



COMPREHENSIVE PLANNING AND REGULATORY FRAMEWORK FOR LARGE-SCALE GROUND-MOUNTED SOLAR PHOTOVOLTAIC DEVELOPMENT IN NIGERIA

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ABSTRACT

The rapid growth of solar photovoltaic (PV) deployment globally has increased interest in ground-mounted solar farms as a strategic solution for enhancing renewable electricity generation. In Nigeria, escalating energy costs, the introduction of supportive regulatory frameworks, and national climate commitments have strengthened the economic and policy rationale for large-scale solar PV development. This article examines the technical, planning, environmental, and regulatory considerations associated with commercial-scale ground-mounted solar PV installations. It situates the analysis within Nigeria's Climate Change Act (2021), Renewable Energy Master Plan (REMP), National Renewable Energy and Energy Efficiency Policy (NREEEP), and the National Renewable Energy Action Plan (NREAP). The study reviews planning requirements such as environmental impact assessment, agricultural land classification, landscape and visual impact, biodiversity implications, heritage management, security needs, and community engagement. It also evaluates site selection criteria, construction requirements, ecological assessments, drainage management, glint and glare analyses, and electricity generation capacity reporting. Findings demonstrate that while solar PV farms provide major environmental and socio-economic opportunities, their successful delivery depends on rigorous planning, landscape-sensitive design, compliance with policy frameworks, and robust ecological and security considerations. The article offers comprehensive guidance for planners, developers, policymakers, and stakeholders involved in Nigeria's transition toward low-carbon energy systems.

1. INTRODUCTION

Escalating energy expenses, along with the backing of the Feed-in Tariff (FiT) and Renewable Obligations Certificates, have markedly enhanced the economic feasibility and appeal of

installing solar photovoltaic panels. These installations may be fixed on roofs or walls, or they may be standalone or ground-mounted. This article offers optimal planning assistance about the development of large ground-mounted arrays, outlining planning concerns and criteria. The potential energy that can be extracted from solar radiation is frequently undervalued. The UK receives a substantial quantity of solar energy, averaging up to 60% of the solar energy received at the equator annually. This is comparable to the annual output of 1,000 power plants

For planning purposes, stand-alone solar PV installations refer to those that are not physically affixed to a building, although they may be connected to supply electricity to a building. This represents an alternative interpretation of the FiT, wherein installations must not only be physically detached from a building but also must not be wired to supply energy to an occupied structure; instead, they are directly connected to the electricity grid.

2. LITERATURE SURVEY

Ground-mounted solar photovoltaic farms have emerged as critical infrastructures in the global movement toward sustainable and low-carbon energy systems. With decreasing module costs and improved efficiencies, countries across Africa, Europe, and Asia have adopted solar PV installations as part of broader decarbonisation policies (International Energy Agency [IEA], 2020). The United Kingdom, Germany, Italy, Spain, Morocco, and Nigeria have implemented large-scale PV farms to expand grid capacity and diversify their energy mix (REN21, 2023). Ground-mounted systems—unlike rooftop installations—offer scalability, easier maintenance, and higher electricity yields due to optimal orientation and tilt angles.

Solar PV adoption in Nigeria has accelerated due to chronic energy shortages, dependence on fossil fuels, and rising grid instability. Nigeria receives an average global horizontal irradiation (GHI) of 4–7 kWh/m²/day, making it one of the most solar-endowed nations in Africa (Shaaban & Petinrin, 2014). Despite this potential, deployment has historically been slow due to inadequate regulatory support, limited financing, and infrastructural constraints. However, the Climate Change Act (2021) and the National Renewable Energy and Energy Efficiency Policy (NREEEP, 2015) have played transformative roles in shaping Nigeria's renewable energy trajectory.

The Climate Change Act (2021) established a legally binding framework for reducing greenhouse gas emissions, instituting a National Council on Climate Change, and implementing carbon budgeting mechanisms. It mandates a national pathway toward net-zero emissions between 2050 and 2070, aligning Nigeria with global climate governance under the Paris Agreement (Federal Republic of Nigeria, 2021). The Act strengthens investor confidence by formalising climate governance structures and institutional responsibilities.

The Renewable Energy Master Plan (REMP) outlines progressive targets aimed at increasing renewable electricity to 23% by 2025 and 36% by 2030 (Energy Commission of Nigeria [ECN], 2016). The NREEEP complements this by detailing policies for promoting renewable energy technologies (RETs), encouraging private sector involvement, and establishing technical standards (ECN, 2015). These frameworks identify solar PV as a core driver of Nigeria's transition due to its modularity, accessibility, and declining cost trends.

NREAP provides a detailed implementation roadmap for NREEEP, including incentives such as low-interest loans via the Bank of Industry and enabling frameworks for off-grid and on-grid solar systems (ECN, 2016). Together, these policies aim to diversify energy sources, reduce fossil fuel dependence, strengthen rural electrification, and promote inclusive green

growth.

Large ground-mounted PV farms require careful land selection to minimise agricultural, ecological, and visual impacts. Studies highlight the need to prioritise brownfield, degraded, or low-grade agricultural lands to avoid competition with food production (Hernandez et al., 2015). Nigeria's land evaluation aligns with global best practices by discouraging development on high-grade agricultural lands (Classes 1, 2, 3a), unless impacts are minimal and reversible.

Environmental Impact Assessments help determine whether proposed solar developments may significantly affect biodiversity, soil quality, hydrology, or landscape character. International guidelines emphasise cumulative impact analyses, especially where multiple solar projects exist in proximity (Bureau of Land Management, 2020). In Nigeria, EIAs are guided by the Environmental Impact Assessment Act (1992), requiring detailed screening and scoping, especially in sensitive ecosystems.

Ground-mounted PV arrays alter land cover and can impact scenic quality. European research indicates that visual intrusion is often the most contentious issue in planning applications (Turney & Fthenakis, 2011). Nigeria's LVIA procedures—supported by local landscape character assessments—ensure developments maintain rural aesthetics by preserving hedgerows, mature vegetation, and avoiding prominent ridgelines.

Solar farms can produce both negative and positive ecological outcomes. Habitat disturbance, species displacement, and fragmentation are common risks (Lovich & Ennen, 2011). However, solar farms can also provide ecological co-benefits, including grassland restoration, pollinator habitats, and controlled grazing practices. Nigeria's planning frameworks encourage biodiversity integration through buffer zones, eco-friendly fencing designs, and species-specific mitigation—especially for bats, reptiles, dormice, and avifauna.

Construction activities require detailed planning to protect soil structure, prevent erosion, and preserve agricultural viability for post-decommissioning restoration. Best practices emphasise temporary construction compounds, separate storage of topsoil/subsoil, minimal trenching, and avoidance of mass concrete foundations (Solar Energy UK, 2021). Nigeria's planning guidelines similarly advocate reversible installations, including pile-driven foundations and avoidance of permanent earthworks.

Solar farms are high-value targets for theft and vandalism. Research indicates that remote sites lacking surveillance are particularly vulnerable (Haakana et al., 2017). Recommended strategies include SEAP-compliant security fencing, monitored CCTV, access control, layered security zones, and covert panel marking for traceability.

Glint and glare assessments are increasingly mandated in solar farm applications, particularly near airports or major roads. PV modules are designed to absorb light, but reflections may still occur (Ho et al., 2015). Nigeria's Civil Aviation Authority provides interim guidance on siting solar facilities near aerodromes to minimise aviation hazards.

Global studies demonstrate that community acceptance improves significantly when developers provide early consultations, transparent communication, and local benefit schemes (Walker & Devine-Wright, 2008). Nigerian communities stand to gain from employment creation, environmental trusts, local equity ownership, and improved rural electrification.

Understanding installed capacity, capacity factors, and annual energy yield is essential for evaluating the contribution of solar farms to national energy objectives. Capacity factors for utility-scale solar PV typically range between 18% and 26% depending on location (IEA, 2020). With Nigeria's high solar irradiance, projected yields can significantly strengthen national grid supply.

3. CONTEXT OF RENEWABLE ENERGY POLICY

At the national level, various statutory and non-statutory policy drives and initiatives pertain to the evaluation of planning applications for solar energy. The Climate Change Act 2021 is a Nigerian statute designed to build a legal framework for addressing climate change through the implementation of a low-carbon and climate-resilient development strategy. Essential provisions encompass the establishment of a national objective for net-zero emissions by 2050 to 2070, the formation of a National Council on Climate Change, the creation of a Climate Change Fund, and the implementation of a carbon price mechanism. The Act requires ministries, government organisations, and commercial companies to adhere to its stipulations.

