Solar energy: managing biodiversity risks

Business relevance and implications

- *Solar energy expansion is key for tackling climate change, but needs careful planning to avoid impacts on biodiversity;*
- *Applying the mitigation hierarchy to solar power developments can minimise biodiversity risks.*

Biodiversity impacts of solar energy projects

The solar energy sector has been rapidly expanding, increasing from approximately 5 GW of installed capacity globally in 2005, to over 300 GW in 2016. Photovoltaic (PV) technology has provided the vast majority of growth, with concentrated solar power (CSP) retaining a limited niche.

Solar is often seen as ‘green energy’. However, utility-scale projects can have major impacts on species and habitats.

Biodiversity impacts can present a risk to project developers, leading to project delays, disrupting project financing and threatening project sustainability credentials[1]. Biodiversity impacts from large-scale solar projects remain poorly understood. Often, only limited data are available on the extent and severity of potential impacts to sensitive species.

At a glance

- Solar power has the potential to be a green energy, but poorly-designed projects can significantly impact biodiversity.
- Potential impacts come mainly from land -take and wildlife interactions with infrastructure (e.g. collisions).
- The mitigation hierarchy, comprising Avoidance, Minimisation, Restoration and Offsetting, is an effective practical framework to reduce business risks.
- Avoidance of impacts (direct, indirect, cumulative), through early risk screening[2] and appropriate site selection and infrastructure siting, is the most effective and least costly way of reducing impacts.

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[1] See TBC’s Industry Briefing Note on the business case for managing biodiversity risk

[2] See TBC’s Industry Briefing Note on biodiversity risk screening

Land-take

The development of utility-scale PV and CSP plants requires vegetation removal and surface grading of large areas of land. For example, Hernandez et al., 2014 identified solar power projects (planned, in construction or operational) covering 86,000 ha of land in California[3]. This can lead to habitat loss, fragmentation, and the degradation of surrounding habitats (see Case Study 1).

Associated infrastructure such as roads and transmission lines can create further habitat fragmentation. Biodiversity impacts may be more or less significant depending on the condition of the site and its geographic location. In some cases, there may be scope to enhance degraded habitat around solar arrays, to achieve a positive biodiversity impact.

Attraction to reflective surfaces

Flat PV panel surfaces polarise reflected light. So do water bodies, and some insects and birds use this effect to find water on which to land and/or lay their eggs. Aquatic insects appear to mistake PV panels for water bodies, leading them to aggregate around panels and lay eggs on them that cannot survive.

Wildlife mortality

Solar infrastructure (e.g. reflective mirrors, PV panels) can represent a collision risk to bird, bat and insect species, in part because PV panels resemble water bodies (see above, and Case Study 1). Birds may also be burned or singed when passing through light-concentration points above CSP plants. However, the extent and importance of these impacts is not well understood.

Wildlife mortality can also occur from collisions on roads and transmission lines associated with solar plants. Evaporation ponds for CSP plants may also present a drowning risk to wild animals such as birds, reptiles and mammals.

Case Study 1: Quantifying biodiversity impacts, South Africa

The 96 MW Jasper PV facility, located 30 km east of Postmasburg, is one of South Africa's largest utility-scale solar projects. The plant is within the Eastern Kalahari Bushveld bioregion and there is a diverse community of bird species present.

Birds are known to use the facility area to forage. However, research showed that bird species richness was lower at the plant than it was in buffer zones surrounding the plant or in undisturbed areas.

Shrub and woodland birds were particularly badly impacted, likely due to the vegetation clearance required for the plant development. Monitoring also identified bird collision risks, extrapolating from a 3-month study to estimate 4.5 bird fatalities per megawatt per year (Visser et al., 2019)[4].

[3] Hernandez, R.R., Hoffacker, M.K., Field, C.B., 2014. Land-Use Efficiency of Big Solar. Environ. Sci. Technol. 48, 1315–1323.

[4] Visser, E., Perold, V., Ralston-Paton, S., Cardenal, A.C., Ryan, P.G., 2019. Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa. Renew. Energy 133, 1285–1294.

Changes in hydrology and water availability

CSP plants may use large amounts of water for cooling the system and for washing mirrors. PV panels also require routine operational washing to remove dust and particulates. Especially in arid regions, water abstraction could alter the availability of surface and groundwater sources to sustain habitats such as riparian vegetation.

Applying the mitigation hierarchy

Good practice for managing biodiversity risk focuses on implementation of the mitigation hierarchy, an approach that guides projects towards limiting impacts as far as possible. The hierarchy has four stages - Avoidance, Minimisation, Restoration, and where necessary Offsetting. The mitigation hierarchy can be applied to achieve no net loss and/or net gain of priority biodiversity, as required by lending standards such as the International Financial Corporation's Performance Standard 6.

