European Parliament

Will distributed energy resources (DERs) change how we get our energy?

Summary

Distributed energy resources (DERs) are small technologies that produce, store and manage energy. Examples include solar panels, small wind turbines, electric vehicles and microgrids. Greater use of DERs could improve resource efficiency, increase energy system resilience, and give individuals and communities a stronger role in decarbonisation. As such it appears to fit well with the European Green Deal and EU plans for secure, affordable, and clean energy. However, the growth of DERs will disrupt traditional electricity markets and, without proper regulation, their benefits may not be felt equally across society.

Background

Traditionally, electricity has been provided in a centralised manner by a small number of utility operators. It is generated in power stations and then sent to consumers over long distances through large, centralised grids. At present, DERs account for a small proportion of the market (IRENA, 2019). However, some industry estimates suggest that by 2024, global deployment of DERs will outstrip the deployment of centralised energy generation by more than 5-to-1. Whilst power from DERs is not always clean, renewable DERs are gaining increased popularity thanks to favourable environmental policies and the falling cost of solar photovoltaic (PV) technology. In Germany, renewables produced from DERs already hold a significant market share (OECD, 2018). This paves the way for more **decentralised** energy production.

Policy-makers have a key role in preparing electricity markets for this **paradigm shift**. An influx of variable renewable energy from multiple sources will challenge a grid infrastructure designed and built for a traditional form of supply. A decentralised system with a high share of renewables is less predictable than a centralised one that is reliant on fossil fuels, and operators face difficulties when responding to peaks in demand and falls in supply. If not managed correctly, DERs may in fact increase the cost of electricity and foster inequality between resource owners and non-owners.

Main trends

When DERs connect to the electricity grid, the relationship between the customer and the energy market changes. It becomes more **interactive**. Owners of DERs move from being passive energy consumers to being active producers of energy and providers of energy services. The term **prosumer** is used for those who both produce and consume electricity. Prosumers can sell any surplus generated by DERs back to the main grid thus increasing its share of renewable generation. A study by CE Delft estimates that 83 % of EU households could become prosumers by 2050. Clean energy for all Europeans, an EU package, reforms EU electricity markets and promotes the integration of renewable energy sources. As part of these initiatives, it recognises the rights of citizens to produce, store or sell their own energy, independently, through an aggregator or in a citizens' energy community. These rights will prevent countries from applying prohibitive charges to prosumers, such as Spain's 'sun tax'.

Advances in **energy storage technology** could lead to a scenario in which electricity production is localised and consumers become less dependent on the grid. Companies such as Tesla and Engie Storage are developing batteries suitable for households and small businesses. This trend is complemented by the rise in electric vehicles (EVs). 'Smart' EVs can act as storage services, allowing for vehicle-to-grid charging. Energy storage systems stockpile electricity generated during the day so that it can be used in the evening, or sold back to the grid, when prices are at their peak.

Alternatively, better energy storage may foster greater **interconnectivity** between consumers. Households with installed battery capacity can store energy and sell this power to other consumers. **Peer-to-peer**

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trading could bring a change in utilities' business models. Rather than supplying energy, utilities could operate trading platforms, similar to that of Uber or AirBnB. In the UK, a P2P trading platform, Piclo, has been trialled by a firm in collaboration with electricity regulators.

Blockchain technology that accounts for real-time pricing and verifiability of energy sources could remove the need for utilities as an intermediary entirely. The first P2P electricity trade via blockchain was executed in Amsterdam in November 2016.

Off-grid application of DERs can provide electricity supply in remote areas where **access** to national or regional grids is insufficient, notably in developing and emerging economies. There are 600 million people in Africa without access to electricity today. The International Energy Agency has predicted that 20 % of solar PV capacity in Sub-Saharan Africa will be sourced from 'off-grid' DERs by 2024 (IEA, 2019).

Energy communities are increasingly seen as part of the clean energy transition. Households, individuals and businesses jointly invest in the development and operation of energy-related assets. Estimates suggest that by 2030, energy communities in the EU could own some 17 % of installed wind capacity and 21 % of solar (European Commission, 2016). These communities promote local economic development, provide secure and affordable energy and foster community cohesion (Caramizaru, A. and Uihlein, A., 2020). In 2019, the EU Clean Energy Package for the first time established a legal framework for citizen energy communities. Through Horizon 2020, the EU has funded initiatives, such as COMPILE, that aim to support energy communities.

Uncertainties

If consumers increasingly choose a localised grid, rather than a more interconnected one, a **sound regulatory framework** must be in place to ensure that the benefits of decentralised generation are felt equally across society. As consumers defect from the main grid, the fixed costs of grid maintenance become higher per capita for the smaller number that remain. Such hikes in electricity prices could in turn prompt more to leave the main grid, leaving it in a **'death spiral'** (OECD, 2018).

The socio-economic element of electricity decentralisation should not be ignored. Home ownership and the ability to afford upfront investment costs are preferable prerequisites to investing in DERs. Without careful policy-making, there is a risk that vulnerable, low-income households could be left behind as a '**prosumer divide**' emerges between those that can afford DER technology and those left reliant on the main grid, paying higher electricity costs for a less reliable service.

'Interoperable smart grids' reliant on AI and the Internet of Things would modernise grid infrastructure and support decentralised generation. Real-time data, machine-to-machine connections and AI-learning would allow automated devices to adjust usage to more energy-efficient and cost-efficient patterns, meaning a saving for households (WEF, 2017). By adjusting usage in response to variations in demand and supply, smart appliances address the issue of intermittent supply from decentralised, renewable generation. A city-wide smart grid, the first of its kind, has operated in Austin, Texas since 2009. Integrated devices from homes, factories, and offices provide data on consumption patterns to the grid. The accumulated data are used to make the grid more responsive to demand, and to more efficiently manage the variable supply from decentralised, renewable sources.

Disruptions

DERs could suffer the 'biggest hit' in the fall-out from the **coronavirus pandemic** on renewable energies. Households and small businesses facing economic shock and uncertainty will be less willing to pay out installation costs in DERs. Lower energy consumption due to **reduced economic activity** could inhibit investment in renewable technology. Conversely, a decision by policy-makers to incorporate demands for clean, efficient energy into stimulus packages for economic recovery may pave the way for renewables and DERs (EPRS, 2020).

Natural disasters and climate disruptions may encourage the localisation of energy production. Japan saw a significant increase in renewable energy communities in the wake of the 2011 Great East Japan

Earthquake and subsequent Fukushima nuclear disaster. As discussed above, widespread defection by consumers would have a negative impact on the maintenance and resilience of the main grid.

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