3.1 Essential stipulations and objectives of the Climate Change Act 2021

The Act sets a national objective of attaining net-zero emissions by the years 2050 to 2070. The National Climate Change Action Plan mandates the government to formulate a national action strategy and establish a five-year carbon budget with specified annual objectives. The National Council on Climate Change is designed to implement the action plan, manage the Climate Change Fund, and coordinate climate efforts.

The Act establishes a specific fund to facilitate the operations of the Council and other climate-related initiatives. The carbon tax requires the establishment of a framework to regulate greenhouse gas emissions in conjunction with the Federal Inland Revenue Service (FIRS). The legislation is applicable to all Federal government ministries, divisions, and agencies (MDAs), in addition to public and private businesses in Nigeria.

The Goals of the act are:

- To establish a legal framework enabling Nigeria to fulfil its climate objectives and obligations, including the Paris Agreement and its Nationally Determined Contributions (NDCs).
- To promote low-carbon development and an environmentally sustainable framework.
- To advocate for inclusive green growth and sustainable economic advancement.
- To integrate climate change into national development priorities.
- To recognise and mitigate climate-related risks and vulnerabilities.

The Nigeria Renewable Energy Roadmap outlines a set of strategies to achieve the legally mandated objective established in the Climate Change Act 2030. The plan anticipates that over 30% of the Nigerian's electricity will be produced by renewable sources. The Roadmap indicates that the government perceives solar PV as having the capacity to constitute a substantial component of the renewable energy generation portfolio.

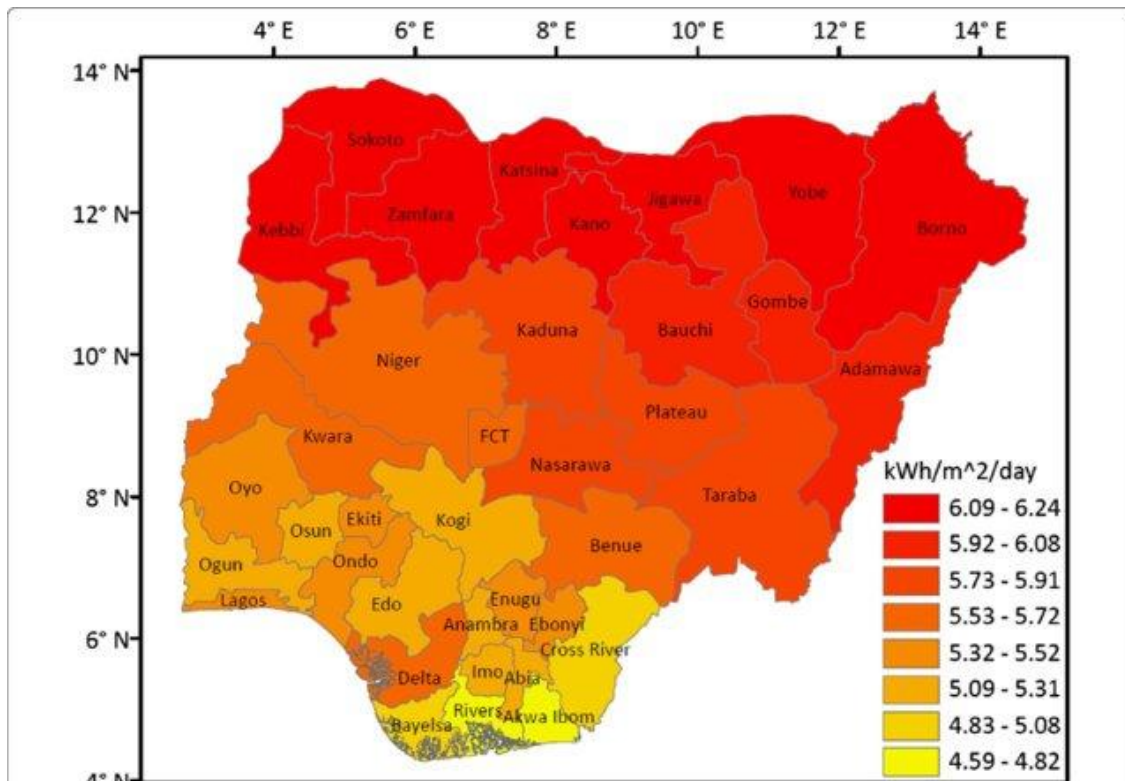


Figure 1. Map of Nigeria illustrating the global solar radiation (Gh) on the ideally inclined plane across the states. Source: https://www.researchgate.net/publication/353690334_Whistleblowing_on_photovoltaic_operations_in_Nigeria_panacea_for_sustainable_development/figures?lo=1&utm_source=google&utm_medium=organic.

3.2 National Planning Policy

Nigeria's National Planning Policy for renewable energy is articulated in frameworks such as the Renewable Energy Master Plan (REMP) and the National Renewable Energy and Energy Efficiency Policy (NREEEP), which seek to enhance the utilisation of renewable energy sources, including solar and biomass, diversify the national energy portfolio, encourage private sector investment, and augment rural electricity access. These plans offer strategic frameworks, establishing objectives, delineating incentives, and fostering a conducive climate for renewable energy advancement within the context of overarching national development objectives.

Principal policy documents

- Renewable Energy Master Plan (REMP): This is a strategy framework comprising particular, time-sensitive initiatives aimed at advancing renewable energy development.
- National Renewable Energy and Energy Efficiency Policy (NREEEP): This policy establishes the overarching framework for advancing renewable energy and energy efficiency in Nigeria.
- National Renewable Energy Action Plan (NREAP): This plan delineates the implementation strategy for the NREEEP, specifying definitive policies, regulations, and methods to attain the established targets.

3.2.1 Objectives and aims

- The REMP seeks to substantially augment the proportion of renewable electricity in the overall generation mix, targeting 23% by 2025 and 36% by 2030.

- Enhance rural accessibility: Due to the low rates of rural access, renewable energy technologies are seen as optimal for delivering decentralised electricity to rural populations.
- Diversify the energy portfolio: The policies seek to diminish the excessive dependence on fossil fuels, while oil is anticipated to continue being a significant component of the economy.
- Encourage private sector involvement: The initiatives seek to establish a conducive framework for private sector investment and engagement in the renewable energy sector.

3.2.2 Strategies and initiatives

- The technical and regulatory framework facilitates the establishment of standards, testing, and certification to enhance consumer confidence and expand the market.
- Market expansion: They enable both grid-connected and off-grid operations for renewable energy generation.
- Resource development: The strategy encompasses the creation of a comprehensive resource database to assist investors in making educated selections.
- The NREEEP recognises the difficulty of intermittency in energy storage and advocates for solutions such as battery storage to enhance the flexibility of energy systems.
- Biomass integration: The policy encompasses targeted initiatives to utilise and incorporate non-fuelwood biomass resources into the energy portfolio.

3.2.3 The Economic Framework

Nigeria's National Planning Policy framework, formulated through initiatives such as the Renewable Energy Masterplan (REMP) and the National Renewable Energy Action Plan (NREAP), delineates the financial landscape for renewable energy by fostering an enabling environment, encouraging private sector investment, and offering targeted incentives. Essential actions encompass the creation of financial instruments, the promotion of low-interest loans for small-scale initiatives, and the resolution of issues such as elevated interest rates and the scarcity of long-term credit for renewable energy.

3.2.4 Monetary context and motivations

The policy framework seeks to establish a conducive atmosphere for sustainable energy supply by delineating explicit targets, deadlines, and strategic methodologies for renewable energy advancement.

The government intends to offer incentives to stimulate investment and expansion in the renewable energy sector. The National Renewable Energy Action Plan (NREAP) outlines particular initiatives, including the provision of low-interest soft loans via the Bank of Industry for small-scale renewable energy enterprises.

Market development: The strategies acknowledge the necessity of expanding the renewable energy market and facilitating private sector involvement in fulfilling the nation's renewable energy objectives. The strategy recognises financial obstacles, such as banks' hesitance to finance unconventional projects and elevated interest rates, and aims to mitigate these issues through targeted policies and incentives.

Methodical strategy

- Private sector engagement: The active involvement of the private sector is a fundamental aspect of the policy, aimed at establishing an economically sustainable market for renewable energy.
- Renewable energy development aligns with national objectives, including enhancing

electricity availability, encouraging economic growth, generating employment, and alleviating poverty.

