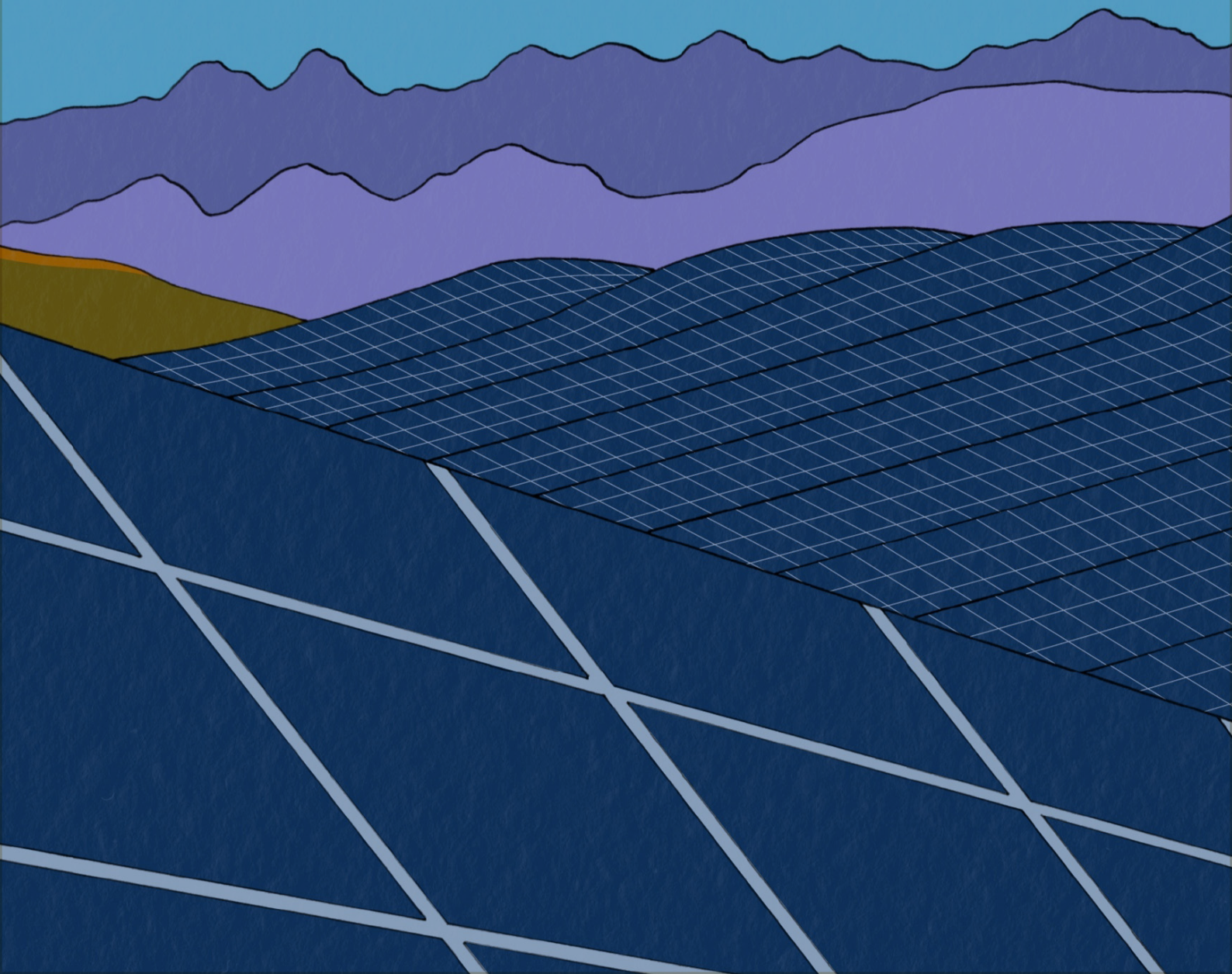
The CAREsolar handbook

A practical guide for supporting socially acceptable solar photovoltaic parks



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Introduction

Driven by the construction of new large solar power plants, recent years have seen a boom in solar PV energy, with global capacity tripling between 2018 and 2023. In 2025, renewables overtook coal as the world's leading source of electricity, and this is driven by the rapid expansion of large-scale solar PV plants, with solar now the cheapest energy source ever. And by the end of this decade, solar is set to become the largest renewable energy source, surpassing both wind and hydropower [1].

