POLICY BRIEF

Energy Data Spaces and Market Power: a new challenge for data sovereignty and its governance

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Understanding the Geopolitics of the Energy Transition – a new world in the making

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INTRODUCTION

The digitalisation of the energy sector is transforming every phase and layer of the electricity networked value chains; how electricity is produced, consumed, and traded (Rosetto and Reif, 2021).[1] At the heart of this transformation lies the deployment of smart meters and their central role in the generation of granular energy data (Davi-Arderius *et al.*, 2024). Focusing on the energy retail side only, one of the key implications of these technological innovations is that they enable: dynamic pricing (Borenstein and Holland, 2005), flexible demand (Nicolson *et al*., 2018; Cavus, 2025; Jørgensen, Gunasekaran and Ma, 2025), and bundling of innovative services. However, the availability of large personal data sets within energy platform markets also presents new economic and regulatory challenges, particularly around issues on leveraging of market power across adjacent sectors and countries, increasing barriers to entry, and consumer protection. These challenges are at the core of the debate on national and international data governance.

While there is a clear awareness about the national vulnerabilities – due to international value chains that exploit international cost advantages for material production processes – digital services chains based on data spaces (such the energy services) create new, often less visible, vulnerabilities – enabled by the availability and analysis of granular personal data. Digital values chains can display fuzzy national boundaries and governance, due to the ease of data storage and analysis relocation in response to mutating economic incentives and regulatory landscapes.

1 This policy brief draws on recent research and policy developments to highlight how the emergence of Energy Data Spaces (EDS), enabled by the diffusion of smart meter data, is necessary to support a competitive, consumer-centric and decarbonized energy system might, while simultaneously posing new challenges for data sovereignty. This research stems from the work developed within the project European Distributed Data Infrastructure for Energy (EDDIE), co-funded by the European Union's Horizon Innovation Actions under grant agreement No. 101069510, and aimed at enabling a secure exchange, accessibility, and sovereignty of energy data among EU actors. Scholars from different disciplines contributed to the development of the design of a decentralised, distributed, interoperable, and secure data infrastructure model tailored to the energy sector. In this brief, we focus on the economic aspects and trade-offs, associated with the emergence of Energy Data Spaces.

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By decentralising control and ensuring compliance with EU regulations, project EDDIE focussed on technological and data autonomy, advancing digital sovereignty by enabling Europe to host and govern its own data infrastructure for energy, addressing the problems of naturally emerging alliances that may naturally relying on foreign cloud services. The adoption of a data architecture based on the key principles of federated identity, data interoperability, and governance frameworks controlled by European actors is essential to this purpose.

DIGITALISATION AS A MARKET TRANSFORMER

The process of digitalisation of the energy sector is not merely a technological upgrade. After its diffusion through the different layers of the electricity value networks, digitalisation is generating a structural shift in these markets' dynamics, especially in terms of the economic incentives faced by the different participants to this ecosystem. Smart and sub-smart meters, representing the material interface between data and energy consumption, allow suppliers to offer finely personalised and dynamic tariffs as well as bundled services, tailored to the specific individual household's consumption patterns. This creates opportunities for innovation and efficiency, but also risks reinforcing incumbent dominance, and raising barriers to entry, especially due to the impact that digitalisation might have on creating new energy retailers' strategies, and on the incentives to pursue them.

While there is a policy recognition of the current trade-offs, their understanding requires moving forward from the simple acknowledgements of these problems.[2] There is a policy need for the development of a *logical mapping* that starts from the new technological possibilities opened by the digitalisation of the energy sector and links them into well understood information economic concepts (Davi-Arderius *et al*., 2025). This mapping allows to frame the emerging policy trade-offs posed by these processes and provides a new perspective, needed to identify the new energy system actors, understand the changing roles of the existing players, and analyse the shifts in their incentive structures, due to the digitalisation transformation.

2 See for example the UK's Energy Digitalisation Strategy and the Energy Digitalisation Taskforce Report (2022), available at https://www.gov.uk/government/publications/digitalising-our-energy-system-for-net-zero-strategy-and-action-plan/energy-digitalisation-taskforce-report-joint-response-by-beis-ofgem-and-innovate-uk. Similarly, see the EU Action Plan on Digitalising the Energy System outlining the need for a smarter, more interactive energy system, supported by interoperable data frameworks and consumer empowerment tools; available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560.