- The National Energy Masterplan offers a cohesive framework for optimising Nigeria's energy resources to satisfy increasing domestic demand and establish the nation as an energy powerhouse in West Africa.
- Commercial-scale ground-mounted solar photovoltaic systems. Extensive, centralised solar photovoltaic power systems, predominantly at the multi-megawatt scale, have been established to provide electricity for local or regional grids in several countries, including Nigeria, Morocco, Germany, Switzerland, Spain, and Italy. Recently, substantial solar photovoltaic projects have been established in England and Wales. This handbook is to offer planning information regarding large-scale commercial ground-mounted solar photovoltaic installations.
- Ground-mounted solar PV projects over 50 kWp should preferably employ previously built land, brownfield sites, polluted land, industrial land, or agricultural land classified as 3b, 4, and 5, while avoiding the use of "Best and Most Versatile" cropland if feasible. The chosen land must prioritise the preservation of visual aesthetics, uphold natural beauty, and be primarily level, effectively concealed by hedges and tree lines, while minimising adverse effects on adjacent residential properties or roadways.

3.3 Pre-application considerations.

Engagement with the Local Planning Authority and the local community is advised at an initial phase. The developer should engage the local community throughout the pre-design conceptual phase, preferably through a local exhibition or presentation to solicit and document community feedback.

3.4 Environmental Impact Assessment (EIA)

Large-scale solar photovoltaic arrays are not explicitly enumerated in Schedule 2 of the EIA Regulations 1999; the environmental impact of such developments, whether beneficial or detrimental, is contingent upon their location.

3.5 Environmental Impact Assessment Screening

The proposal should initially be evaluated according to the selection criteria outlined in Schedule 3 of the EIA Regulations. An Environmental Impact Assessment (EIA) is often required for Schedule 2 developments if the solar photovoltaic project is situated in an environmentally sensitive or vulnerable area. It is essential to assess if the anticipated environmental impacts of the development will be substantial in that specific site. To assess the significance of a development's effects, it is essential to consider the visual impact on landscape character, particularly regarding the installation of a solar PV farm, as well as the potential cumulative effects with any existing or approved developments. This should encompass scenarios involving many applications for solar PV development that must be evaluated collectively. All opinions articulated by consultees must be considered. Consultation with experts is advisable where there is uncertainty regarding the impact of a development on a 'sensitive region' as delineated in the EIA Regulations.

3.6 Formulating Performance Agreements

To enable the Local Planning Authority to provide adequate resources to address demand, applicants may consider entering into a Planning Performance Agreement (PPA) with the Local Planning Authority. The PPA mandates that developers provide a financial contribution to the Authority, which will thereafter allocate these monies to assign staff resources for the planning proposal submitted by the developer. The PPA mandates the Authority to collaborate with the

developer during the pre-application phase, facilitate public comment and involvement, and maintain communication with the developer throughout the planning application process.

4. PREREQUISITES FOR APPLICATION

4.1 Application Fee for Planning

No national advice exists regarding the fee category for large-scale ground-mounted solar photovoltaic installations. Typically, such applications are classified under Category 5 (erection, alteration, or replacement of plant or machinery) of the Town and Country Planning (Fees for Applications and Deemed Applications) as amended. Nonetheless, it is recommended that this be verified with the pertinent Local Planning Authority.

Essential information may encompass:

- A site plan (1:1250 metric scale)
- A site/block layout at a 1:500 metric scale
- Altitudes
- Design and Access Statement
- A corroborative declaration
- Fencing specifications and pertinent details (if appropriate)
- Specifications of electrical grid connection
- Specifications of any further structures or edifices envisaged, including elevations
- A relevant ecological assessment
- A landscape and visual evaluation if the application site is located inside or would affect an Area of Outstanding Natural Beauty, National Park, or World Heritage Site (see to Appendix A).
- A historic environment statement, if relevant (see to the above).
- Assessment of impact on agricultural land if relevant.
- Evaluation of Flood Risk.
- Finalized the 'Electricity Generating Capacity' form (refer to Appendix B).
- Construction Traffic Management Plan (CTMP)
- Required application fee.
- Application Fee for Planning

No national guidelines exist regarding the fee classification for large-scale ground-mounted solar photovoltaic projects. Typically, such applications are classified under Category 5 (erection, alteration, or replacement of plant or machinery) of the Town and Country Planning (Fees for Applications and Deemed Applications) as amended. Nevertheless, it is advisable to verify this with the pertinent Local Planning Authority. The most recent fees can be computed online via the Planning Portal Online Fee Calculator by selecting Yes > Full Planning Consent > Calculate > Non-Residential > Erection, alteration, or replacement of plant or machinery (inputting site area in hectares). Refer to the details below concerning the calculation of the site area.

4.2 Determining the Site Area for fee assessment

As a directive:

- If the solar panels are situated near a field boundary and there is an existing or proposed fence, the planning application area must encompass these field boundaries.
- If the solar panels are situated more than 50 meters from the field boundaries, where a distinct fence is envisaged, the planning application boundary should encompass the

proposed solar panels, with an additional planning application area surrounding the fenced region. In such cases, it would be imprudent for the application area (and planning application cost) to encompass substantial portions of land where no development is intended. In the absence of a proposed fence and with solar panels situated centrally inside a field, distanced from the field limits, the planning application boundary should encompass the proposed array and any adjacent ancillary works, such as access tracks.

- It is the responsibility of the applicant to ensure that all proposed developments are encompassed within the boundaries of the planning application.

4.3 Comprehensive Planning Approval

Outline planning approval cannot be approved for a planning application categorised under section 5 of the aforementioned fee regulations. Only comprehensive planning proposals will be validated. Certain aspects, such as the precise dimensions or model of the solar panel, may be 'reserved'; nonetheless, adequate specific information must accompany any planning application to enable the Local Planning Authority to thoroughly assess the application.

The most recent fees can be computed online via the Planning Portal Online Fee Calculator by selecting Yes > Full Planning Consent > Calculate > Non-Residential > Erection, alteration or replacement of plant or machinery (inputting site area in hectares). Refer to the details below concerning the calculation of the site area.

4.4 Considerations for Planning Applications

- a. Site Levelling Operations: Attention must be directed on the prevailing site topography. Any proposed site levelling works to enable the building of a solar panel array should be addressed during the pre-application phase and thoroughly specified in the planning application.
- b. .Development Concerning Current Land Use: Ideally, ground-mounted large-scale photovoltaic arrays should be situated on previously built land, brownfield sites, polluted land, industrial land, or agricultural land classified as 3b, 4, or 5. Although there is no prohibition against ground-mounted large-scale photovoltaic arrays on sites classified as agricultural 1, 2, and 3a, or designated for their natural beauty or recognised ecological or archaeological significance, it is improbable that planning permission will be approved if there is a substantial impact on these designations.

4.5 Evaluation of the Effects on Agricultural Land

Paragraph 112 of the National Planning Policy Framework mandates that the presence of best and most versatile agricultural land, classified as grades 1, 2, and 3a, must be considered in conjunction with other sustainability factors. The NPPF favours directing development away from land classified as 3b, 4, and 5; yet, paragraph 28 acknowledges the necessity of supporting agricultural land diversity to sustain agricultural enterprises.

This policy stance must be considered when selecting locations for extensive solar panel development. When development is proposed on agricultural property, it is advantageous for the applicant to suggest a project completion date to illustrate the transient character of the solar farm. The developer should conduct the following procedures when contemplating the placement of a large-scale solar PV project on agricultural property. Should a planning application be submitted afterward, it must include the pertinent information outlined in the following steps. Agricultural Land Classification: safeguarding the finest and most adaptable agricultural land.

