THE LOW CARBON ENERGY TRANSITION: BRIGHT TIMES AHEAD FOR ECOSYSTEMS?

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Society faces the impending and interlinked challenges of climate change and ecosystem collapse. Science indicates that we need to address both urgently, necessitating solutions that are implementable, scalable and applicable across the world. With supportive policies in place, land use change for renewable energy could be a win-win solution to the climate and ecological emergencies.

Energy production is the greatest single contributor to greenhouse gas emissions globally, prompting decarbonisation efforts across the world. In recent years, the UK has taken significant steps to reduce the carbon intensity of electricity, with the National Grid reporting a decrease of 59 % from 2013 (529 g CO2/kWh) [1] to 2019 (215 g CO2/kWh). This reduction in carbon intensity was due to the diminishing contribution of coal, with the gap filled by renewables (Figure 1). Globally, solar photovoltaics (PV) account for about 60% of the expected growth in renewable energy capacity additions. [2] Within the UK, as of May 2020, there was 13.5 GW of PV with 57% of the capacity comprising ground-mounted solar parks. [3] Historically, solar parks were often below 5 MW, given the limit imposed by the feed-in tariff. However, in May this year, the UK's largest solar park – Cleve Hill Solar – at 350 MW was approved by the Secretary of State for Business, Energy and Industrial Strategy. [4] Whilst development of ground-mounted solar parks provides low carbon electricity, contributing to the nation's net-zero targets, the implications of the land-take need to be considered.

Whilst the deployment of PV is a positive move in terms of climate change mitigation, the land-take, including the impact of increasing solar park sizes, raises questions about the impacts on the hosting ecosystem. Whilst land-take for solar parks is relatively small compared to the size of the UK (see Box 1) we are living in a time of land scarcity and of increased pressures on the environment to provide other essential resources such as food, fibre and space for recreation. Critically, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (for ecosystems what the IPCC is for climate) identifies land use change, not climate change, as the biggest driver of

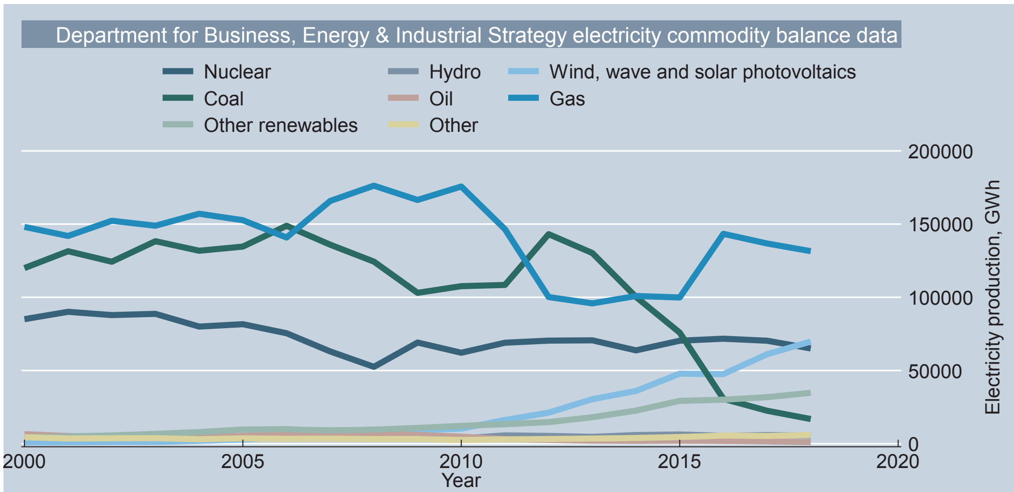

Figure 1. Change in sources of electricity in the UK from 2000-2018. Data source: BEIS [20]

BOX 1. SOLAR PARK FACTS & FIGURES.

Solar parks take up 1.8 ha per MW, equating to a total land-take of 14,281 ha in March 2020. This represents 0.06% of the total land area and 0.8% of the land area taken up by urban and suburban areas. Solar parks provide approximately 6.87 TWh of electricity per year, approximately 2 % of total demand.

Data sources
Unpublished: land areas of 1032 solar parks in March 2020.

Renewable Energy Planning Database: Capacities of solar parks. [16]

CEH land cover: total, urban and suburban land areas. [17]

DUKES: average load factor for 2019 [18] and total electricity demand. [19]

the decline in nature. [5] Consequently, there is a risk that we swap global climate change for local scale ecosystem degradation – out of the frying pan and into the fire? More compellingly, there is an underutilised opportunity to embed ecological co-benefits into the design and operation of solar parks, delivering much needed low carbon energy ***and*** ecosystem improvements, contributing to both energy and environment policy goals.

WHY ARE SOLAR PARKS GOOD PLACES FOR ECOLOGICAL ENHANCEMENTS?

Solar parks offer significant opportunities for ecological benefits for several reasons. Firstly, unlike many land use changes, their footprint (i.e. the area of the ground in contact with the infrastructure) is very small – around 5% of the total solar park area, leaving much space for ecological enhancements. Solar parks are secure and relatively undisturbed areas, thus offering the potential to host rich ecosystems, as observed on the Salisbury Plain due to military ownership limiting disturbance. [6] Moreover, the land is 'paid for' for between 25 and 40 years, providing opportunities for gains in both the short-term (e.g., development of a species rich sward if it was previously a low-grade arable field) and long-term (e.g., establishment of hedgerows). Finally, the physical presence of the solar arrays provides climate niches, [7] which could mitigate climate change impacts.

THE POTENTIAL IS THERE, BUT WHAT CAN WE DO?

