are the optimal means of storage is also debatable. The use of double (or old) batteries, logistical issues pertaining to charging periods and infrastructure costs, as well as the optimization of the network with vehicles plagued off the grid in rush hours, all remain thorny issues to be sorted out in the near future. On the bright side, the spill-over to one of the most pollutant energy sectors—transportation—holds high promise for scaled-up performance in carbon reductions, an outcome direly needed if designated climate measures fail to stabilize the rise of global temperature in time.[89]

The modern grid has been operationally grounded on the worst case dispatch philosophy. Given that the supply side was *a priori* known, utilities had to balance it with demand which could be in most cases predicted to lie within certain bands. In order to tackle any incidents of supply-demand imbalance (owing either to any supply side failure or to an unpredicted surge in demand), a large reserve capacity was retained. While this added to overall costs and carbon emissions, it provided a shield of protection against power cuts and inevitable load-shedding.[90]

Following the same principles and rationale hardly makes any sense for smart grids, whose very function is based on the stochastic and dynamic nature of both supply and demand. An increased degree of intermittent renewable energy, unreliability of storage, micro-grids, variability in consumer choice and the function of smart appliances all increase uncertainty in both supply and demand of electric power. This variability and unpredictability can be mediated and tackled by a number of tools, such as sensors, smart meters, and a wide range of demand response mechanisms that provide accurate information on the state of the power system and the supply-demand equilibrium, as well as more refined means of control of energy use.[91]

[88] Eid, Rudi Hakvoort and Martin de Jong, 'Global Trends in the Political Economy of Smart Grids: A Tailored Perspective on "Smart" for Grids in Transition' (2016) *UNU-WIDER Research Paper wp2016-022. World Institute for Development Economic Research* 3.
[89] International Energy Agency, 'World Energy Outlook. Executive Summary', Paris (2016) 3, 5.
[90] Pravin P Varaiya, Felix F Wu and Janusz W Bialek. 'Smart Operation of Smart Grid: Risk-Limiting Dispatch' (2011) *Proceedings of the IEEE Xplore* 99 41-43.
[91] Louis Boscán and Rahmatallah Poudineh, 'Flexibility-Enabling Contracts in Electricity Markets' (2016) *Oxford Energy Comment, The Oxford Institute for Energy Studies* 7-8.

Following this rationale, a reconsideration and ensuing redefinition of risks management seems appropriate. What constitutes acceptable risk must certainly be adjusted to the new operating conditions of smart grids and replace the current measures of risk. In this context, it is necessary to pass from only quantities to quantities plus probabilities in supply–demand information analysis. Demand response of individual consumers has to be aggregated into a probabilistic demand curve, analogous to the generation availability curve of intermittent renewable energy.[92] The focus lies constantly on the fluctuations in the *net load,* the difference between total demand (load) and variable generation. A number of attributes are fundamental when considering balancing the load, such as capacity, ramp rate, duration and lead time for increasing or decreasing supply as appropriate.[93]

Cross-border markets and their potential must also be integrated into risk management analysis. The EU's current cross-border electricity trade has worked well in the day-ahead market. A big part of national markets are now coupled, stimulating price competition, improving balancing, and enhancing back-up capacity and hence resilience. Importantly, cross-border markets should increasingly expand to include non-EU member-states that have joined the Energy Community, and can also include capacity from neighbouring states outside the Energy Community. While cross-border capacity is definitely a source to tap from, a number of physical barriers such as congestion, lack of transmission capacity and/or underutilization have, in several cases, result sub-optimal transmission returns and hub market differentials, which impede, rather than facilitate, cross-border trade. Moreover, while the traditional timeframe for most of electricity trading has been day-ahead trade, moving towards "real-time", intra-day trade remains a challenge.[94]

## 5. Prosumers: Key issues

### 5.1. Supply security

The development of prosumer markets fits into the EU's traditional diversification agenda regarding fuels, sources of supply, and routes of supply diversification.[95] This is because it adds to traditionally imported sources of energy such as oil and gas, and indigenous energy