The growing number and scale of solar projects are raising concerns about their socio-ecological impacts and fairness. Conflicts and injustices at deployment sites are becoming more frequent, challenging long-held assumptions about solar energy's public acceptability [2]. While social sciences research on people's responses to renewable energy has traditionally focused on other technologies, there is a growing body examining people's responses to large-scale solar plants.

Box 1. What do we mean by "large-scale solar"?

When we talk about large-scale solar in this handbook, we mean ground-mounted photovoltaic (PV) power plants that produce electricity at a utility scale. These projects usually range from several megawatts (MW) to hundreds of MW in capacity and are designed to feed electricity directly into the grid, rather than serving a single household, building or community.

Large-scale solar is different from rooftop solar or community-scale projects, which are typically smaller, more locally owned, and directly linked to end-users. Because of their size, land requirements, and visibility, utility-scale solar plants often raise unique challenges around land use, environmental impacts, and community acceptance – issues at the heart of this handbook.

Many scholars are focusing on potential solutions to the challenges around community acceptance and the multiple economic, environmental, social and political impacts that large-scale solar plants produce. These studies suggest that certain socio-technical innovations can help bridge gaps between planners, developers and communities, with the aim of fostering more sustainable and equitable deployment of large-scale solar.

This handbook provides an overview of the key innovations that are reshaping how we think about site selection; project design; and business models for large-scale solar projects and how principles of *energy justice* (see Box 2) can be integrated in them. First, we address issues of spatial planning, showing how site evaluation and decision-making can be improved by mobilising local knowledge in geographic information systems (GIS). Second, we show how principles of energy justice can be integrated in the project design stage of development and how stakeholders can co-create sustainable energy landscapes. Third, we provide an overview of the concept and practice of "agrivoltaics" and show how it can potentially help in some contexts to partially overcome land-use conflicts, particularly those between agriculture and large-scale solar.

the CAREsolar project

The social sciences have long studied the social dynamics around the deployment of large-scale renewable energy generation and associated infrastructures, like high voltage power lines, offering different frameworks for understanding public acceptance. Early explanations often relied on the idea of NIMBY ("Not in My Backyard"[1]), but recent research shows that opposition is more complex, often resulting from top-down, technocratic decisions that are unjust for the territories where infrastructures are located. Concerns about the transparency and participatory nature of decision-making; who gains and who loses; and broader justice-related issues play a major role in shaping public responses.

Despite this growing body of knowledge, it remains difficult to translate research insights into practical guidance for specific projects. Much of the earlier work has also focused on wind energy, meaning that large-scale solar has received less attention. The CAREsolar project set out to close this gap. Its main goal was to create an updated framework for understanding and co-constructing, between communities, developers and other stakeholders,

1 NIMBY (Not In My Backyard) is a concept used in the study of social acceptance of renewable energy technologies to explain the perceived tension between general support for renewables, such as wind energy, and opposition to specific local projects. It is often used to suggest that negative attitudes arise from physical proximity or from the visible and technical features of developments, such as installation size, appearance, or location. However, this interpretation has been widely critiqued for oversimplifying public responses and lacking strong empirical support. Devine-Wright [93] argues that local attitudes are not simply selfish or proximity-based, but reflect a diverse set of socially constructed meanings, values, and emotional responses, as well as concerns about fairness, participation, and decision-making processes – emphasizing that how projects are developed can matter as much as what is built.

community acceptance of solar plants – one that supports socially equitable and environmentally sustainable energy transitions.

