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Research note: Three dimensions of decentralization in energy and information systems

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Bibliographical note: This research note is part of a forthcoming cover essay of my PhD thesis on information and energy systems in a power perspective - please cite chapter 2 of the cover essay¹.

Is decentralization just ‘technological utopianism’ (Schrape 2019), an elusive quest? Why does the backlash to decentralization efforts come as a surprise, and how can we explain continuous cyclic decentralization-recentralization struggles?

In this problem-driven conceptual note (Flyvbjerg 2001, Gilson & Goldberg 2015), I build a theoretical bridge between the energy and information sectors: In both sectors, technology development has enabled decentralization (‘everybody can be a producer (of energy/of web content’). However, it has been counteracted by re-centralization, as expressed in recent concerns regarding ‘data oligopolies’ in the information sector; and as stalling installations of renewable energy globally, despite historically low renewable energy technology prices.

By addressing the seemingly contradictory development of technology-induced increased decentralization that digital and renewable energy technologies have led to in their respective sectors, and the simultaneous re-centralization in both, I argue that the false implications drawn from technological development arise because only two dimensions of decentralization are considered, while the third dimensions is frequently ignored. The model developed in this article seeks to explain why the seemingly inevitability of decentralization does not come to fruition.

The model is built up around a graphic representation of a cube. The x-axis denotes the spatial dimension of decentralization, with increasing decentralization outwards, indicated by a high density of suppliers within a given area. Energy systems examples include rooftop solar (spatially decentralized generation) vs. coal power plant (spatially centralized generation). Information systems examples include hotels (spatially centralized) vs. individual apartments for rent (spatially distributed); as well as Public network TV shows (spatially centralized generation), Youtube Channels (spatially decentralized generation).

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¹ See https://vbn.aau.dk/en/persons/135747/projects/
The **y-axis** denotes the economic dimension of decentralization, with increasing decentralization upwards. The definition follows the economic notion of atomized vs. centralized market structures from competition economics; decentralization is indicated by many suppliers, whereas centralization signifies oligopolistic or monopolistic supply structures. Hence, by definition, market power decreases upward on the scale, because the number of suppliers increases.

Generally speaking, technology development has increased decentralization both in terms of dimension x and y (this argument is supported through a comparison of digital and renewable technologies regarding their cost structures and historical development).

The third dimension of decentralization is described by the **z-axis**, which denotes increasing decentralization of power, or the institutional dimension of decentralization. I use the concepts of infopower and energopower to unpack this third dimension. One way of exerting control over the third dimension of decentralization is through market rules, which happens both in the energy and in the information sector (for example, the market rules of the electricity wholesale market; the market rules of platforms like Airbnb).

To provide an example from energy, centralized control over regulatory affairs has halted decentralized solar and wind development in Germany. Although decentralization in terms of dimension x and y was high, dimension z remained relatively centralized and has pushed back both dimension x and y towards more centralization.

Similarly, in information systems, the governance over the bitcoin blockchain (dimension z) remained centralized, so although dimensions x and y were decentralized at the outset, they became increasingly re-centralized over time; the centralized control (z) pushed back both the spatial (x) and the economic (y) dimensions towards centralization – i.e. the hidden institutional logics of dimension z are pushing back the more readily observable dimensions x and y.

The term decentralization is frequently used to characterize changes in information and energy systems, but different concepts of decentralization cause misunderstandings at best and false implications at worst.

**Relevant literature:**