[92] Pravin P. Varaiya, Felix F Wu and Janusz W Bialek. 'Smart Operation of Smart Grid: Risk-Limiting Dispatch' (2011) *Proceedings of the IEEE Xplore* 99, 55.
[93] Louis Boscán and Rahmatallah Poudineh, 'Flexibility-Enabling Contracts in Electricity Markets' (2016) *Oxford Energy Comment, The Oxford Institute for Energy Studies* 9.
[94] Ibid, at pp. 2-7*;* David Buchan and Malcolm Keay, 'EU Energy Policy – 4th Time Lucky? (2016) *Oxford Energy Comment. The Oxford Institute of Energy Studies* 6-9.
[95] Filippos Proedrou, 'EU Energy Security Beyond Ukraine: Towards Holistic Diversification,' (2016) *European Foreign Affairs Review* 21.

sources such as solar and wind energy via different pathways. On the one hand, prosumer markets can lead to improved security of supply and market resilience through increased indigenous energy generation, substantial rationalization of energy use, and increased energy conservation and efficiency. On the other hand, they can decrease needs and quantities of imports, thus also de-securitizing their importance for the smooth operation of the EU, in particular for national markets that are less interconnected and more dependent and vulnerable.

The exact shape prosumer markets will take is significantly contextualized and contingent upon both local conditions and national regulation. A one-size-fits-all approach hence is hardly feasible. In Greece, for example, geography plays a critical role, with the plethora of islands calling for different treatment than that of the mainland, as is reflected in the institutional energy structure and the associated regulatory provisions.[96] The existence of a big number of small islands in the Aegean Sea creates a strong rationale for autonomous energy generation, since connection to the main grid is rather costly. Utilizing the rich potential of energy generation through strong winds and ample sunshine could substantially boost indigenous energy generation. A smart grids architecture that would interconnect the grids of several adjacent islands, and then create interconnection points for these different groups of islands (most probably on the basis of existing administrative divisions), could also provide the appropriate scale, as well as interconnectivity options, necessary to ensure resilient security of supply.

With regard to affordability, the development of prosumer markets can bring a plethora of positive results. The first result is that it can lower electricity bills in two ways: self-consumption and enhanced demand management. The second is that is can add to prosumers' income via the financial gains they make by selling the (excess) energy they produce.[97] On top of these, prosumers become less sensitive to abrupt international energy price increases and/or supply disruptions. One can hardly overestimate the potential of prosumer markets in the long term if one thinks of the downward trajectory of renewable-energy investments costs and prices.[98] On the other hand, international energy prices are underpinned by consistent fluctuations, with occasionally high prices being a prerequisite for new rounds of investments[99]

[96] HEDNO, 'Regulatory Framework', http://www.deddie.gr/en/i-etaireia/ruthmistiko-plaisio.

[97] Filippos Proedrou, 'Are smart grids the key to EU energy security?' in Rafael Leal-Arcas and Jan Wouters (eds.) *Research Handbook on EU Energy Law and Policy* (Edward Elgar, 2017).

[98] OECD/IEA, Renewable Energy Medium-Term Market Report. Market Analysis and Forecasts to 2020. Executive Summary, Paris (2015) 5.

[99] On investment law and policy, see generally Leal-Arcas, R. *International trade and investment law: Multilateral, regional and bilateral governance*, Edward Elgar Publishing, 2010.

and juxtaposing them to the structurally cyclical nature of international energy prices and their ensuing boom-and bust-cycles. While high fossil energy prices are at times indispensable in order to finance a new wave of investments, this is not the case with renewable energy.[100]

While the potential is immense, the development of prosumer markets faces significant critiques as well as several hurdles. Starting with the former, it remains unclear how and whether prosumer markets will be able to offset the projected increase of energy demand. The ubiquitous electrification of society, seen in all sectors, from electric mobility (electric or hybrid cars, electrified public transportation), to heating (replacing oil, gas and biomass heating) and an exponentially growing number of electric appliances, evidently feeds electricity demand.[101] In other words, while smart grids target energy efficiency, there is no clear pathway to counter the well-known rebound effect, or Jevon's paradox. The more energy use becomes more efficient, the more energy use grows, with the end result being more amenities, but hardly any tangible benefits in the indispensable energy savings needed if even the contemporary mediocre climate targets (in the sense that they do not bring us to the maximum acceptable level of a 2-degree Celsius increase in global temperature above pre-industrial levels) are to be met.