To achieve this, we carried out two activities:

A systematic review of 255 scientific publications on the social dimensions of large-scale solar PV projects, allowing us to develop an integrated conceptual framework and identify best practices and which has been published in the peer-reviewed international academic journal *Energy Reports*. [Available at https://doi.org/10.1016/j.egyr.2025.108988]

A full-day workshop with leading experts and stakeholders on solar energy, hosted by the Swiss Research Foundation for Electricity and Mobile Communication at ETH Zurich on 3 February 2025. The workshop enabled us to share early results, refine our framework, and debate pressing issues in the field.

Together, these activities highlighted both the challenges and the wealth of innovative solutions emerging across different contexts. From agrivoltaics and participatory landscape design to community benefit agreements and participatory GIS, new socio-technical approaches are helping to bridge divides between policymakers, planners, developers, and communities.

During the CAREsolar workshop participants were invited to reflect on the relationships and processes shaping community acceptance and energy justice in large-scale solar deployment.
Diagram courtesy of Susanne Hanger-Kopp.

chapter 1

Why do people oppose large-scale solar projects?

Solar PV projects are essential to decarbonization in current political economies, especially if they are large-scale. Explaining this opposition requires more than a focus on attitudes or values of the public. It also demands attention to the nature of the projects themselves – their size, location, and the wider institutional, cultural, and political contexts in which they unfold. Integrating these dimensions, our systematic review of the social scientific literature on large-scale solar showed that opposition rarely stems from simple "not in my backyard" reactions by host communities. Instead, it reflects deeper questions about energy justice.

Local values, identities, and ways of life are overlooked

Recognition justice highlights how solar development intersects with place-based meanings, cultural identities, and marginalised groups. People's reactions are not only about physical impacts but also about whether their values, livelihoods and attachments to place are respected.

In some areas, people want solar farms to be farther away, especially if the land has high ecological value. For example, research from California, USA, found that residents preferred greater distance between solar projects and wildlife areas than between solar and homes [3].

Box 2. Energy justice

Energy justice is a framework for evaluating how energy systems affect people and communities, focusing on fairness in recognition, outcomes and processes. It is often described through four dimensions:

- Recognition justice: the acknowledgement and respect of the diverse groups and communities affected by energy infrastructures, and the associated identities, values, and knowledge systems, particularly those of marginalized or vulnerable groups.
- Distributive justice: the fair allocation of benefits and burdens, including who gains from renewable projects and who bears costs such as land-use change or environmental impacts.
- Procedural justice: the fairness of decision-making processes, emphasising transparency, accountability, and meaningful participation.
- Restorative justice: the responsibility to repair harm caused by past or present energy systems, whether through compensation or other mechanisms that address historical inequities, such as between rural (where most large-scale solar is deployed) and urban areas.

Practitioners often apply a set of guiding principles – such as availability, affordability, sustainability, transparency, due process, accountability, and responsibility – to help translate abstract justice concepts into concrete project design and policy measures.

But in other contexts, the opposite is true. In Australia's Northern Territory – home to the world's largest solar farm – people living closest to the project expressed the strongest support and feelings of pride, hope, and trust in the developer [4]. This shows that proximity alone doesn't determine public opinion. What matters is how people relate to the project and the place it's in.

People also respond differently to different sizes of solar projects. Earlier surveys didn't always separate large-scale solar from smaller rooftop or community-based installations [5]. But more recent studies show that as project size increases, public support often decreases, especially when the project has a big visual footprint or causes emotional reactions tied to land use [6]. However, the relationship isn't black and white. Many communities support medium-sized projects, especially when they're built on land that isn't environmentally sensitive [7, 8]. This highlights the importance of recognising local context. What makes sense in one area might not be accepted in another.