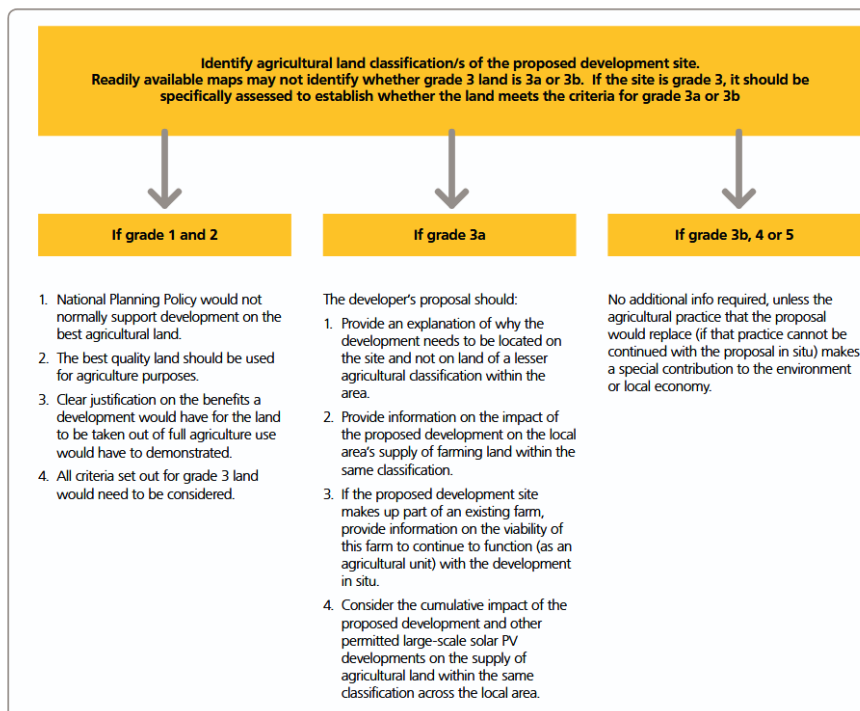


Figure 2. Procedures for developers regarding agricultural land classification

4.6 Landscape Maintenance

Vegetation will proliferate beneath the solar panels, necessitating maintenance to prevent the area from becoming overrun with invasive weeds and to facilitate the eventual restoration of the property, typically for agricultural purposes. Numerous strategies exist for vegetation management, including mowing, trimming, spraying, and mulching. Application of sprays should be minimised whenever feasible, and mulching extensive areas may provide technical difficulties and potentially enhance the landscape or visual impact of a development concept. Several of these management strategies are considered unsustainable, especially on sites up to 15 hectares, and there is a strong inclination, regarding both food production and the rural landscape, to maintain agricultural usage on the site.

During periods of growth, controlling grazing should be promoted whenever feasible. Cattle, horses, pigs, and goats are likely to be excessively 'physical' with the solar arrays; however, sheep, chickens, or geese should be permissible. To enable grazing within the solar farm, it is recommended that solar panels be installed at a minimum height of 700mm above ground level, with all cabling adequately safeguarded.

4.7 Construction Site

The establishment of a large-scale solar array will necessitate the transportation and storage of construction materials, equipment, machinery, and office/welfare facilities. A temporary construction compound will likely be necessary. These compounds must be strategically positioned to mitigate environmental or amenity impacts, and any planning application should include specifications for their dimensions and placement. Topsoil and subsoil must be excavated from these areas and retained on-site for reinstatement after the building activities are concluded. Any planning application must include details regarding soil stripping, storage, and replenishment, along with the expected duration of the construction compound's operation.

4.8 Soil Excavation, Preservation, and Reinstatement

The establishment of a substantial solar installation will likely necessitate the excavation of soils related to construction compounds, access roads, cable trenching, and similar activities. In instances of soil stripping, topsoil and subsoil must be removed, stored, and reinstated separately to mitigate soil degradation and ensure optimal conditions for site rehabilitation. Every planning application must include a system for soil stripping, storage, and replacement, which should be strictly followed throughout the site development process.

4.9 Access Routes

Solar panel installations established on agricultural property should:

- a. strive to reduce disruption to the agricultural terrain;
- b. be transient, removable, and 'reversible'; and
- c. reduce their landscape and visual impact as well as their effect on the rural environment.

The establishment and utilisation of access tracks should be minimised to the utmost extent. A minimum of one track connecting the inverters may be required to facilitate the swap of inverters and the replacement of heavy gear. Agricultural vehicles, such as tractors, quad bikes, and 4WDs, must be able to service the facilities daily without requiring the construction of access tracks on the site. A buffer zone beyond 5 meters between hedges and solar panels is preferable to enhance ecological and biodiversity prospects, if feasible.

4.10 Security Fencing and Lighting

Applicants must exert significant effort to reduce the landscape and visual impact of solar photovoltaic systems. Although there is a recognised necessity to maintain the necessary security of solar PV systems, it would be regrettable if such precautions led to an unacceptable impact on the landscape or visual aesthetics. Candidates must:

- a. Reduce the utilisation and elevation of security fencing.
- b. Employ existing elements, such as bushes or landscaping, to obscure security fencing;
- c. Utilise natural elements, such as the installation of vegetation, to enhance site security.
- d. Reduce the utilisation of security illumination. All lighting must employ passive infra-red (PIR) technology and be designed and placed to avoid glare, light pollution, and effects on biodiversity, particularly concerning bats (see to the ecology section).
- e. implement suitable steps to enable ongoing access for larger species, including badgers and foxes.

In certain cases, specialised fence may be required to restrict deer access. Deer fencing can be significantly less obtrusive than alternative fencing methods and should be contemplated wherever feasible. Planning applications must provide comprehensive descriptions and specifications of all security and lighting installations to facilitate an accurate landscape, visual, and ecological assessment of the design. The placement of pole-mounted CCTV facilities should be meticulously evaluated to reduce visual and landscape effect. Such constructions should be avoided in exposed areas if feasible.

The subsequent details are derived from a general survey conducted in Nigeria.

The commercial-scale generation of power from solar energy utilising photovoltaic panels in Nigeria presents novel hazards and problems, necessitating measures to safeguard the site and equipment from criminal activities. Due to the novelty of this research, there is presently no available crime data from Nigeria to provide crime prevention recommendations. Law

enforcement experience suggests that situating substantial amounts of costly solar panels in remote areas without sufficient security measures may entice criminals, resulting in the theft of the panels and related infrastructure. The primary threat will originate from organised gangs employing heavy-duty tools and vehicles to extract substantial quantities of the panels. The stolen panels are likely to be relocated from the crime scene prior to being resold.

Site: A significant issue from a policing perspective, while evaluating appropriate locations for solar farms, will be the measures implemented to safeguard the site against illegal vehicle access. Comprehensive evaluation of the site's natural fortifications, such as steep gradients, substantial hedging, and rivers, should be undertaken. The site's boundary barrier should be positioned at a suitable distance from the panels to deter vehicles from parking against the boundary and facilitating the manual theft of panels.

Site Access: The solar company or site owner will necessitate vehicular access to the location. The physical security protecting this access must be resilient to withstand significant assaults, as these locations are likely to be isolated and devoid of natural observation. Protection of the access road at two distinct points should be prioritised;

- a. at the actual entry to the site and;
- b. Remove authorised vehicles from the designated entry to maintain a considerable distance from the location.

The security of solar farms must be thoroughly evaluated by all participants in the design process. Consequently, all planning applications must have comprehensive information of the security provisions within the Design and Access Statement. Security measures at each place must be evaluated on a site-specific basis. They will undoubtedly be influenced to some extent by factors such as the prevailing terrain and local zoning restrictions. The fundamental idea of crime prevention is to establish many layers of defence for that which requires safeguarding. Solar farms will likely necessitate both physical barriers, such as fences or ditches, and the implementation of suitable technology, such as CCTV. The following information encompasses essential crime prevention considerations for all applicants.

Perimeter Security and Access Control: If perimeter fencing is employed, it must be a verified security fence. It is advisable to install fencing that has been tested and authorised according to current Nigerian Government regulations. Fencing that complies with SEAP (Security Equipment Approval Panel) class 1-3 may be the most suitable. Non-specialist fencing is likely to provide, at most, just nominal resistance to invaders. Planting adjacent to any fencing is permissible, provided it does not adversely impact site surveillance. Landscaping methods, including ditches and berms (bunds), may be suitable in some situations. To effectively halt cars, meticulous design is needed. The police can offer additional particular guidance regarding the design of such defences upon request. There should be a minimum of automobile access points to the site, preferably limited to a single entry. Clearly, such access points will provide the most apparent opportunities for criminals and hence necessitate a powerful and sufficient defence. Consideration should also be afforded to the broader access difficulties around any site. If the area adjacent to the site is under the same ownership, may security be enhanced by upgrading gates and similar measures? This presents multiple layers of complexity for the criminal to navigate.