With respect to the hurdles, prosumer markets and EU regulation in this field lag significantly behind the pace of innovation and proliferation of renewable energy production. Some solar-rich countries such as Greece and Spain, for example, have only very recently passed laws (Spain in 2015[102] and Greece in 2016[103]) that allow for energy self-generation. This regulatory gap has been part of a broader emphasis on large corporate players, and the associated fiscal stimuli, to invest in large wind parks and photovoltaic panels, rather than in individuals and small-scale installations.[104] Such inertia has blocked the immense bottom-up potential of renewable energy generation at a massive scale, as has been the case in much less sunlit countries such as Belgium and Germany. The new law has come under severe scrutiny in Spain for two main reasons:

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[100] Filippos Proedrou, 'A New Framework for EU Energy Security: Putting Sustainability First (2017) *European Politics and Society*, 18:182-198, at 194.
[101] Verbong, Geert PJ, Sjouke Beemsterboer, and Frans Sengers. "Smart grids or smart users? Involving users in developing a low carbon electricity economy." *Energy Policy* 52 (2013): 123.
[102] Government of Spain, Ministry of Energy Tourism and Digital Agenda, 'Royal Decree 900/2015 on Self-Consumption' (2015), 9 October.
[103] Republic of Greece, Ministry of Environment and Energy, 'Decree 4414/2016' (2016) 9 August.
[104] Gaëtan Masson, Jose Ignacio Briano and Maria Jesus Baez, 'Review and Analysis of PV Self-Consumption Policies', *International Energy Agency, Photovoltaic Power Systems Program, Report IEA-PVPS T1-28:2016*, 13

1. Firstly, individual investors are expected to pay a "tax on the sun;" and
2. Secondly, they are not remunerated for any energy quantities they ship to the grid.[105]

In countries where self-generation has been actively endorsed and subsidized, on the other hand, such as Belgium, the charging of a fee for individual energy producers to be granted the right to supply the grid provides a significant disincentive for cascading renewable generation schemes.[106] All these tax and regulatory impediments counter the very rationale and philosophy underpinning the transition towards the development of prosumer markets. Instead of compensating the DSOs for handling further supply, as is currently the case, a fairer and more stimulating approach seems to be that the prosumer has to be incentivized to increase his/her energy savings and shipments to the grids, rather than be charged for this right.

The operation of the electricity markets, moreover, calls for continuous balancing. In some cases, the incapacity of the grid to receive and utilize renewable energy meant that wind turbines had to be switched off, and that solar power was not brought into use.[107] On the other hand, in case demand exceeds supply what results is higher prices, or even load-shedding. Such problems are to be tackled in the underway prosumer markets by means of demand response management, real-time pricing, decentralized control automation, intra-day markets and flexible targeted contracts.[108]

### 5.2. Sustainability

Actors can contribute to integrated sustainability only if the energy they use and the technologies which enable their participation in the distribution are, throughout the entire life cycle, able to reduce environmental and climate change impacts. The EU energy targets promote energy efficiency, renewable energy as well as decentralisation. But these also need to fit within the broader EU sustainable development agenda post-SDGs[109] and its Circular Economy Program to increase resource efficiency and decrease waste.[110] In fact, one could

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[105] Mira Galanova, 'Spain's Sunshine Toll: Row over Proposed Solar Tax', *BBC News*, 7 October 2013, Barcelona, Spain.

