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Development of a Solar Park Carbon Calculator (SPCC) to assist deployment decisions

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Following the Paris agreement, many nations have committed to targets of net zero emissions, resulting in a significant increase in low-carbon energy generation. Recent improvements in the cost and efficiency of photovoltaic (PV) technology have made their deployment cheaper than new coal and gas fired power stations in a number of regions, with the uptake of PV projected to surpass fossil fuels by 2035. Large-scale, ground-mounted systems are likely to constitute a considerable portion of this expansion, with the International Energy Agency suggesting that 69% of new capacity additions in 2021 will be utility scale deployments (although some of this may be building-mounted). Despite the expansion of ground-mounted solar parks and the knowledge that land use change is a greater threat to nature than climate change, there is very little understanding of the environmental implications. In particular, the effect on ecosystem carbon cycling, and thus the decarbonisation attraction of the technology, is unknown. Whilst the carbon impacts of the technological components have been relatively well resolved, the true carbon costs cannot be determined without quantifying the impacts on land carbon. Here, we present a solar park carbon calculator (SPCC) that quantifies the full suite of solar park carbon impacts.

The SPCC provides information on the technological and environmental carbon flows, drawing on established quantifications of carbon costs for system components, operation, and land management. Key components include the emissions factors for production of panels and mounts, machinery related emissions and the associated carbon flows of ground disturbances, before and after park construction. The SPCC is applied to a case-study solar park, providing insight into the dominant carbon flows and payback time in light of grid electricity carbon intensities. Ultimately, the SPCC can help inform solar park developer decisions in order to minimise carbon costs and maximise carbon sequestration.