SMART METER DATA AND ECONOMIC INCENTIVES

Granular data from smart and sub-smart meters provide a clear opportunity to shape new incentive structures within energy markets. Consumers have the potential to become active participants, responding to time-sensitive tariffs and personalised recommendations. Retailers gain the ability to segment markets and bundle energy with complementary services such as EV charging or heat pumps (Sanjalawe *et al*., 2025). However, these obvious benefits are not evenly distributed across consumers, as shown in the seminal work by Reiss and White (2005) showing the heterogeneity California's household price responsiveness. Indeed, the ability to respond to, and benefit from, dynamic tariffs often depend on a household's level of digital literacy and on its access to enabling smart technologies and remote wireless applications. This heterogeneity also stems from multiple factors reflecting income constraints and technological adoption (Climate Change Committee, 2025; Cavus, 2025; Jørgensen, Gunasekaran and Ma, 2025).[3] Moreover, Nicolson *et al*. (2018) identified 'behavioural segmentation' that extends beyond simple demand elasticity measures underlying distinct consumer's types; this includes 'enthusiastic engagers', 'passive acceptors' and 'active resistors' – each exhibiting different responsiveness to price signals.

This consumer's segmentation may result by retailers designing *choice architectures*, based on access to their customers personal energy data, and on behavioural economics insights detailing how consumers interact with smart meter and smart homes technologies. For example: energy suppliers may use nudges to influence data-sharing preferences, by framing a customer's choice around whether to allow the retailer the collection of detailed half-hourly energy data as *environmentally beneficial*. While such nudges can align individual choices with societal goals, they must also be carefully understood, from an economic incentive's perspective, to avoid manipulative practices or unintended customers' lock-in effects. Since energy suppliers increasingly use digital interfaces to guide consumers through energy tariff selections, data-sharing preferences, and service bundles, the underlying choice architectures – referring to the way in which options are presented to individuals influencing their decisions without restricting freedom of choice – need to be carefully analysed.

Davi-Arderius *et al*. (2025) discuss an example of these interventions in analysis of Octopus Energy's smart tariffs onboarding process. Customers were asked to choose how frequently their smart meter readings should be stored: half-hourly, daily, or monthly. The half-hourly option was framed as environmentally beneficial, subtly nudging consumers toward

3 Available at https://www.theccc.org.uk/publication/progress-in-reducing-emissions-2025-report-to-parliament/.

a choice that enhances the supplier's access to granular data. Within the same tariff choice process, this framing was followed by a deterring message that choosing the option of less frequent data access would have limited a customer access to certain additional services. Such framing exemplifies the soft constraints design elements that might steer behaviour without coercion.

These practices raise important policy questions. While nudging can align individual behaviour with societal goals like decarbonisation, it must be transparent, proportionate, and non-exploitative. Regulators should ensure that consumers understand the implications of their choices, especially when these affect pricing, service access, or data privacy. While smart meter data is considered as personal data, under the General Data Protection Regulation (GDPR) requiring opt-in consent for data collection and processing, and mandating transparency about data usage, the key implications from a market competition point of view need additional considerations. In the UK, the Data Access and Privacy Framework (DAPF) complements GDPR by setting additional rules for smart meter data access, designed to enhance public trust in the rollout of smart meters.[4] However, even though these policies address the need that energy data governance frameworks respect privacy rights, it is unclear whether they suffice to enable innovation and support entry and competition. Arderius *et al*. (2025) also discuss the economic incentives linked to a specific 'tracker-based' Octopus smart tariff, 'offering dynamic energy prices based on the wholesale cost of energy'. These smart tariffs enable specific business strategies, presenting potential economic risks and benefits. Of relevance are the possibility of a **Tailoring strategy**, defined in the tracker cookie agreement as the ability to 'make predictions about future behaviour based on current behaviour… to help develop and tailor our products and services' introducing stronger brand loyalty and leading to increased switching costs. Also of critical interest is the easiness of using tracker cookies to implement strategies of **Market segmentation**, since these cookies require an agreement to be used to 'build a profile personally for you, so we can do things like show you products and services that we think will be of particular interest and relevance to you'. This approach risks reducing competition due to the reduced demand elasticity in a more segmented market. Finally, tracker cookies also enable strategies leading to **ecosystem alliances and mergers**. Such strategies allow data-focussed firms to enter the market as energy retailers, or to join in through (possibly transnational) strategic alliances, initiating concentration processes which may make markets less competitive if a merged supplier gains access to significant larger amounts of personal data than its existing competitors.

