A Brief Economics of Energy Data Space – The EDDIE Project

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The appeal of decentralised approaches to structure energy generation, transmission and distribution networks, and consumption to scholars and practitioners has grown in the past 20-30 years. Moreover, in the coming years digitalisation will become a key enabler for the sustainable and efficient management of key areas in our economies including the energy sector. A European, decentralised, and open-source energy data space solution such as the one proposed in the Horizon Europe Innovation Action project EDDIE (European Distributed Data Infrastructure for Energy), fits into this trend. In this policy brief the authors outline their initial views on EDDIE and some economic concepts related to the project's vision.

The appeal of decentralised approaches to structure energy generation, delivery networks, and consumption to scholars and practitioners has grown in the past 20-30 years. A European, decentralised, and open-source energy data space solution such as EDDIE fits into this trend. In the following we outline our initial views and related economic concepts related to this perspective.

The current trend towards the all-encompassing digitalisation of key sectors of the economy has also reached the energy sector and plays a key role in conceptualising the green transition. Digitalisation, often considered as an end, should rather be viewed as means to achieving specific ends. In policy terms, these ends broadly correspond to the main components of the Energy Trilemma (i.e., energy security, energy equity, and environmental sustainability) with digitalisation as a key enabler. Digitalisation is to support efficient functioning of future energy systems and is increasingly regarded as a necessary condition for the active participation of all customers.

There are two distinct, but interrelated aspects to the debate around decentralised vs. centralised solutions. One relates to the physical configuration of the assets. The other is concerned with the organisation and the rules and regulation governing the system. Both aspects are in turn related to technology and scale. The usefulness of many energy solutions has been dependent on our ability to up-scale or down-scale technologies. For instance, in the 1990s, Combined Cycle Gas Turbines (CCGTs) experienced renewed technological progress that enabled building of new plants that were smaller, cheaper, and faster. This enabled entry of Independent Power Producers (IPPS) into the newly liberalised electricity markets removing some of the exiting barriers to competition. Progress in wind and solar power technology started by allowing the emergence of initially small wind turbines, then gradually leading to entry of ever larger installations.

The development of early electricity and town gas systems in the 1800s provided our first encounter with key policy questions around central vs. decentral models. The early systems were mainly the result of local private or public initiatives. National and central systems emerged only later, as the need for technical standardisation and operational coordination grew. For instance, in the UK, at the time of establishment of the national electricity grid in 1926, there were more than 600 electricity distribution networks that operated at several different voltage levels. A national system was clearly needed for technical standardisation of assets and harmonisation of system operations. Also, the network benefits of systems supporting Automated Teller Machines (ATMs) and cellular phones was vastly enhanced with the harmonisation of standards and protocols for access to these networks of networks, by all users.

"Centralisation" can promote competition or achieve better regulation, since it is often a means for achieving technical and non-technical "standardisation". Standardisation is, in turn, important for promotion of "innovation". Markets alone cannot be relied on to provide these three elements in an efficient way due to the specific "public" nature of the good provided (network infrastructure). In fact, economic theory suggests that markets do not supply enough public goods and the above elements of the energy systems, bear characteristics of public goods, with consequences for private underinvestment due to incentives for freeriding. These might emerge when there are non-excludable and/or

