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Microbially mediated energy storage in the pedosphere

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Energy storage is vital to buffer intermittency in power supplies comprised largely or wholly of variable sources (e.g. wind, solar) at large and small scale. Present technologies and those in development (e.g. electrochemical cells) have disadvantages (e.g. cost, resource use, chemical hazard) whilst the capacity required is extremely large and widely distributed. Storage is needed for burgeoning off-grid small-scale infrastructure such as sensor networks as well as larger scale power sources. To address challenges with current technologies we demonstrate the ability of the pedosphere to store electrical energy and act as a natural, biogeochemical battery. The pedosphere, consisting of porous geomaterials such as soil and sediment, is an extensive potential energy repository covering much of the Earth and underpins most infrastructure or situations where power is generated or required. This pre-existing capacity has the potential to simplify energy storage and the installation and management of power generating or consuming infrastructure.

In this study the concept of such 'geo-batteries' is demonstrated. Controlled microbial synthesis of simple organic molecules in natural porous media (estuarine sediment) is shown, with this organic matter acting as an accessible form of energy storage. When combined with the employment of a microbial fuel cell to extract this energy electrically through degradation of the organic molecules, a battery is formed, with external control over energy input and output through switching of charging and discharging cycles.

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