4 See https://assets.publishing.service.gov.uk/media/66016b44a6c0f7f514ef9198/smart-metering-implementation-programme-review-data-access-privacy-framework.pdf

AI AND ALGORITHMIC PRICING MODELS

The integration of digitalisation and artificial intelligence into energy retail markets, brings out additional fundamental questions, as AI enables real-time optimisation of retailers' tariffs based on predictors – such as fine-grained consumption patterns, weather forecasts, and market signals. These models can be designed to allow for different dynamic pricing, segmenting consumers based on behavioural flexibility and demand elasticity, and offering personalised pricing that reflects individual usage profiles. While this can enhance efficiency and consumers' satisfaction, it also introduces new risks, including opacity in pricing logic, potential bias against less flexible consumers, and market concentration due to data-driven advantages. Under the EU AI Act such systems are classified as high-risk and must meet strict requirements for transparency, oversight, and data governance.[5]

CONCLUSIONS AND POLICY RECOMMENDATIONS

This research stems from the work by the Horizon Europe project European Distributed Data Infrastructure for Energy (EDDIE), aimed at designing a decentralised, distributed, interoperable, and secure data infrastructure tailored to the energy sector. Its goal being to enable a secure exchange, accessibility, and sovereignty of energy data among EU actors.

By decentralising control and ensuring compliance with EU regulations, project EDDIE focussed on technological and data autonomy, advancing digital sovereignty by enabling Europe to host and govern its own data infrastructure for energy, addressing the problems of naturally emerging alliances that may naturally relying on foreign cloud services. The adoption of a data architecture based on the key principles of federated identity, data interoperability, and governance frameworks controlled by European actors is essential to this purpose.

This policy brief has advocated that the availability of granular personal energy data, and the potential of their integration with additional non-energy personal ones, provides incumbent energy retailers with the ability of using advanced business analytics based on algorithmic learning predictive models. These models can be used by energy retailers to develop different business strategies, such as tailoring, bundling and dynamic pricing with the aim of locking-in existing customers with their existing providers of energy services increasing their switching costs. This, in turn, leads to reduced inter-retailer and market price elasticity, even while facilitating intra-day and intra-retailer price elasticity.

5 https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

Business strategies, based on AI algorithms accessing large quantities of granular data, present two types of benefits: individual and societal ones. The individual benefits are based on the potential of dramatically improving the experienced quality of the services, and on providing means to optimise usage and costs of energy, while staying with an existing provider. The societal benefits are, instead, linked to the ability of incentivising optimal off/on-peak usage at very short time intervals, or intra-day demand flexibility within a contract; this facilitates the integration in the electricity grids of highly time-variable Renewable Energy Sources.

As a result of these processes, granular data that are fed into algorithms to create 'intelligent' business strategies for energy retailers are particularly welcome. However, the duty of an economist is to go beyond the obvious first-degree benefits and to focus on the emerging trade-offs and possible unintended consequences, especially from a dynamic efficiency point of view. The business strategies, enabled by the digitalisation of EDS discussed in this brief, increase brand loyalty, hence customers satisfaction and willingness to pay that, in absence of effective competition, creates a surplus that can be entirely appropriated by the current retailer.

Based on the analysis summaries in this brief, our key recommendations are that:

1) Policies should focus on nurturing a truly competitive environment, protect entry and digital sovereignty. This is essential as Energy Digital Spaces enable business strategies which exploit the power of personal data to generate increasing return; the better and the more data are fed into an intelligent tariff algorithm used to provide tailored and bundled energy services, the more likely it is that a customer will stay with their original provider, further generating personal data, and therefore further increasing the retailer grip on their custom.