Electronic Security: A vast array of electronic security options exists. For the majority of sites, it is highly probable that this will assume a significant role. A thorough site-specific assessment should be conducted to determine the appropriate technology to guarantee the system is suitable for its intended purpose. This evaluation for CCTV is typically referred to as an Operational

Requirement (OR). A clear example would be to determine the effectiveness of the CCTV during nighttime at these sites. Deploying CCTV or other security measures is likely to yield no benefit unless they are monitored or capable of providing immediate alerts; furthermore, it raises the question of who would respond to such alerts. CCTV that merely records is likely to possess minimal utility.

Alternative Considerations: The inclusion of site security staff in various capacities should be evaluated, particularly for specific responses to site alarm activations. The utilisation of security bolts to fasten photovoltaic panels and locked enclosures to safeguard inverters, among other components. Clearly marking individual solar panels would diminish their resale and reuse potential, so serving as an additional deterrent and aiding in future detection. Covert security markings should further be employed.

4.11 Soil Anchors

Solar photovoltaic installations established on agricultural land should be 'reversible', facilitating the site's restoration to a more intense agricultural use. Consequently, intrusive development, including trenching and foundations, should be limited, and the utilisation of mass concrete should be eschewed. Solar PV arrays should, where feasible, be built using pile-driven or screw foundations, or pre-molded concrete blocks (shoes), and designed for simple removal. Footwear may be mandated in archaeologically sensitive regions. When proposing 'pile' driven foundations, applicants should assess the development consequences on adjacent noise-sensitive properties.

5. MONITORING AND NAVIGATION

Certain solar photovoltaic arrays will track the sun's daily trajectory to optimise solar energy absorption. These devices, referred to as 'trackers,' optimise solar gain; however, they entail high installation and maintenance costs. Certain solar photovoltaic arrays will remain stationary. These systems are more economical to build and maintain; nevertheless, due to their inability to track the sun's trajectory, they are less efficient than 'trackers.' A compromise is established with certain solar photovoltaic arrays that are predominantly stationary but may be relocated quarterly to accommodate seasonal variations in the sun's trajectory across the sky. The installed solar PV array type and the degree of any tracking will influence the landscape and visual assessment; thus, the planning application must explicitly specify the planned array type.

The influence of 'trackers' on grazing animals, such as sheep, must be meticulously evaluated to prevent these animals from becoming ensnared in any moving components. The alignment of stationary solar photovoltaic panels should also be taken into account. Recently, developers are evaluating the benefits of altering the orientation of panels across the development to optimise electricity output over the year and day. These details should be delineated in the planning application and evaluated in the landscape effect assessment.

5.1 Topographical / aesthetic influence

The visual impact of a solar PV farm is expected to be one of the most significant effects of such development. Developers may be drawn to south-facing locations, where solar exposure is maximised. Nonetheless, such places may possess significant agricultural value and are likely to be more prominent within the broader landscape. Solar PV farms are considered a temporary land use (see Duration of Planning Permission at the conclusion of the Guidance), and consequently, the removal of existing vegetated field boundaries, including hedges, will not be authorised, since this would permanently modify the landscape character of the site.

The development must consider both its architectural layout and future maintenance plans to ensure the preservation and expansion of vegetation along these significant borders, including the potential for individual trees within these boundaries to reach maturity.

The landscape and visual impact must be meticulously evaluated during the pre-application phase. The Local Planning Authority Landscape Officer must be consulted promptly, and mitigation measures should be proposed if needed. The information required for a Landscape and Visual Impact Assessment is detailed in Appendix A.

Existing hedges and established vegetation, including older trees, should be preserved if feasible. Arboricultural and hedgerow preservation must be ensured during building activities. The proposed development's effect on existing trees and hedges must be assessed using a tree survey (according to BS 5837) and/or a hedge evaluation where necessary.

Buildings intended to accommodate electrical switchgear, inverters, and similar equipment must be designed and erected to reduce their landscape and visual impact, with construction materials chosen to align with the local landscape environment. When utilising a pre-fabricated structure, it is essential to contemplate the necessity of concealing the building with greenery.

5.2 Aggregate Effect

The Local Planning Authority must keep a comprehensive record of all planning applications pertaining to large-scale solar PV systems, as well as a record of all planning decisions made. Prospective applicants should consult their Local Planning Authority to examine these data promptly, ensuring that the cumulative impact of the development is assessed and addressed throughout the preparation of any planning application.

Thorough evaluation must be conducted about the influence of current or planned vegetation to guarantee that any resulting shade of solar panels does not necessitate future trimming or removal of said vegetation.

5.3 Ecology

The effects on ecology will be contingent upon the site's natural attributes and its sensitivity to proposed alterations. Solar photovoltaic arrays may result in habitat loss, fragmentation, change, and species displacement. Nevertheless, solar PV arrays may also provide environmental benefits, such as fostering habitats through preserved grasslands over extended periods, wildflower meadows, taller hedgerows, and woodlands, among others.

The National Planning Policy Framework delineates the national approach to ecology within the planning process and articulates certain guiding concepts. It is essential to evaluate the effects that may arise during the building, operation, and decommissioning phases of a project.

Design must be guided and shaped by ecological evaluations, such as phase 1 habitat surveys and protected species assessments. Concerns requiring specific evaluation encompass ground-nesting avifauna, wintering birds, chiropterans, dormice, reptiles, and badgers. Engaging an advising ecologist during the design phase can guarantee the mitigation of detrimental consequences and the maximisation of biodiversity gains. Protected species surveys are contingent upon the season; therefore, it is prudent to consult an ecologist at an early stage.

The assessment must incorporate a 'desk study' of current ecological records, an appraisal of

the anticipated consequences of the solar farm on ecological features, describe mitigation measures to prevent or limit these impacts, and enumerate any additional surveys needed. The primary effects and necessary mitigating measures are expected to be:

- a. .Illumination - security lights may impact bat populations. It is recommended that lights be utilised only when absolutely essential. If illumination is required, it should be reduced and directed away from hedges, woodlands, and scrub. A bat survey is necessary to determine any additional mitigation required and whether illumination is permissible on the site.
- b. Overhead and subsurface cables may negatively affect biodiversity. Cable routes must be meticulously planned in collaboration with the consulting ecologist.
- c. In construction, it is recommended that existing hedges be preserved in their entirety and that no new hedge gaps be established. Should any hedges or bush be removed, more surveys for dormice and reptiles may be required. Pile driving may impact surrounding badgers; this necessitates a badger survey, and a licence may be required.
- d. .It is recommended that substantial buffer strips (a minimum of 4-5 meters) be maintained between perimeter fencing and hedges. The fencing must permit access for badgers, reptiles, and other species to the site, while also accommodating grazing sheep, as stipulated in the ecological study. A gap should be maintained around the entire base of the fence to permit access for small mammals and reptiles, with larger openings or gates for badgers at appropriate intervals.
- e. Enhancement, Management, and Monitoring – Solar farms can augment the biodiversity worth of a site if the area was previously subjected to rigorous management. Grazing by sheep or an autumn mowing with the removal of grass clippings could enhance the botanical diversity of the area. The ecological consultant must delineate an appropriate management strategy for each instance, considering the shading effects of the solar panels. Hedges must be managed effectively and may be laid to minimise gaps. Proposed improvements should augment and expand current habitats or establish new significant habitats, such as cultivated strips or plots for rare arable flora, rough grassland margins, bumblebee plant mixtures, and wild bird mixes. It is recommended that an ecological monitoring program be established to assess the impacts on the site's flora and specific features, such as bats and wintering birds. The monitoring results will subsequently guide any necessary modifications to the management or grazing regime.

5.4 Checklist for advising on possible nature conservation impacts:

- a. Can the development site, individually or collectively, affect a designated site and its designation objectives?
- b. Is the habitat or species sensitive to alterations that may arise from a solar array project?
- c. Is the site capable of effectively integrating land uses and providing environmental advantages?
- d. Are the proposed mitigation actions sufficient and likely to be effective?
- e. Is post-construction monitoring essential?
- f. Have the implications been adequately evaluated in the Environmental Impact Assessment/Hazard Risk Assessment or other environmental evaluations? Do we concur with the conclusions?
- g. Are there prospects for environmental improvement, including the establishment of additional natural screening elements or the management of land and margins for conservation objectives?
- h. Are enhancing measures suitable and do they further broader objectives in the region, such as the Biodiversity Action Plan (BAP) initiatives?

Solar PV farms can enhance biodiversity, making it essential to optimise the environmental

benefits of the land on which they are situated.