Effective implementation of the mitigation hierarchy requires a robust biodiversity baseline[5] to assess risks, support the development of appropriate mitigation measures, and serve as a reference for comparison when monitoring the effectiveness of mitigation actions over the project's lifetime.

Avoidance

Avoidance is the most reliable, and usually the most cost-effective, approach to prevent biodiversity risk, especially when considered early in project development. Ideally, avoidance should be guided by existing national- or regional-level Strategic Assessments, and land use planning policies that identify priority biodiversity features, map their occurrence, and overlay this with potential development sites (see Case Study 2). Such studies allow a company to consider biodiversity constraints alongside technical and social feasibility, helping to identify sites that are suitable for development whilst minimising biodiversity impacts.

Case Study 2: Avoidance through sensitivity mapping, East Africa

To guide potential solar and wind developments in an East African country, The Biodiversity Consultancy supported the development of a technical, environmental and social scoping assessment of solar and wind development risk.

The main output was a proof-of-concept nation-wide heat maps identifying the relative risks and opportunities relevant to solar and wind projects.

We undertook sensitivity mapping of focal environmental components which included sensitive species and sites (e.g. threatened and range-restricted species, protected areas, and species or sites of stakeholder concern). Th objective of the completed maps was for the government and developers to identify bankable solar and wind development areas, developers to understand risks at candidate project sites, and in scenario evaluation to demonstrate how energy generation goals can be met, while minimising biodiversity impacts.

[5] See TBC Industry Briefing Note on how to make biodiversity surveys relevant to your project

In the absence of such studies, developers can use a similar approach to assess development site options. Screening multiple sites can identify those with a greater or lesser biodiversity risk. The potential biodiversity risk at each location can guide decisions on where to site a project, whether to take it forward into the design stage, and what additional studies or mitigation actions are needed. In many cases, solar projects can entirely avoid significant biodiversity impacts through siting on previously converted lands. Repowering of existing projects can also often be a strategy to avoid creating additional impacts.

Within a chosen development site, biodiversity impacts may be avoided by 'micro-siting' (optimising the layout of project infrastructure), and re-routing or burying powerlines.

Minimisation

Modifications to the physical design of solar project infrastructure can help minimise impacts to biodiversity. Using dry or hybrid cooling systems rather than wet cooling systems reduces water use. Removing or redesigning perimeter fencing can reduce habitat fragmentation by enabling continued wildlife movements. Installing bird flight diverters along overhead transmission lines can reduce risk of collision to at-risk species. Good practice operational controls during construction and maintenance help to minimise dust and noise pollution, and prevent introduction of alien invasive species.

Restoration

Restoration of temporary construction impacts, or enhancement activities on site, can help promote biodiversity value within and surrounding the solar plant. This may include managing the land beneath the panels for species-rich semi-natural grassland, and or planting hedgerows and trees throughout the plant to enhance biodiversity value (see Case Study 3).

Case Study 3: On-site biodiversity management, Germany

Salmdorf Solar Plant was developed within an old gravel pit near Munich, Germany. Use of this brownfield site minimised biodiversity impacts associated with land clearance and vegetation removal.

The operational plant now implements measures to enhance biodiversity on site. This includes managing grassland, using fencing that allows small mammal access, planting hedgerows and trees, and creating new ponds on site for an endangered toad species.

Grassland management has been successful, with several rare plant species now present on site (e.g. Meadow Cranesbill *Geranium pratense*) (Science for Environment Policy, 2015)[6].

[6] Science for Environment Policy, 2015. Wind & Solar Energy and nature conservation (No. 9), Future Brief. European Commission DG Environment, Bristol, U.K.

Offsets

Offsets compensate for significant adverse residual impacts that remain after all feasible avoidance, minimisation and restoration actions have been implemented[7].

Solar energy projects that are well-sited and implement effective minimisation and restoration measures can likely avoid the need for biodiversity offsets. Projects that have footprint impacts (i.e. actual physical areas of land that are impacted by the project) to natural habitats, operate in areas where restoration opportunities are limited, and/or are operating within or close to sensitive biodiversity sites may require offsets to address significant residual impacts.

There are two main types of offset defined by how they produce the gains: 'restoration offsets' and 'averted loss offsets' (see Table 1).

Table 1 Restoration' and 'averted loss' offsets

Offset type	Description
Averted loss	Where gains are generated by reducing or preventing ongoing decline of a priority species or ecosystem, that is not caused by the project (see Case Study 4).
Restoration	Where habitat is created or improved off-site to benefit the species or ecosystem being impacted.