[106] European Environment Agency, 'Country Profile- Belgium'. Energy Support 2005-2012.

[107] Matthias Wissner, 'The Smart Grid – A Saucerful of Secrets?' (2011) *Applied Energy*; Eid, Rudi Hakvoort and Martin de Jong, 'Global Trends in the Political Economy of Smart Grids: A Tailored Perspective on "Smart" for Grids in Transition' (2016) *UNU-WIDER Research Paper wp2016-022. World Institute for Development Economic Research.*

[108] Cédric Clastres, 'Smart grids: Another Step Towards Competition, Energy Security and Climate Change Objectives' (2011) *Energy Policy* 39.

[109] This is articulated in the Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions Next Steps for a Sustainable European Future European Action for Sustainability, Strasbourg, 22.11.2016 COM(2016) 739 final.

[110] Communication from the Commission to the European Parliament, Closing the Loop – An EU action plan for the Circular Economy, COM (2015) 614, Brussels 2.12.2015

divide by half the energy we use because much of it is wasted due to outdated technology, which means that saving energy is the most profitable thing we can do. The creation of a carbon tax can help here.[111] Others have come up with ecological solutions that bridge the gap between ecology and the economy.[112]

For prosumers, delivering on sustainability requirements will depend on obligations placed directly on them as commercial actors, rather than consumers, as opposed to manufacturers of technologies and physical infrastructure like solar panels. Finding a balance between these is essential to secure sustainability and improve the decentralised energy ecosystem resilience. Moreover, we are living on credit because we are, on a daily basis, using large amounts of fossil fuels, which is not sustainable, and fossil fuels are being consumed without replacement.

The emergence of prosumers requires that they are empowered to themselves generate renewable energy. This, along with increased energy efficiency and conservation, should lead to a cleaner energy mix, all else being equal. This is because self-consumption minimizes the losses involved in energy transmission. The end result is, hence, overall reduced energy consumption. Moreover, the development of prosumer markets enables distributed generation (micro-generation), giving rise to local energy communities. Belgium features here as an excellent case in point. Enhanced incentives for the installation of solar panels has rendered individuals and households producers of their energy, both releasing pressure from the grid, as well as supplying the grid with renewable energy.[113]

Self-generation and self-consumption, moreover, will lead to cleaner energy systems, in that clean fuels will decrease the need for oil and gas imports.[114] This represents a potentially far-reaching game-changer. A recent study has convincingly shown that

> utilizing existing infrastructure such as existing building roofs and shade structures does significantly reduce the embodied energy requirements (by 20–40%) and in turn the EPBT [energy pay-back time] of flat-plate PV systems due to the avoidance of energy-intensive balance of systems (BOS) components like foundations … [while] a greater life-cycle energy return and

[111] See the proposal of senior Republican statesmen regarding a carbon tax in the United States. Mooney, C. and Eilperin, J. "Senior Republican statesmen propose replacing Obama's climate policies with a carbon tax," *The Washington Post*, 8 February 2017, available at https://www.washingtonpost.com/news/energy-environment/wp/2017/02/07/senior-republican-leaders-propose-replacing-obamas-climate-plans-with-a-carbon-tax/?utm_term=.1ceadf0fe007.
[112] See World Alliance for Efficient Solutions, available at http://alliance.solarimpulse.com/.
[113] Gaëtan Masson, Jose Ignacio Briano and Maria Jesus Baez, 'Review and Analysis of PV Self-Consumption Policies', *International Energy Agency, Photovoltaic Power Systems Program, Report IEA-PVPS T1-28:2016,* 13.
[114] Lehmann, Paul, and Erik Gawel. "Why should support schemes for renewable electricity complement the EU emissions trading scheme?." *Energy Policy* 52 (2013) 603.

carbon offset per unit land area is yielded by locally-integrated non-concentrating systems, despite their lower efficiency per unit module area.[115]

A potential extension of prosumer markets involves bringing clean energy to the transportation sector via charging infrastructure, which holds high promise for further sustainability gains in terms of lower emissions.[116]

### 5.3. Digital security

Energy systems are critical infrastructure. The loss of delivery capacity can have multiple impacts on domestic households, public utility services such as hospitals, as well as transport and communication systems. The cyber-hacking of Ukraine's existing large-scale energy systems illustrated new weaknesses in digitalised infrastructures.[117] Smart-grid energy systems will compound existing security threats.