5.5 Heritage Environment

The effects of solar PV advancements on the historic environment will necessitate expert evaluation in the majority of instances. Solar photovoltaic developments may impact heritage assets, including sites, monuments, buildings, and landscapes, both above and below the surface. Above-ground impacts may encompass the effects of applications on the settings of Listed Buildings, provided the setting is included in the listing, Scheduled Monuments, and the Historic Landscape Character. Subsurface effects may encompass direct consequences on archaeological deposits due to ground disturbances linked to trenching, foundations, fencing, temporary haul routes, and similar activities. Equally, findings may be safeguarded by a solar PV farm, as the location is exempt from conventional tillage, and the use of shoes or low-level piling is mandated.

If a proposed development site contains or may contain heritage assets of archaeological significance, local planning authorities should mandate that developers provide a suitable desk-based assessment and, if required, a field evaluation. This should be conducted in collaboration with the local authority planning team or historic environment officer, who can furnish a brief for the necessary expert assessment or evaluation work. Results from these assessments will be necessary as supporting documentation prior to the validation of applications, as stipulated in The National Planning Policy Framework. Applications must consider the outcomes of historic environment assessments in their design, particularly through the careful planning of installations. Opportunities to enhance the management of impacted assets or to optimise the conditions of designated sites should be recognised.

5.6 Drainage, Surface Water Discharge, and Flooding

The Environment Agency has indicated that, owing to the scale of solar PV farms, planning applications must include a Flood Risk Assessment. This must take into account the effects of drainage. The drainage of solar PV panels into the existing ground will generally have a negligible impact, thus this should not be a burdensome requirement.

Permeable access tracks should be utilised where necessary, and localised Sustainable Urban Drainage Systems (SUDS), such as swales and infiltration trenches, should be implemented to manage runoff as advised. Due to the transient nature of solar PV farms, sites must be designed or chosen to prevent interference with existing drainage systems and watercourses. It is advisable to refrain from culverting existing watercourses or drainage ditches. When culverting for access is indispensable, it must be evidenced that no feasible alternatives are available, and if necessary, it should be implemented only temporarily during the construction phase.

5.7 Reflection and Shine

Glint may occur as a direct reflection of sunlight on the surface of the solar PV panel. It may be the origin of the visual problems related to viewer distraction. Glare is a persistent source of luminosity, in contrast to diffused illumination. This is not a direct reflection of the sun, but rather a reflection of the luminous sky surrounding it. Glare is markedly less vivid than glimmer. Solar photovoltaic panels are engineered to absorb, rather than reflect, irradiance. Nonetheless, the sensitivities related to shine and glare, as well as the landscape/visual impact and the potential effects on aviation safety, must be taken into account. In certain cases, a glint and glare assessment may be required as part of a planning application. This may be especially significant if 'tracking' panels are suggested, as they may result in varying diurnal and/or seasonal effects.

The possibility for solar PV panels, frames, and supports to possess a collective reflective quality should be evaluated. This evaluation must account for the probable reflecting properties of all materials utilised in the construction of the solar PV farm.

5.8 Community Engagement and Benefit

Community involvement must be regarded as a fundamental component of the development process. The developer should engage the local community throughout the pre-design conceptual phase, preferably through a local exhibition or presentation to gather and document community feedback. A subsequent exhibition or presentation must be organised by the developer several weeks before the submission of the planning application. The second consultation should provide adequate time to gather community perspectives and incorporate them before submitting any final planning proposal. Every planning application must specify the exhibitions or presentations, the opinions or representations received, and how the application was modified or influenced to align with those representations. The developer may also desire to conduct an exhibition or presentation subsequent to the submission of a planning application.

Community Gain - Opportunities for communal advantage should be pursued whenever feasible. Opportunities encompass;

- a. Creation of a local Environmental Trust or Community Benefits Trust, funded annually by the developer for energy conservation initiatives.
- b. Local equity issuance.
- c. Local or community ownership of solar panels.
- d. Investment in the provision and management of Green Infrastructure, particularly at the landscape level.

While community benefits are advocated, it must be explicitly stated that any proposal is not pertinent to the evaluation of any planning application. Neither the fundamental idea of any initiative nor its specific elements may be presented to directly alleviate a particular planning objection to a proposal. The stipulation for community benefit is deemed non-compliant with the Community Infrastructure Levy Regulations 2010 (as modified) and cannot be mandated under planning legislation. Consequently, no significance can be attributed to the incorporation of a community benefit program while evaluating a planning proposal.

5.9 Aviation Security

The Nigerian Civil Aviation Authority (NCAA) has issued recommendations regarding solar energy, including interim instructions for the construction of solar panels in proximity to Nigerian aerodromes.

5.10 Electricity Generation Capacity

Planning applications for commercial-scale solar photovoltaic projects must explicitly specify the installed capacity (MW) of the planned facility. While the NPPF indicates that local authorities should not mandate applicants for energy developments to prove the overall necessity for renewable or low carbon energy, and acknowledges that small-scale projects significantly contribute to reducing greenhouse gas emissions, this is regarded as pertinent background information.

Although it is acknowledged that the efficiency of solar PV panels may diminish over time, the original installed capacity should be specified. The 'capacity factor' and projected yearly production (MWh p.a.) must be included alongside the number of residential premises

equivalent in electricity for Nigeria. An explanatory pro forma table is included as Appendix B. This information will enable the public and elected officials to comprehend the producing capacity of the proposed facility accurately.

5.11 Duration of Planning Authorisation

Solar photovoltaic farms should often be considered a transient utilisation of land. Consequently, it is probable that planning clearances will restrict the length for which the system may be operational. Planning permissions will typically;

- a. Must be executed within a timeframe of three years
- b. Include a timeline for the completion of the construction and commissioning of the project.
- c. Be limited to a temporary duration commencing with the facility's commissioning.

5.12 Tourist Destination/Learning Institution

Applicants should consider, when applicable, the creation and implementation of viewing spaces, explanatory panels, and visitor or educational facilities as components of any development proposal. Although not all solar PV farm ideas are expected to require such facilities, there may be circumstances when such development is suitable.

6. CONCLUSION

Ground-mounted solar photovoltaic farms present a transformative opportunity for Nigeria's pursuit of sustainable, low-carbon energy development. Supported by robust policy frameworks—including the Climate Change Act (2021), NREEEP, REMP, and NREAP—solar PV deployment is positioned to expand significantly over the next decade. Successful implementation, however, requires meticulous planning, environmentally sensitive site selection, comprehensive EIAs, and careful consideration of agricultural, ecological, aesthetic, and security factors. The integration of community engagement, heritage protection, drainage management, and glint-and-glare mitigation further strengthens project viability. As Nigeria confronts rising energy demand, rural electrification deficits, and climate-related vulnerabilities, well-planned solar PV farms can enhance energy security, stimulate economic growth, and contribute meaningfully to national climate commitments. Ensuring compliance with best-practice planning standards will be essential for maximising the social, environmental, and economic benefits of large-scale solar developments.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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Appendix A:

Recommendations about the material should be included in a Landscape and Visual Impact Assessment

Standard Solar Farm Evaluation Response

Incorporating landscape considerations into the decision-making process is essential, as the primary environmental consequence of such a development will be its effect on landscape character and visual amenity. The inquiry pertains to the potential for this solar farm project to generate substantial environmental impacts on the landscape, and consequently, whether the Environmental Impact Assessment Regulations are applicable to the application.

Several factors related to solar farm construction may affect the magnitude of affects on landscape character and visual amenity.

- a. Gradient of the site and the adjacent topography,
- b. Scope of the application site,
- c. Dimensions and arrangement of the panels,
- d. Colour of the panel's surrounding frames,
- e. .Management of the soil beneath and between the panels, such as cultivating crops, grazing cattle, or applying mulch to minimise upkeep.
- f. .Boundary enclosure.

This is an illustration of how significance may be assessed, initially concerning landscape character and subsequently about visual effect.

- Evaluation of the influence on landscape character can be categorised as high, medium, or

low, either harmful or helpful, based on the assessment of the:

- erosion of essential components of the pre-development environment;
- Integration of items into the receiving landscape resulting in alterations to the overall landscape character.

Significant impact on landscape character - complete loss or substantial modification of essential components of the pre-development landscape, or the incorporation of elements deemed incongruous with the characteristics of the receiving landscape, or the proposal emerges as a predominant feature within the scene, rendering surrounding elements subordinate, resulting in a transformation of the overall character.

