

potential to increase C benefits from ground-level changes in microclimate needs to be examined, and placed in the broader context of the full C costs of electricity produced by LBRs; we argue that there is much scope to maximize beneficial effects.

To determine the long-term operational impacts of LBR on plant and soil C, and allow generalization and prediction of effects across the globe, we strongly advocate the investigation of LBR-induced microclimatic effects under different atmospheric conditions, across a range of ecosystems occurring in different climatic zones. Furthermore, understanding and modelling needs to be developed to account for the range of wind farm and solar park designs and consequently designs optimized for energy production and plant-soil C cycling. Therefore, we call for an increase in research effort in this emerging field and propose specific research priorities should be (i) field assessment of the effects of LBR on the local climate, especially solar parks for which there is no evidence, with potential for remote sensing to provide data at a larger scale; (ii) field experiments in carbon relevant hosting ecosystems to examine the effects of LBR-induced microclimates on plant-soil C cycling *in situ*; (iii) controlled environment studies examining the interactive effects of diurnal, seasonal and annual microclimatic controls on plant-soil C cycling; and (iv) modelling that uses mechanistic understanding from field and laboratory studies to upscale, and forecast effects of LBR-induced microclimates on C cycling and greenhouse gas emissions across the globe. Given the dominance of temperature on plant-soil C cycling, it is crucial that new experiments and models examine LBR effects on this parameter. However, the effects of other abiotic and biotic factors that are affected by LBR, and their interactions, also need to be resolved, across the full range of hosting systems.

Land use change for LBR is global, widespread and predicted to increase. Understanding of microclimatic effects is growing, but currently incomplete, and subsequent effects on plant-soil C cycling, GHG emissions and soil C stocks are unknown. We urge the scientific community to embrace this research area and work across disciplines, including plant-soil ecology, terrestrial biogeochemistry and atmospheric science, to ensure we are on the path to truly sustainable energy provision.

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