Case Study 4: Developing offsets for a solar project, Australia

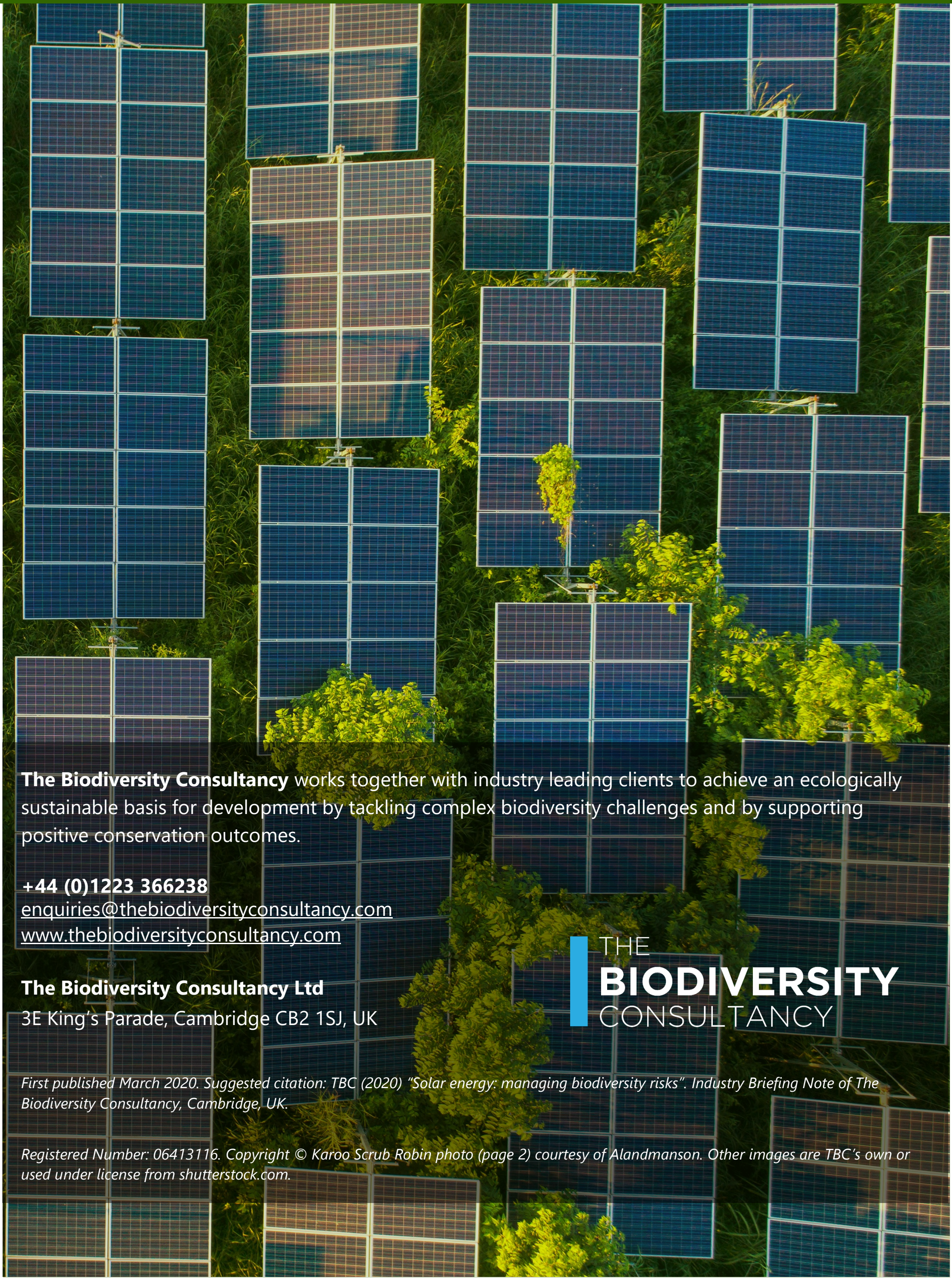
Manildra is a 120 ha 56 MW solar plant, located in New South Wales, Australia that was commissioned in early 2018. Residual impacts were predicted to native Box Gum *Eucalyptus* woodland, grassland habitats and habitat used by the Superb Parrot *Polytelis swainsoni*.

In line with national offset requirements the project has developed a strategy for identifying, securing and managing an offset site.

A potential offset site has now been identified close to the proposed development which contains the same vegetation type, and is large enough to potentially offset residual project impacts to the Box Gum *Eucalyptus* woodland (nghenvironmental, 2016)[8].

[7] See TBC Industry Briefing Note on biodiversity offsets

[8] nghenvironmental, 2016. Offset Strategy: Manildra Solar Farm, Manildra disclosure documents. New South Wales, Australia.



The Biodiversity Consultancy works together with industry leading clients to achieve an ecologically sustainable basis for development by tackling complex biodiversity challenges and by supporting positive conservation outcomes.

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