Smart-grid energy systems are Internet-of-Things (IoT) networks, comprising billions of smart objects, such as smart meters, smart appliances, and other sensors, all interconnected.[118] As a cyber-physical system, an IoT-based smart grid presents risks across different domains (i.e., generation, transmission, distribution, customer, service provision, and operations markets).[119] The classical electric grid of the past did not allow for attacks such as energy theft and fraud, sensitive information theft, service disruption for the purpose of extortion, vandalism, hacktivism, and terrorism.[120] As Sander Kruese, privacy and security adviser at Alliander, a distribution system operator in the Netherlands, notes, "every component in the grid that has become digitized is becoming an attack point." [121] Based on previous experience gained from

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115 Halasah, Suleiman A., David Pearlmutter, and Daniel Feuermann. "Field installation versus local integration of photovoltaic systems and their effect on energy evaluation metrics." *Energy Policy* 52 (2013): 462.

116 See generally the proposal of the EU Commission, "Clean energy for all Europeans," COM(2016) 860 final, 30 November 2016. One should add that global CO2 emissions from energy use remained flat in 2016 according to a report of BP. See BP Statistical Review of World Energy June 2016, https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf.

117 "Ukraine power cut 'was cyber-attack'," *BBC News*, 11 January 2017, available at http://www.bbc.co.uk/news/technology-38573074.

118 K.T. Weaver, Smart Meter Deployments Result in a Cyber Attack Surface of "Unprecedented Scale", Sky Solutions (7 January 2017) – available < https://smartgridawareness.org/2017/01/07/cyber-attack-surface-of-unprecedented-scale/> accessed 8 February 2017.

119 Polinpapilinho F. Katina · Charles B. Keating · Enrico Zio · Adrian V. Gheorghe, A Criticality-based Approach for the Analysis of Smart Grids, Technology Economy Smart Grids Sustain Energy (2016) Springer.

120 K.T. Weaver, Smart Meter Deployments Result in a Cyber Attack Surface of "Unprecedented Scale", Sky Solutions (7 January 2017), available < https://smartgridawareness.org/2017/01/07/cyber-attack-surface-of-unprecedented-scale/> accessed 8 February 2017.

121 Hackers Threaten Smart Power Grids," by Anca Gurzu, 1/4/17, 6:18 PM CET Updated 1/6/17, 3:32 PM CET; available at http://www.politico.eu/article/smart-grids-and-meters-raise-hacking-risks/

both IT and telecommunications, it is reasonable to envision that smart grids will be potential targets for malicious, well-equipped, and well-motivated adversaries.[122]

Within a decentralised energy market with multiple small scale providers who are dependent on digital technology, concerns arise over a range of security matters that need to be addressed. Prosumers could be a security weak point that could impact the security of the energy system at any time. Automated smart meters, for example, rely on tracking actual power usage in real time and allow for two-way communication between the utilities and end users. Hackers targeting this technology could cause disrupted power flows, create erroneous signals, block information (including meter reads), cut off communication, and/or cause physical damage.[123] Therefore, it is crucial that prosumers and consumers have the power to control their energy bills.

