MERLIN

Modelling the Economic Reactions Linking Individual Networks

Milestone 0

Scope of Milestone 1 Report: International Experience in smart platforms for distribution planning and energy trading

By **Karim Anaya** and **Michael Pollitt**

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UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

This report scopes out the work that will be carried out by Cambridge EPRG during Milestone 1. It includes general background to the research as well as the methodologies that will be implemented to complete this Milestone.

1. Background

The decentralisation, decarbonisation and digitalisation (Three D's) of the energy system is not only contributing to the transition to a low carbon economy but also is creating new business opportunities for all the participants of the electricity value chain, such as suppliers, demand customers, traders, aggregators and network operators.

The democratisation of smart technologies (e.g. smart meters, artificial intelligence, active network management, blockchain[1]) in the different components of the electricity supply chain is facilitating the management and trading of different flexibility services[2] provided by distributed energy resources (DER)[3] and demand customers, contributing among other things, to a more efficient and reliable operation of the electricity network. These services can be traded in two ways: between consumers and prosumers within the same local networks (i.e. microgrids) commonly known as Peer-to-Peer; and within conventional wholesale and retail markets (end-consumers and DER with the capability to interact with the grid, usually aggregated in order to meet grid requirements)[4]. Many of the different grid requirements can be in the form of ancillary services (Pollitt and Anaya, 2019).

For instance, in the wholesale market, ancillary services have been traditionally provided by the supply side (i.e. transmission connected generators) and procured by electricity system operators using different mechanisms (Anaya and Pollitt, 2018a). However, the deployment of decentralised generation and the transition from passive to active consumers, encourages the participation of new market players in the provision of flexibility services to the grid[5]. Distribution and system operators are also expanding their options for contracting flexibility services from DER and active consumers connected to their networks.

This can take different forms: individually, via a common trading platform that involves several DSOs (e.g. Piclo Flex) or via a common platform for distribution system operators and electricity system operators that can place bids for flexibility services simultaneously (e.g. Cornwall Local Energy Markets)[6].

Regulation and policies that promote the trading of flexibility services from DER are still a work in progress in many jurisdictions. Many of the current initiatives are still under development, with an important number of pilot projects/trials that aim to evaluate the economic, technical and commercial viability.

2. Aim of the Report

The aim of the **Milestone 1 Report** is to analyse and evaluate the deployment of smart platforms in key jurisdictions that provide flexibility services to network operators in order to identify key lessons for MERLIN.

A special consideration is given to the way in which economics and technical solutions are combined in order to maximise the value that flexibility services can provide to network operators and to the users of the grid.

We propose to evaluate a set of key projects/initiatives (trials and business as usual) that make use of smart platforms for trading flexibility services (including those services contracted for grid management) and that involve the participation of key parties such as distribution system operators and electricity system operators, among others.

3. Methodology

The report will look for a diverse set of projects/initiatives that operate in different jurisdictions including UK, Germany, Japan, Netherlands, Australia, US and Canada among others[7].

A review of the different national public funded programmes and demonstration projects required by governments including those subject to regulatory sandbox (e.g. Network Innovation Competition programme in UK[8], ARENA DER projects in Australia[9], REV Demonstration Projects in New York[10]) will be performed. In addition, a review of academic papers and industry reports that compile information about energy trading platforms (Andoni et al., 2019; CERRE, 2019; Küfeoğlu et al., 2019; Origami, 2019; BDEW, 2019) will be made as well. Key interviews are expected to be done in specific cases. A list with potential projects/initiatives is provided in Table 1.

4. Structure of the Report

The report is composed of five sections.