We need to ensure that policy takes a positive approach, aiming to embed as many ecological benefits as possible. At a national level, stipulation of the need for *'net environmental gain'* in the 2018 Defra 25 Year Environmental Plan's delivers to this. [8] Moreover, *'net environmental gain'* is reflected in the National Policy Planning Framework, [9] although care must be taken that the low carbon electricity produced is not used to fulfil this criterion. Industry must also take up the mantle, embedding an ecologically beneficial approach in both development and operation. Many companies are already active in this area, evidenced by the Solar Trade Association's 'The Natural Capital Value of Solar' report [10] and the individual profiles of numerous companies. Moreover, there is a commitment across the industry to be good land stewards, detailed in the Solar Trade Association's Ten Commitments. [11] However, ensuring ecological betterment is central *industry-wide* remains a challenge given the economic nature of the energy industry and often-limited ecological expertise of solar park developers, operation and maintenance companies, and asset managers. [12] Ensuring that net environmental gain beyond low carbon electricity is driven through the planning process is one means to achieve sector-wide take up. Moreover, the post-Brexit Agricultural Bill offers significant scope. Specifically, if the Environmental Land Management Scheme allows 'dual use' there is the potential for payment for ecosystem services to be incorporated into business cases for solar parks. Finally, increasing awareness that ecologically beneficial site design and management does not have to cost more could increase uptake. For example, many sites are mowed in their entirety, yet reducing mowing strips in front of the panels to prevent shading will reduce costs and offer biodiversity benefits.

WHAT KNOWLEDGE IS THERE?

Whilst there is much potential, how do we know how best to design and manage solar parks? Given the relative immaturity of solar parks and the research funding landscape, relatively few studies have been undertaken. However, a NERC-funded collaboration between Lancaster University and the University of York produced the Solar Park Impacts on Ecosystem Services (SPIES) decision support tool.[13] It is grounded in over 700 pieces of peer-reviewed scientific evidence that links land management actions to ecosystem services impacts. It enables users to select management actions they are considering (e.g., grazing and habitat provision) and provides the implications for ecosystem services (e.g., biodiversity and soil quality), or users to select ecosystem services of interest and provides management actions that impacts them. The easy-to-use SPIES tool was co-developed with a cross-sectoral group of stakeholders, including developers, operation and maintenance firms, asset managers, consultants, local

government, farmers and nature conservation bodies such as the RSPB. This has assured it is fit for purpose, with ecological consultants, for example Wychwood Biodiversity, using it as part of their package of work; renewable energy investors, such as Low Carbon, encouraging all their ecologists to use it; and local government ecologists suggest planning applicants use it. A SPIES policy briefing can be found at https://www.lancaster.ac.uk/spies/.

However, more research and innovation are required - we are progressing this at Lancaster University through collaborations with a host of stakeholder partners. For example, we are examining the potential for solar parks to boost pollinator populations. If managed well, solar parks could provide appropriate habitats and forage resources for pollinators, with benefits for surrounding agriculture and implications for the Defra Pollinator Strategy along with food, energy and biodiversity goals. Within UKERC, [14] we are developing a standardised protocol for quantification of the ecosystem service and natural capital value of solar parks. The protocol includes biodiversity, soil, water, and atmosphere impacts, with the aim of guiding the solar industry and providing evidence for any payments under the new Agricultural Bill. Currently, there is no knowledge of the impacts of land use change for solar parks on land carbon sequestration, despite the relevance to net-zero targets; we are working to fill this gap. Resolution of the impact of floating solar on the hosting water bodies is also limited and we are working with UK Water Companies to further knowledge. The impacts could be positive, with good ecological outcomes and reductions in water treatment costs, but alternatively could be negative or negligible. We are also contributing to the Prospering from the Energy Revolution programme within EnergyREV, [15] investigating the environmental impacts of smart local energy systems.

HOW CAN PARLIAMENTARIANS HELP?

To capitalise on the win-win potential of land use change for renewable energy, we need to progress knowledge drawing on research, industry, and policy expertise. This knowledge needs to be embedded in policy and industry practice. The pandemic recovery, the desire to build back better and to grow back greener provide the perfect opportunity to achieve this. Now is the time to develop strategies, collaborations and generate roadmaps to ensure the decarbonisation of our energy system is coupled with the enhancement of our invaluable natural ecosystems. If we do this well, we stand much to gain economically, environmentally and socially.

Footnotes

1 https://www.nationalgrideso.com/media/national-grid-electricity-system-operator-data-shows-record-breaking-year-britains
2 https://www.iea.org/reports/renewables-2019
3 https://www.gov.uk/government/statistics/solar-photovoltaics-deployment
4 https://infrastructure.planninginspectorate.gov.uk/projects/south-east/cleve-hill-solar-park/
5 https://ipbes.net/global-assessment
6 https://nerc.ukri.org/latest/publications/planetearth/spr15-plain/
7 https://ec.europa.eu/environment/integration/research/newsalert/pdf/solar_park_impacts_microclimate_plants_greenhouse_gas_emissions_479na4_en.pdf
8 https://www.gov.uk/government/publications/25-year-environment-plan
9 https://www.gov.uk/government/publications/national-planning-policy-framework--2
10 https://www.solar-trade.org.uk/about/the-natural-capital-value-of-solar/
11 https://www.solar-trade.org.uk/sta-solar-farms-10-commitments/
12 https://services.parliament.uk/bills/2019-21/agriculture.html
13 https://www.lancaster.ac.uk/spies/
14 https://ukerc.ac.uk/
15 https://www.energyrev.org.uk/
16 https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
17 https://www.ceh.ac.uk/land-cover-map-2015-statistics
18 https://www.gov.uk/government/publications/quarterly-and-annual-load-factors
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