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## Environmental impacts of smart local energy systems

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Energy systems around the world are rapidly transitioning towards decentralised and digitalised systems as countries aim to decarbonise their economies. However, broader environmental effects of the upscaling of these smart local energy systems (SLES) beyond reducing carbon emissions remain unclear. Land-use change associated with increased deployment of renewables, new infrastructures required for energy distribution and storage, and resource extraction for emerging energy technologies may have significant environmental impacts, including consequences for ecosystems within and beyond energy system project localities. This has major implications for biodiversity, natural capital stocks and provision of ecosystem services, the importance of which are increasingly recognised in development policy at local to international scales. This study assessed current understanding of the broader environmental impacts and potential co-benefits of SLES through a global Rapid Evidence Assessment of peer-reviewed academic literature, with a critical evaluation and synthesis of existing knowledge of effects of SLES on biodiversity, natural capital and ecosystem services. There was a striking overall lack of evidence of the environmental impacts of SLES. The vast majority of studies identified considered only energy technology CO<sub>2</sub> emissions through simulation modelling; almost no studies made explicit reference to effects on ecosystems. This highlights an urgent need to improve whole system understanding of environmental impacts of SLES, crucial to avoid unintended ecosystem degradation as a result of climate change mitigation. This will also help to identify potential techno-ecological synergies and opportunities for improvement of degraded ecosystems alongside reaching decarbonisation goals.