2) The scope of sovereignty should not be based on national boundaries, due to the incredible relevance of scale economies, but should be extended to jurisdictions sharing agreed principles on international data governance. It should cover not only consumer protection but also definitions and restrictions on market dominance, by sharing and agreeing the criteria for identifying the emergence of gatekeepers and their obligations toward fair access to their data infrastructure – by entrants and non-discriminatory access pricing, along with non-excessive consumers' pricing.

3) There is a need for the clarification about the distinction between personal and derived data, ensuring that interoperability and associated data portability are technically feasible at low economic and cognitive costs. This is required since when personal data are merged across

consumers, an algorithm can create even more useful *intelligent* outputs; the more customers, the more useful the data are for each single user. This process is a typically self-reinforcing process generating *positive network externalities* – further reducing the potential for innovators and entrants to compete in these markets.

4) A new theoretical framework and appropriate new metrics are needed to adapt traditional definition of energy retail markets, to cover both in product and geographic spaces and the impact of Energy data spaces. This would facilitate the emergence of *ecosystem mergers* encompassing different but related services, such as EV, electricity, home-chargers, batteries, and IoT – all components that can be data-integrated and bundled into one complex contract.

5) Focussed impact analysis on households should be performed to assess the social impact of the emergence of Energy data spaces, due to their differentiated impact on pricing and services. The quality benefits of improved services can be appropriate at different levels, by different categories of consumers – depending on their technology readiness levels, in terms of skills, time, income and availability of smart home features. Often, for example, smarter white good are less affordable than the less smart ones, whereby being smarter may be related to remote activation, required to make the most of intra-day flexible tariffs. Asymmetric consumers' levels of awareness, as well as relative affordability, might pre-empt effective competition. Hence, it is also essential to empower consumers by launching public education campaigns and digital literacy programmes, helping consumers understand smart tariffs and data usage, shifting the costs of smart tools adoptions from the consumers to the sector providers.

6) Strategic impact analysis of the market impact of the emergence of Energy data spaces on market entry is also needed. Typical policy responses designed to deal with the risks of increasing returns are grounded in the promotion of Data Interoperability, mandating open standards for energy data exchange and ensuring fair access for all market participants. This clearly aims at reducing switching costs – as users might be porting their data – and possibly also do *multihoming* at reduced costs, without the need to duplicate fixed data costs; multiple competing providers might use their data, independently on whom they are customers of. However, Giovannetti and Siciliani (2020; 2023), showed that essential data portability might not be enough; when incumbents face the incentives to price more aggressively, in order to keep entrants away, this prevents their use of *legally* portable data.

In conclusion, this policy brief shows the necessity to find novel ways to monitor market power and concentration in markets whose boundaries are dynamically shifting, being modified by the bundling of disparate data enabled services, offered through intelligent algorithms. Policies should therefore refine their ways to assess the impact of data-driven bundling and profiling on market concentration through a network approach (ITU-T, 2025). A network approach, focusing on all the interrelated digital value chain components that includes all services bundled into energy services, will also contain a key international dimension, requiring further analysis and possibly transnational regulatory harmonisation. Some of the bundled energy components are clearly non-local.

Consider the case of data centres storing merged and derived data-intelligence, developed on the basis of the original individual personal data but now are located in foreign jurisdiction. As we have learned from recent crises, the shortening of the value chain is often advocated as a policy response to their fragility and exposure to international geopolitical tensions. This is not necessarily an efficient response: a better approach should focus on building resilient multi-route alternatives, along the lines of the early development of the Internet, and should be characterised by a *flat* hierarchy where no critical node might become a critical chokepoint. Control over these would allow specific agents/firms/ nodes to exert significant market power, influence competition by stifling innovations and pose geopolitical risks by becoming unavoidable trading partners (Internet Society, 2014).

Smart meter data and digitalisation offer transformative potential for the energy sector. However, without thoughtful transnational governance and harmonised regulation, these innovations may reinforce existing inequalities and market dominance. Policy and regulators must act decisively to ensure that digitalisation – while facilitating the green transition and integrating RES – also keeps serving the public interest and supports a resilient, consumer-centric energy system. Lastly, the EU experience offers an opportunity to reflect more globally upon how to address these challenges of inequality and market dominance. ■

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