Moderate impact on landscape character - partial loss or modification of one or more key landscape elements prior to development, or the introduction of elements that may be prominent or create a visibly recognisable new feature, yet may not be deemed significantly uncharacteristic within the context of the receiving landscape's attributes.

Minimal impact on landscape character – slight loss or modification of one or more essential elements of the pre-development landscape, or the incorporation of elements that represent a minor aspect of the broader landscape and are consistent with the characteristics of the surrounding landscape.

The sensitivity of the landscape as a resource can be categorised as high, medium, or low, contingent upon the landscape's:

- a. *Character*: What contribution does the site provide to how rge occupants behave? What is the character of the place in its natural state? Does it conform to a discernible pattern of Elements or qualities pertinent to the region? Does the site enhance the area's feeling of identity and uniqueness?
- b. *Quality*: What is the condition of the current landscape?
- c. Is this landscape esteemed by individuals, the local community, and visitors? Are there certain cultural Affiliations? Does the area possess a landscape, ecological, or historical designation? Is the landscape acknowledged at the local, regional, or national level?
- d. *Capacity*: What potential exists for modification in the current framework?
- e. landscape characteristics?
- f. *Significant importance* - a landscape of high quality with esteemed attributes and a favourable character that is especially susceptible to alteration. A landscape of significance or uniqueness at a local, regional, or national level.
- g. *Moderate significance* - typically possesses a favourable character; yet, there may have been deterioration or erosion of attributes, leading to regions with a more heterogeneous character and diminished total worth. Moderately sensitive to change; while certain alterations may be accepted, improper management could be damaging. A landscape of moderate significance or uncommonness at a regional or local level.
- h. *Minimal significance* — few esteemed attributes, the environment is accommodating to considerable alteration. A region of minimal significance and infrequency at a local level.

The sensitivity levels of the landscape to change and the amount of the landscape effect are combined in Table 1 to ascertain the relevance of the effect on landscape character.

Table 1

		Sensitivity Of Landscape		
		High	Medium	Low
Magnitude of Landscape Effect	High adverse	High adverse significance	High / Medium adverse significance	Medium adverse significance
	Medium adverse	High / Medium adverse significance	Medium adverse significance	Medium / Low adverse significance
	Low adverse	Medium adverse significance	Medium / Low adverse significance	Low adverse significance
	Nil	Neutral significance	Neutral significance	Neutral significance
	Low beneficial	Low beneficial significance	Low beneficial significance	Low beneficial significance
	Medium beneficial	Medium beneficial significance	Medium beneficial significance	Medium beneficial significance
	High beneficial	High beneficial significance	High beneficial significance	High beneficial significance

Evaluation of the visual effect

The extent of visual change can be categorised as high, medium, or low, as well as detrimental or positive, by evaluation of:

- a. alteration or incorporation of essential components of the pre-development perspective;
- b. modification of the overall composition of the broader perspective regarding the fraction of the view occupied by the development,
- c. What proportion of the region will exhibit a noticeable shift in view?
- d. Will the alteration be transient?
- e. To what degree will the scale, massing, layout, and colour of materials differ from the predevelopment perspective?
- f. topography of the location and the adjacent landform
- g. .proximity between the observer and the development.

Significant impact - complete loss or severe modification of essential features of the current landscape, resulting in a markedly atypical and adverse transformation in visual character. The proposal emerges as the predominant element in the picture, relegating other components to a subordinate status.

Moderate size of influence - partial loss or significant alteration to certain components of the current landscape, which may be conspicuous and easily perceived by the viewer, and are atypical in the overall visual character.

Minimal effect magnitude - slight loss or modification of one or more essential components of the landscape/view. The concepts represent a modest aspect of the broader perspective and incorporate aspects that are not atypical within the overall visual character. Knowledge of the plans would not significantly impact the overall quality of the scene.

- No discernible alteration to components within the image or the overall visual aesthetic. The sensitivity of visual receptors can be categorised as high, medium, or low, contingent upon:
the distance from the location, its dimensions, the angle/elevation of the vantage point, contextual factors, meteorological conditions
- The varying individual receptors and the anticipated perspective they provide
The significance of the viewpoint is evaluated based on the number of individuals impacted, its popularity, its appeal to residents and tourists, and its mention in literature, guides, and maps.

Significant perspectives inside a high-quality environment, acknowledged in official maps and guides. In instances where numerous residential properties share a comparable view. Receptors are individuals with a keen interest in their environment who participate in leisure activities related to the aesthetic appreciation of their surroundings.

Moderate significance — perspectives inside a landscape of medium quality. In instances where a limited quantity of residential properties share a comparable perspective. Receptors/individuals possessing a moderate interest in their surroundings while participating in outdoor activities, sports, or recreation.

Minimal significance - perspectives within a subpar landscape. Receptors are individuals with a transient interest in their surroundings, typically while occupied with other activities such as work or travelling through the area on an infrequent basis.

The sensitivity levels of the visual effect and the size of that effect are combined in Table 2 to ascertain visual significance.

The existing Environmental Impact Assessment Regulations (EIA) do not mention solar farms; nonetheless, this should not be a basis for concluding that an EIA is unnecessary. Upon reviewing the EIA Regulations, a comparison may be established between solar panels and the subsequent two categories of development:

- Glasshouses, which also modify land cover across potentially extensive areas, are associated with considerable landscape and visual impacts. “Development, such as greenhouses, on previously uncultivated land is unlikely to necessitate an Environmental Impact Assessment (EIA) unless it exceeds 5 hectares.” EIA circular
- Industrial facilities for power generation - where the development area exceeds 0.5 hectares, with visual impact being a primary concern.

Table 2. sensitivity levels of the visual effect and the size of that effect

		Sensitivity Of Receptor			
		High	Medium	Low	
Magnitude of Visual Effect	High adverse	High adverse significance	High / Medium adverse significance	Medium adverse significance	Low adverse significance
	Medium adverse	High / Medium adverse significance	Medium adverse significance	Medium / Low adverse significance	
	Low adverse	Medium adverse significance	Medium / Low adverse significance	Low adverse significance	
	Nil	Neutral significance	Neutral significance	Neutral significance	
	Low beneficial	Low beneficial significance	Low beneficial significance	Low beneficial significance	
	Medium beneficial	Medium beneficial significance	Medium beneficial significance	Medium beneficial significance	
	High beneficial	High beneficial significance	High beneficial significance	High beneficial significance	

The impact of the plan on landscape character and visual amenity must be assessed through a full Landscape and Visual Impact analysis, regardless of the applicability of the EIA Regulations to the application.

Evaluation.

This assessment must encompass the following details:

- Overview of the evolution
- The necessity for the establishment of a set within local, regional, and national strategies;
- The timeline for building, operation, and decommissioning;
- The site's geographical position and general configuration;
- .Design and specifications of solar panels, construction and installation methods;
- Prudent assessments of the volume and nature of traffic anticipated during development and operation.

Overview of the Site

- a. an exposition of the primary rationale for site selection and any alternative designs or layouts that have been contemplated.

- b. Designated area for the installation of panels, explicitly delineated and represented on a map or plan;
- c. Depiction of the land utilisation in the adjacent region;
- d. A description of the policies, plans, and designations pertinent to the proposal;
- e. Assessment of the direct, indirect, secondary, and cumulative effects, both short-term, medium-term, and long-term, arising from the presence of the development.

Preliminary Landscape Conditions

- a. The present state of the terrain;
- b. Local Authorities Landscape Character Assessment will furnish the foundational landscape character information, augmented by a study to evaluate the specific effects of the development.
- c. The site's relationship to designated landscape areas at national, regional, or local levels, as well as to areas of landscape significance or aesthetic quality.
- d. A comprehensive account of all foundational data sources and the methodologies employed to augment this information;
- e. The landscape baseline must be assessed about its sensitivity and significance. The sensitivity assessment of each landscape element must correspond to its quality value, its contribution to landscape character, and the extent to which the specific element or characteristic can be changed or substituted.

Projections of Consequences

- a. Evaluate the extent of alteration to the landscape and visual components as a divergence from the baseline conditions for each phase of the proposal. Attention must be paid to tourist and resident demographics, as well as seasonal fluctuations;
- b. Generate a Zone of Theoretical Visibility (ZTV) diagram for the development, delineating at least 1km, 2km, and 4km radii from the site.
- c. The techniques employed to determine the magnitude must be explicitly articulated and deemed suitable and rational for the significance of the landscape and visual impact;
- d. Assumptions or unsupported data utilised in the projections must be identified and accompanied by an assessment of the dependability or confidence in those assumptions or data.
- e. Assessment of the direct, indirect, secondary, and cumulative consequences, both short-term and long-term, arising from the development's existence.