Section 1 introduces the project, the aim and scope of the report. It also discusses briefly the main drivers of the deployment of smart grids and platforms in the energy sector (i.e. three Ds) and the demand for flexibility services. Section 2 discusses the evolution of smart energy trading platforms with a focus on technical, commercial and economic aspects, trading mechanisms and current deployment. Section 3 describes briefly the project (MERLIN). Section 4 introduces and discusses the projects/initiatives to evaluate. The discussion concentrates on different aspects such as services to offer (reactive power, local congestion management, energy), pricing mechanisms (e.g. fixed rate, dynamic rate), procurement methods (e.g. market-based, bilateral), power system economics (subject to data availability and maturity of the project/initiative), trading mechanisms (e.g. blockchain and others), type of asset (mixed, EV batteries, solar PV and others etc.), type of initiative (public funded, private, other), type of participants (residential, commercial, industry, independent generators), coverage (local, regional, national), and key roles (DSOs, TSOs), among others[11]. Section 5 analyses and compares the projects/initiatives discussed in Section 4, identifies main limitations related to their implementation and expansion at large scale (including regulatory and economics issues)[12] and identifies key lessons for MERLIN. Section 6 presents the conclusions and key recommendations.

Table 1: Potential list of projects/initiatives to evaluate

Name	Location	Services to trade	Assets	Buyer
Projects awarded by Australian Renewable Energy Agency (ARENA)	Australia	To be explored	To be explored	DSO/TSO/end customers
Ponton (Enerchain/ Gridchain)	Germany	Several flexibility services	Several, including those contracted by wholesale traders	DSOs/TSOs
KEPCO – Power Ledge	Japan	Energy, RECs	Solar PV	DSO
Stedin – Smart Solar Charging	Netherlands	Energy (for congestion management)	EV batteries	DSO
Tennet-Vandebron	Netherlands	Regulating and reserve capacity	EV batteries, household batteries	TSO
Cornwall Local Energy Market	UK	Flexible demand and generation	Storage, solar PV, CHP, wind	DSO/ESO
Piclo Flex	UK	Flexibility services (down/ up consumption)	Several (including aggregation), batteries (including EV ones)	DSOs
Projects awarded via Network Innovation Competition (NIC)	UK	To be explored	To be explored	DSO/TSO/end customers
Brooklyn Microgrid	US	Flexibility services (including frequency regulation)	Mainly solar PV	End customers

Source: companies' websites. REC: Renewable energy certificates.

Milestone 1 Report sets the baseline for the other two reports. **Milestone 3 Report** *(Regulation and policies for the smart integration of DER)* aims to expand the discussion regarding regulatory challenges associated with the implementation of smart energy trading platforms in the provision of different services from DER.

Milestone 8 Report *(The Economics of Smart Platforms for the Integration of DER: A case study)* looks at the economics of these platforms, proposing a cost benefit methodology[13] in order to identify and quantify the benefits of MERLIN especially to the distribution system operators under the UK electricity market context.

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References

Anaya, Karim L., Pollitt, Michael G. (2018a), "Reactive Power Management and Procurement Mechanisms: Lessons for the Power Potential Project. Final Report, June 2018. *Report to NGESO.*

Anaya, Karim L., Pollitt, Michael G. (2018b), "Towards a Cost Benefit Analysis for the Power Potential project," Final Report, Dec. 2018. *Report to NGESO.*

Andoni, M., Robu, V., Flynn, D., Abram, S., Geach, Jenkins, D., McCallum, P., Peacock, A. (2019), Blockchain technology in the energy sector: A systematic review of challenges and opportunities. *Renewable and Sustainable Energy Reviews* 100, 143-174.

BDEW (2018), Blockchain in the Energy Sector. The Potential for Energy Providers. German Association of Energy and Water Industries. https://www.sap.com/documents/2018/11/c0ef1cf7-277d-0010-87a3-c30de2ffd8ff.html

CERRE (2019), Smart Consumers in the Internet of Energy: Flexibility Markets and Services from Distributed Energy Resources. Centre on Regulation in Europe, Nov. 2019. https://www.cerre.eu/events/smart-consumers-internet-energy

EPRI (2015), The Integrated Grid. A Benefit-Cost Framework. Final Report. Electric Power Research Institute. Feb. 2015. https://www.ftc.gov/system/files/documents/public_comments/2016/06/00151-128392.pdf

Küfeoğlu, S., Liu, Gaomin, Anaya, Karim L., Pollitt, Michael G. (2019), "Digitalisation and New Business Models in Energy Sector," EPRG WP 1920. https://www.eprg.group.cam.ac.uk/eprg-working-paper-1920/