The EU has focused on the data security dimensions, especially data privacy issues, relating to smart meters and smart grids. While acknowledging the risks to potential privacy – primarily consumers – the EU is also placing great faith in the potential benefits of the digitised gig economy and new networks of users and the opportunities to engage and promote products, targeting niche audiences including in energy markets.[124] The Working Party on Data Protection of Smart Grids Opinion states that smart metering systems and smart grids foreshadow the impending 'Internet of Things,' and that the potential risks associated with the collection of detailed consumption data are likely to increase in the future.[125] This will be exacerbated when combined with data from other sources, such as geo-location data, tracking and profiling on the internet, video surveillance systems, and radio frequency identification systems.[126] Ensuring prosumers understand and have the capacity to deliver secure energy provision is integral to maintaining critical infrastructure in the EU at all administrative levels. Legally, prosumers need to have clarity over their obligations in terms of liability for service

[122] Jing Liu, Yang Xiao, Shuhui Li, Wei Liang, and CL Philip Chen. 'Cyber security and privacy issues in smart grids' 14, no. 4 (2012) IEEE Communications Surveys & Tutorials 981-997.
[123] "Transforming the Nation's Electricity System," Quadrennial Energy Review: Second Instalment; U.S. Department of Energy, January 2017; available at https://energy.gov/epsa/downloads/quadrennial-energy-review-second-installment.
[124] Meglena Kuneva, European Consumer Commissioner, Press Release - Roundtable on Online Data Collection, Targeting and Profiling (Brussels, 31 March 2009) available http://europa.eu/rapid/press-release_SPEECH-09-156_en.htm [last accessed 1 March 2017].
[125] Article 29 Data Protection Working Party, Opinion 04/2013 on the Data Protection Impact Assessment Template for Smart Grid and Smart Metering Systems ('DPIA Template') prepared by Expert Group 2 of the Commission's Smart Grid Task Force, 00678/13/EN, WP205, 22 April 2013.
[126] Ibid; Recommendation CM/Rec(2010)13 of 23 November 2010 of the Council of Europe Committee of Ministers to Member States on the protection of individuals with regard to automatic processing of personal data in the context of profiling.

provision and data management going. As yet, this is still to be provided by Member States. This is a further example where new legal challenges are emerging as a result of the digitalised gig economy.

## 6. Conclusion, recommendations and a future research agenda

As part of the theme of this volume on shifting forms and levels of cooperation in international economic law and governance, this paper sheds light on the emergence of a new actor, namely the prosumer, in the EU's energy security arena. Sustainable energy is rapidly becoming an EU special brand, like the protection of human rights, in the quest for looking after the environment. Achieving sustainable energy encompasses the following points: decarbonizing the economy, democratizing access to energy (namely everyone has the right to participate), digitalization, diversification of energy supply, and disrupting traditional energy cycles. Leadership is shifting from national politics to local politics and, therefore, power is being decentralized. For instance, when there is a natural disaster in a given neighbourhood, citizens do not contact the head of State or government of the nation, but the mayor of the city. A clear example of this trend towards local politics is the Local Governments for Sustainability platform.[127]

Following trends in the EU towards decentralization and the emergence of a gig economy, the energy sector is currently undergoing a large-scale transition. One of its core aspects is the progressive top-down diffusion of the potential, competences, and leverage from EU institutions, states and corporate actors across the energy value chain towards prosumers, who need to be at the centre of the energy transition for it to happen democratically in a bottom-up manner. This phenomenon can be conceptualized as energy democratization, namely moving away from a few energy companies monopolizing access to energy towards energy owned mainly by consumers, making consumers of the utmost importance.

All of this is achievable by shifting the current paradigm to one that is more human-centric, by linking projects to people, and more collaborative in how it tackles various obstacles, whether legal or behavioural. Think of the analogy of organic food: it is more expensive, but for many, its benefits outweigh the costs. Moreover, consumers have the power to choose either organic or non-organic. By the same token, many citizens are interested in climate-friendly products even if they are more expensive. This means that we need to look at the whole production

[127] "Local Governments for Sustainability is an international association of local and metropolitan governments dedicated to sustainable development." See http://climateinitiativesplatform.org/index.php/ICLEI_-_Local_Governments_for_Sustainability.

process, not just the end product, if we are serious about consumer empowerment. To get there, legislation must remove barriers to participation and protect and promote consumers to enable them to produce, store, sell and consume their own energy.