Significance of Impact

- a. Explicitly delineate the assessments that provide the basis for the allocation of significance;
- b. The evaluation of importance must take into account the impact's divergence from the defined landscape baseline state, the sensitivity of the landscape and receptors, and the degree to which the impact can be mitigated or is reversible.
- c. The array of factors likely to affect the evaluation of significance should be distinctly delineated;
- d. Elucidate how these variables will influence the importance of the affects during the development's lifespan;
- e. Determine the importance of residual repercussions after mitigation efforts.

Reduction of severity

- a. Outline the strategies suggested to prevent, mitigate, and, if feasible, rectify substantial negative effects on landscape character and visual amenity;
- b. Assess the efficacy of the specified measures;

- c. Explicit delineation of the implementation of mitigation measures.

Presentation of the Landscape and Visual Impact Evaluation

- a. The paper must exhibit clarity and logical organisation in its layout and presentation, ensuring comprehensibility for a non-specialist audience.
- b. The document must present a balanced, impartial assessment of the landscape and visual impacts, supported by reasoned and justifiable reasoning.
- c. A comprehensive lexicon of all technical terms and a complete reference list must be included;
- d. Plans, diagrams, and visual representations must be supplied to facilitate comprehension of the development and its effects, and should be precisely identified with all locations referenced in the text.

Non-Technical Overview

- a. A self-contained document designed for a non-expert audience, facilitating comprehension of the proposal's geography and visual effects;
- b. To provide a comprehensive description of the development, the landscape character and visual amenity features likely to be considerably impacted, the anticipated significant effects, and the mitigation actions to be enacted;
- c. At a minimum, incorporate plans, maps, and other visual representations that depict the application site's location, the development's footprint, and the positioning of essential components.

Appendix B:

Electricity Generation Capacity

Planning applications for commercial-scale solar development must include the following information. Although the National Planning Policy Framework indicates that local authorities should not mandate applicants for energy developments to demonstrate the overall necessity for renewable or low carbon energy, and acknowledges that small-scale projects significantly contribute to reducing greenhouse gas emissions, this is regarded as pertinent background information.

Observations:

- a. Installed capacity refers to the maximum continuous output rating of generating equipment under conditions specified by the manufacturer. This refers to the power produced when the machine operates at maximum capacity.
- b. The capacity factor is a calculated metric that compares a facility's actual production over a certain period with the theoretical output had the plant operated at full capacity throughout that time frame. The capacity factor must consider the particular equipment and the specific site. It is articulated as a percentage.
- c. Projected yearly power generation based on installed capacity and capacity factor.
- d. The quantity of residential properties that could be supplied with energy based on the projected annual output,

Appendix C:

Overview of EIA Screening Procedures

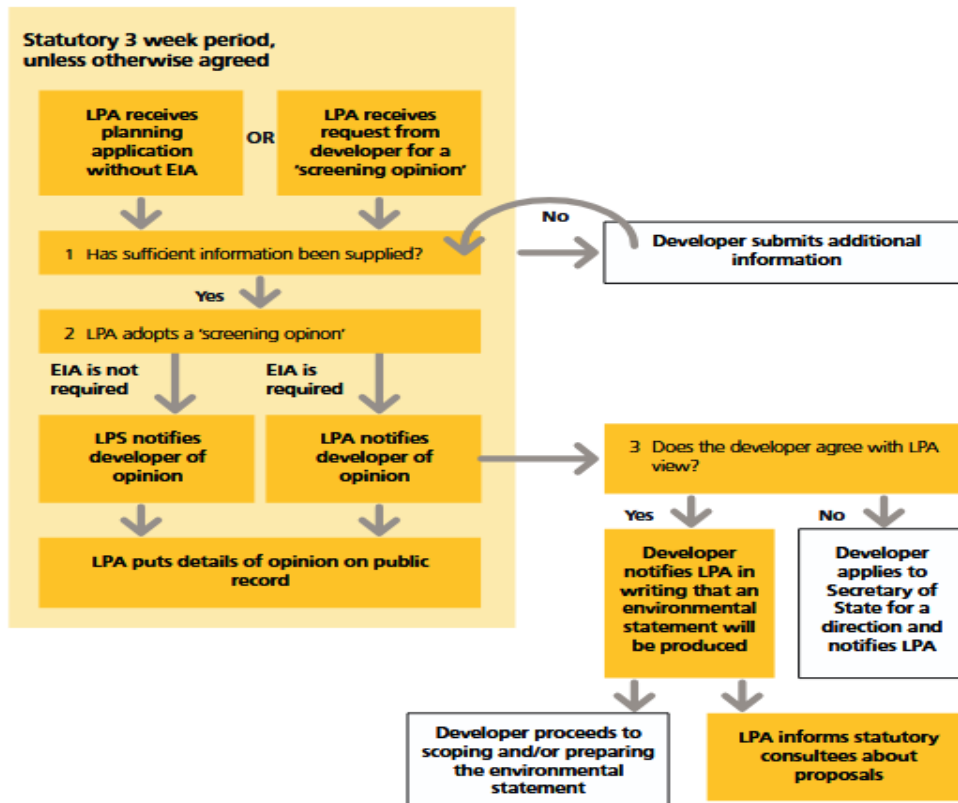


Figure 3. Flow chart 1: Screening procedures overview

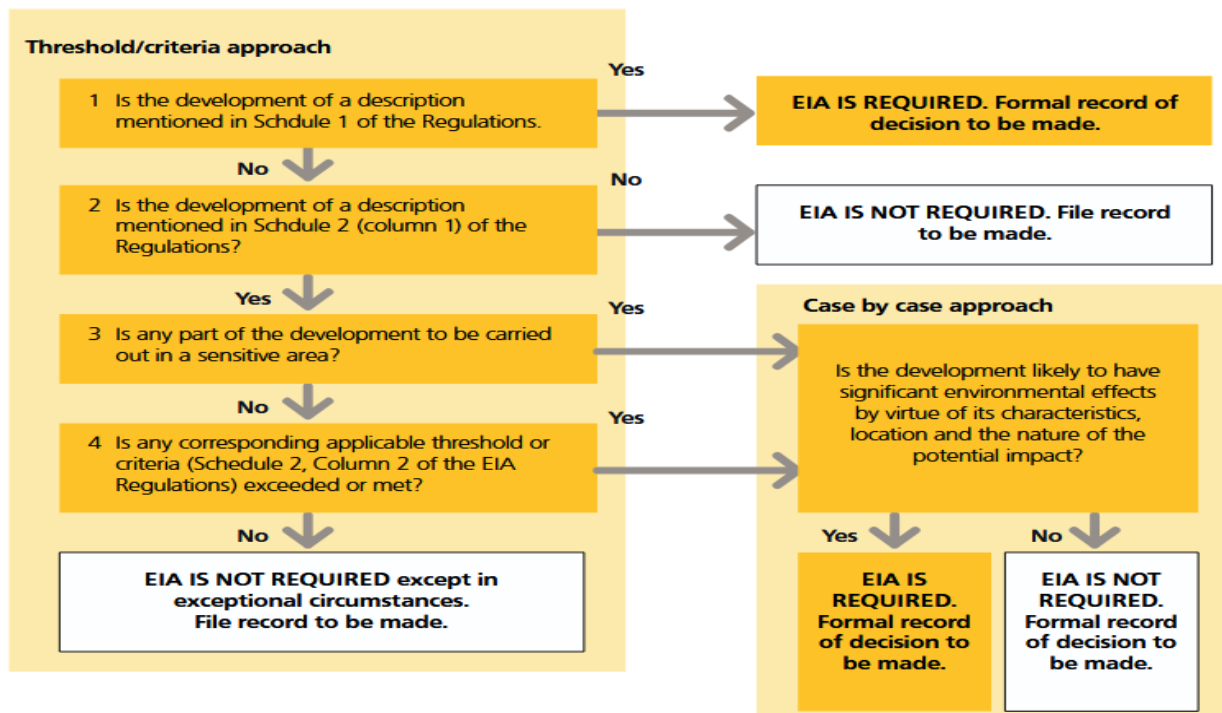


Figure 4. Flow chart 2: The screening decision