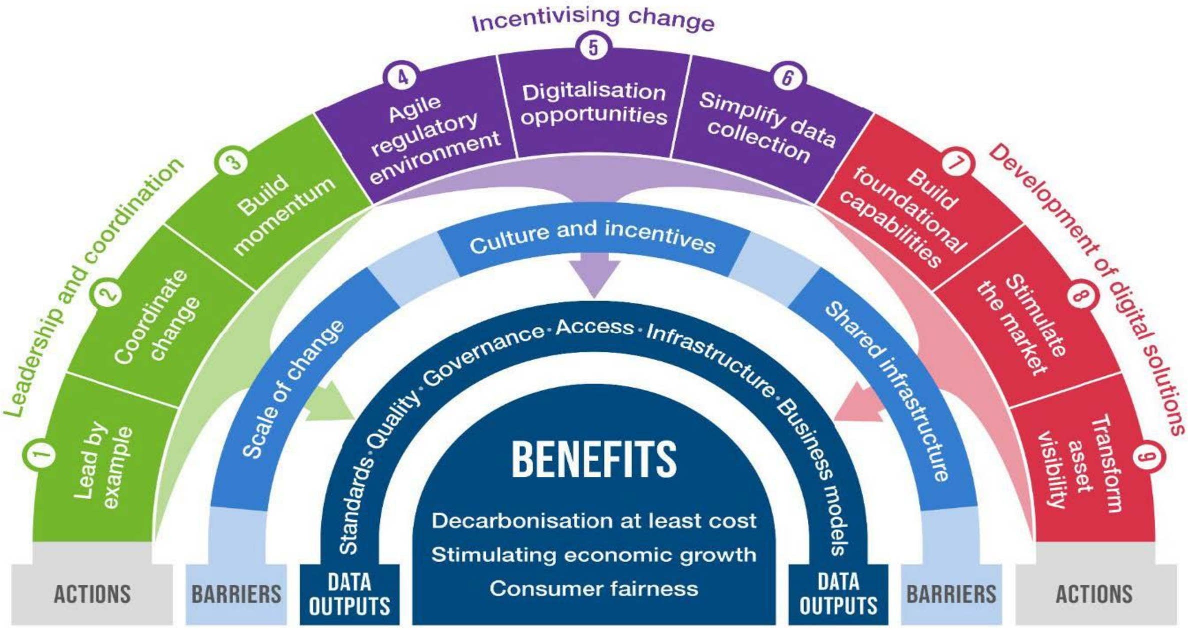

Figure 1: Opportunities within Decentralisation

non-rivalrous elements of the energy infrastructure, for instance, due to asymmetric data referring to individual usage of the shared grid. Similarly, the presence of diverse types of (direct, indirect, cross side) network externalities pose challenges to markets for delivering efficient outcomes. These 'market failures' call for regulatory and policy intervention.

However, implementing centralized solutions might not always be the most efficient solution, especially when some pieces of the puzzle are already developed in different platforms. EDDIE promotes the idea that the existing systems can be coordinated and used to form a data exchange platform. In these cases, decentralized and interconnected solutions might be a more efficient, less costly, and easier to interconnect the parts. Indeed, internet is working nowadays as several networks connected at the same time. In the debate on the relative merits of decentralised vs. centralised solutions, it is important to look at the requirements for effective delivery of policy objectives.

A successful and quickly available energy data space requires both technical standardisation and harmonisation of the rules governing the access to and use of data across systems and borders. Both requirements can, in principle, be met in decentralised models. Indeed, a centralised system is not a prerequisite for a technically and operationally functional data space. However, some degree of coordination and standardisation is necessary for a decentralised network of networks. In other words, centralisation is neither necessary nor sufficient for standardisation and harmonisation of an interoperable network of networks. The aim is to maximise the efficiency of the system using its positive network externalities.

It is helpful to recognise that consumer participation, especially residential users, in the retail energy market is not a given or an exogenous factor. Rather, participation of users should be viewed as endogenous and contingent upon the framework within which they participate. The main factors influencing active demand and the level of participation are technology, incentives, and information, which rely greatly on the ability of accessing, and processing large quantities of microdata, evolving in real time.

In the coming years, digitalisation will be a key factor for efficient use of the physical energy assets within a given economic framework. The overarching aim of an energy data space should be to enable emergence of new business models supported by appropriate regulatory frameworks. In doing so, it should aim to (i) maximise the network effects of the super network, (ii) minimise the transaction costs of using the data space, and (iii) prevent the emergence of dominant players, whose market power might be greatly enhanced by access to vast sets of microdata. In an ideal world, the transaction costs of a centralised data space can be lower. However, political economy considerations of cooperation among the constituent systems and countries that make the enterprise feasible are more likely to be present in a decentralised structure.

It is important to note that new areas for utilising decentralised energy data will evolve gradually over time. Again, just as the early town gas networks evolved over time and with the new uses of the fuel, a future energy data space will also evolve with the increased electrification of the economy and services. Therefore, it is important to allow for time and co-evolution of the data space and the energy sector to generate new business models.

Finally, the aim of regulation from centralisation, standardisation, and innovation perspective is to maximise "network benefits or externalities". As the data space facilitates the emergence of new services, it should also aim to reduce information asymmetry and prevent market power and formation of private information rent. Market competition, regulation, and data space should act as instrument of transferring the efficiency gains not in the narrow sense of the data space but also those of the whole of the sector to consumers.

References:

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