People's views about solar projects are also shaped by how they feel about the landscape and their connection to place and this is deeply shaped by historical and socio-cultural context. In Italy, one study has shown how debates revolve around heritage landscapes and rural traditions [9 , 10]. In the Czech Republic, another study suggested that they echo collective memories of forced land use [11]. In Greece and Spain, scholars describe opposition as rooted in narratives of foreign domination and marginalization, with solar projects framed as a new form of "green" or "energy colonialism" [12, 13]. In former coal regions in the United States, by contrast, solar projects are welcomed when they symbolically and materially support a new local identity beyond fossil fuels [14, 15].

Recognition also matters for livelihoods and social hierarchies. Large-scale projects can exacerbate inequality by undermining landless labour or by reinforcing patterns of exclusion based on class, race, or gender [16, 17]. When communities feel that their cultural identity, knowledge systems, or historical experiences are ignored – or instrumentalized through tokenistic consultation – they are more likely to mobilize in opposition [18, 19]. Conversely, projects that align with local values and empower marginalized groups can generate pride and support [20]. This highlights the importance of always conducting thorough local stakeholders' mappings, that help the identification of all the affected communities that need to be engaged and have a voice in the decision-making processes [21].

Decisions are made without meaningful local involvement

Procedural justice concerns the fairness and inclusivity of decision-making processes. At the planning and permitting stage, decisions about the location of large-scale solar projects are usually based on technical and environmental factors, such as how much sunlight a place receives or how close it is to the electricity grid. However, another crucial aspect is how planning authorities assess the social and environmental impacts of these projects. This process can look very different depending on the political and cultural context, as highlighted above. In the United Kingdom, for instance, where there was considerable controversy about the development of wind energy projects in rural areas through the 2010s, planning regulations under the Conservative government restricted solar development on "prime agricultural land" [22, 23].

Government agencies – especially environmental authorities – often have the final say on whether a project is approved. Public participation is another important part of this process, and it can significantly influence the outcome. But in practice, these systems often give more power to developers and technical experts than to local communities [24, 25]. Developers sometimes even avoid engaging with the public, fearing that it might lead to delays or opposition [26].

This can produce a sense of exclusion and further entrench socio-economic hierarchies. In many cases, political decisions that were made without local input have led to widespread public backlash against renewable energy projects [27, 28]. Conflicts also emerge when communities perceive consultation as superficial or manipulative. Terms like "consent" and "participation" can be used rhetorically to legitimize projects rather than to share decision-making power [18]. Elsewhere, developers respond to resistance with corporate social responsibility initiatives or minor design tweaks that deflect attention from deeper issues of accountability [29]. These practices may calm immediate dissent but rarely address the roots of conflict.

Too often, public participation is treated as a box-ticking exercise – either as a way to speed up approval or to prevent opposition. But genuine participation must go beyond simply sharing information. It means giving communities a real voice in decisions about where projects are located, how projects are designed, and who benefits from them and how. Instead of treating local engagement as an obstacle, decision-makers and developers should view it as a central part of building successful and fair energy systems [30].

Box 3. Tensions between energy justice and community acceptance

The CAREsolar workshop opened with a critical discussion on the relationship between *energy justice and social acceptance*. These concepts can sometimes pull in different directions – in ethics, goals, and theories of change – not only in project development, but also in research and policymaking.

One group reflected on these tensions by comparing experiences from Switzerland and Portugal. "*We live in different worlds. If you implemented such a project [in Switzerland] the way it's done in Portugal, there would be a national outcry. The way things are done in Portugal feels like the Wild West*".

Others questioned whether the concepts themselves were adequate: "*Energy justice is part of the community acceptance equation, but the concepts aren't robust enough to capture the broader complexities.*"

These reflections underscored one of the workshop's central insights: institutional dynamics – how projects are governed, planned, and regulated – are crucial in shaping both community acceptance and justice outcomes. Recognising these tensions is therefore essential for designing fairer and more durable solar transitions.