While all of the above creates ample potential for facilitating and improving the EU's security of supply, as well as fulfilling its climate targets, several caveats exist. These are not only confined within energy security prerogatives, but also extend to the critical management of digital security, which the digitalization of energy services brings to the fore. So, for consumers to become prosumers and engage in the energy transition, it will be crucial to make the process interesting and simple, and inform them much more, given the current level of energy consumer dissatisfaction. Here is where cities can play a major role at educating citizens on energy transition and climate change mitigation, not least because cities consume three quarters of the world's energy,[128] and because they are smaller entities than countries or regions, so it is easier to get things done. Even more impactful would be to educate companies and policymakers on sustainable development, since there are fewer of them than there are citizens. Doing so will shift the paradigm from a system that is producer-centric to one that will be consumer-centric. This paradigm shift is crucial because development is not possible without energy and sustainable development is not possible without sustainable energy.

In an ever-shifting context, demand management emerges as a key issue. The provision of adequate and precise information to prosumers—so that they can optimize their use of smart grids—as well as the transition to targeted, flexible contracts to adjust to the needs of prosumers need to be embedded in well-articulated broader policy and market regulatory frameworks. Moreover, private and public finance should be effectively attracted and directed to indispensable infrastructure schemes that will enable the transition from the traditional centralized power network to the decentralized nexus of smart grids. And it is well known that where finance flows, action happens. Last but not least, the technologies that will be prioritized in terms of energy generation to back renewable energy generation will play a crucial role in facilitating the role of prosumers in the new market in-the-making. Since renewable energy is becoming more competitive, more green jobs will be created in the future and the trend towards a clean energy revolution is ever closer. This energy transition into renewable energy, in turn, will help both enhance energy security and mitigate climate change. So rather than investing

[128] ARUP, "Energy in cities," p. 2.

large amounts of money into building liquefied natural gas terminals and gas pipelines, the EU should make a greater effort to invest in renewable energy.

The emerging establishment of prosumer markets is an invaluable development that will enable the transition from supply-driven to demand-side EU energy policy. This cannot but have far-reaching ramifications for the amply politicized and securitized gas trade with Russia, as well as for furthering the internal EU market architecture. It is expected that it will decrease flows of energy as well as dependence on Russian gas in the medium term while at the same time acting as a stimulus for further market integration in the energy, climate and digital economy realms.

Giving civil society a greater voice is imperative for the energy transition to happen. Below are some of the necessary actions:

1. Speeding up action on the ground and localizing global agendas;
2. More alliances between countries and donors in the decarbonisation process;
3. Greater collaboration between civil society, governments and NGOs to include all layers of governance;
4. Bringing together different camps of governments;
5. Scaling up the capacity of local governments;
6. Webbing[129] will be necessary: we need to look at issues and challenges, not sectors; temporal linkages are required, namely using time as an indicator given its importance in the context of decarbonisation, and there needs to be policy coherence.

Finally, in the future, energy will be consumed near where it is produced. How will this impact international trade (in energy)? Furthermore, the protectionist concept of “buy local” seems to be going global. This policy is suggested, among other things, to reduce greenhouse gas emissions from transportation, which will benefit climate change. But what implications will it have for international trade? Unless there is more innovation in transportation, there is a chance that this policy will result in less demand for international trade. How can international trade and climate change mitigation work together harmoniously without impeding each other in the context of an emerging decentralized energy system? New actors and modes of governance are changing the traditional global trading system, or at least are contributing to the transformation from inter-state dealings to completely different forms of governance in

[129] By webbing, we are referring to connecting different issues in a broader policy approach, rather than approaching them in silos.

which non-state actors (including individuals) play a role. The EU has been a social laboratory to test hypotheses of multi-level governance in the past, which are pertinent for the case of energy transition. The above questions are all very relevant to a future research agenda in the broad field of international economic law and governance.