Ofgem (2019), Ofgem's Future Insights Series. Flexibility Platforms in electricity markets. https://www.ofgem.gov.uk/system/files/docs/2019/09/ofgem_fi_flexibility_platforms_in_electricity_markets.pdf

Ofgem (2015), Making the electricity system more flexible and delivering the benefits for consumers. https://www.ofgem.gov.uk/ofgem-publications/96959/flexibilitypositionpaperfinal-pdf

Origami (2019), Analysis of the relevant international experience of DSO flexibility markets. Origami Power Energy, Aug. 2019. https://ssen-transition.com/wp-content/uploads/2019/08/TRANSITION-Analysis-of-relevant-international-experience-of-DSO-flexibility-markets.pdf

NYPSC (2016), Order Establishing the Benefit Cost Analysis Framework. State of New York Public Service Commission, Jan. 2016. https://nyrevconnect.com/rev-briefings/value-der-pricing-distributed-resources/

Pollitt, Michael G., Anaya, Karim L. (2019), "Competition in Markets for Ancillary Services? The implications of rising distributed generation," EPRG WP 1928. https://www.eprg.group.cam.ac.uk/eprg-working-paper-1928/

Links of potential projects/initiatives

ARENA DER projects (Australia): https://arena.gov.au/assets/2019/04/arena-distributed-energy-resources-projects.pdf

Brooklyn Microgrid: https://www.brooklyn.energy/

Cornwall Local Energy Market: https://www.centrica.com/innovation/cornwall-local-energy-market

KEPCO-Power Ledge: https://www.powerledger.io/article/power-ledger-kepco-extend-trial-to-create-and-track-renewable-energy-credits/

Piclo Flex: https://picloflex.com/

Ponton: https://enerchain.ponton.de/

Stedin-Smart Solar Charging: https://www.usef.energy/implementations/smart-solar-charging/

Tennet-Vandebron: https://www.tennet.eu/news/detail/electric-vehicles-replace-power-plants-to-maintain-supply-demand-balance-on-high-voltage-grid/

Footnotes

1 For further discussion about artificial intelligence and blockchain applications in the energy sector see Küfeoğlu et al. (2019).

2 The Office for Gas and Electricity Markets from Great Britain (Ofgem) defines flexibility as "modifying *generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system" (Ofgem, 2015, p. 5).*

3 The use of blockchain in the energy industry is increasing. In the study of 140 blockchain innovation projects in the energy field, Andoni et al. (2019) find that 33% of blockchain use cases concentrate on decentralised energy trading involving wholesale, retail and P2P energy trading initiatives.

4 OFGEM (2019) identifies two kinds of flexibility platforms for the two approaches (Peer-to-Peer platforms and Grid Services Platforms) and six key tasks associated to the one that provides services to the grid. From these Coordination, Procurement and Dispatch Control are the most relevant to delivering flexibility products.

5 This is the case of Power Potential trial in UK which is currently under implementation by the electricity system operator in GB (NGESO) and UK Power Networks.

6 See: https://www.energylivenews.com/2019/11/11/cornwall-local-energy-market-reaches-flexibility-breakthough/

7 The final list is subject to data availability.

8 See: https://www.ofgem.gov.uk/network-regulation-riio-model/current-network-price-controls-riio-1/network-innovation/electricity-network-innovation-competition

9 See: https://arena.gov.au/projects/?project-value-start=0&project-value-end=200000000

10 See: http://www3.dps.ny.gov/W/PSCWeb.nsf/All/B2D9D834B0D307C685257F3F006FF1D9?OpenDocument

11 The extent of the topics will depend on data availability.

12 For some specific projects/initiatives, and especially those publicly funded, we expect to look at the different reports that evaluate their progress and completion, which can help to understand any limitations and key lessons learned.

13 Different methodologies will be revised for this purpose (NYPSC, 2016; EPRI, 2015; Anaya and Pollitt, 2018b).

Contact us:

futurenetworks@sse.com
www.ssen.co.uk/Innovation
@ssen_fn

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