Trust in political institutions further shapes acceptance. In Portugal, for instance, systemic energy poverty and low institutional trust are increasingly feeding scepticism about the energy transition, whereas in the United States partisan political divides influence views of renewable energy and rural communities often frame large-scale solar plants as the imposition of an urban elite [31, 32]. Where planning frameworks lack transparency or fail to balance national goals with local concerns, opposition can escalate, undermining trust not only in developers but in climate policy more broadly [33]. A key policy challenge is therefore to design planning systems that are more transparent and better able to balance local concerns with national or global energy goals and ecological limits.

Benefits and burdens are unevenly shared

The distributive dimension of justice concerns how the benefits and burdens of solar development are shared. A major factor in responses to renewable energy is how people understand these benefits and burdens. Support tends to increase when people see clear local benefits like jobs, tax revenues, or lower electricity bills [34]. But when people worry about risks – such as health impacts, loss of farmland, or damage to tourism – opposition tends to grow.

One of the main issues is that solar projects require vast areas of land, often leading to competition with farming, ecological systems and biodiversity conservation, or other local uses [37]. In some contexts, land is leased from private owners, generating new income streams, but this can fuel tensions with neighbours who see little benefit. Also, increasingly governments acquire land from rural or Indigenous communities through top-down authoritarian processes that disrupt collective tenure systems [40, 41]. These practices frequently spark conflict, especially when compensation is inadequate or absent [42].

Economic impacts not only relate to land. Panel cleaning can strain water resources in arid regions, while landscape conversion may affect agriculture, tourism, or property values [43]. Although large-scale solar can create jobs or generate local revenues, these are often minimal and not long-term, with negative impacts often more visible and benefits unevenly distributed. Scholars describe this as a process of enclosure, where resources such as land or water are captured by powerful interests while local communities bear the costs [44].

At the same time, financial policies and market mechanisms have also played a major role in shaping the growth of large-scale solar and the distributive outcomes. To encourage investment, many governments have used tools like subsidies, feed-in tariffs (which guarantee a fixed price for solar electricity), tax credits, and public auctions [45, 46, 47]. These policies have helped make solar energy cheaper and more competitive and help developers reduce risk and plan projects with greater confidence [48, 49].

These institutional drivers often channel opportunities toward large corporate actors rather than initiatives that are community-led or that provide the community with direct economic benefits. This leaves residents near solar farms with little chance to participate directly in, or benefit from, the projects in their community. When people perceive that energy infrastructures are imposed for the benefit of others — for distant cities, industries, or investors — distributive injustice becomes a driver of opposition [31, 51, 35, 29].

General strategies for supporting just and acceptable solar projects

Solar projects are more likely to gain acceptance when they are designed and implemented with fairness, transparency, and local benefit in mind. Four strategies are particularly important:

1. Strengthen engagement

Engage early, often, and face-to-face. Move beyond minimum requirements by offering site visits, visualisations, open discussions, and ongoing opportunities for residents to influence project location, design and operation. Such approaches not only reduce misinformation but also signal that residents have a meaningful role.

2. Work with trusted intermediaries

Partner with respected local individuals or organisations who can act as liaisons between developers, officials, and residents. These intermediaries help build trust, translate concerns, and ensure community voices are heard. Importantly, these roles are most effective when initiated by or closely aligned with community members, ensuring that the process enhances equity rather than reproducing top-down control.

3. Communicate trade-offs clearly

Be transparent about both the benefits and the burdens of solar projects. Explain design choices, land use implications, and potential visual impacts in plain language. People often want to know the relationships between cause and effect. Especially when it comes to often ignored infrastructural elements of a large-scale solar project, such as power lines. Inviting residents from communities with existing solar projects to share their experiences can help ground these discussions in real-world outcomes. A study by Bessette et al (2024) showed how this strategy successively communicated to opponents “the opportunity costs of decisions that in the short-term may be seen as victories for residents but later may generate regret” [26]. They give the example of increasing setback distances that ultimately resulted in land that was neither being farmed nor generating electricity. In sum, by addressing both benefits and burdens, developers can foster informed dialogue, build trust and reduce the spread of rumours or misconceptions.

4. Deliver meaningful local benefits

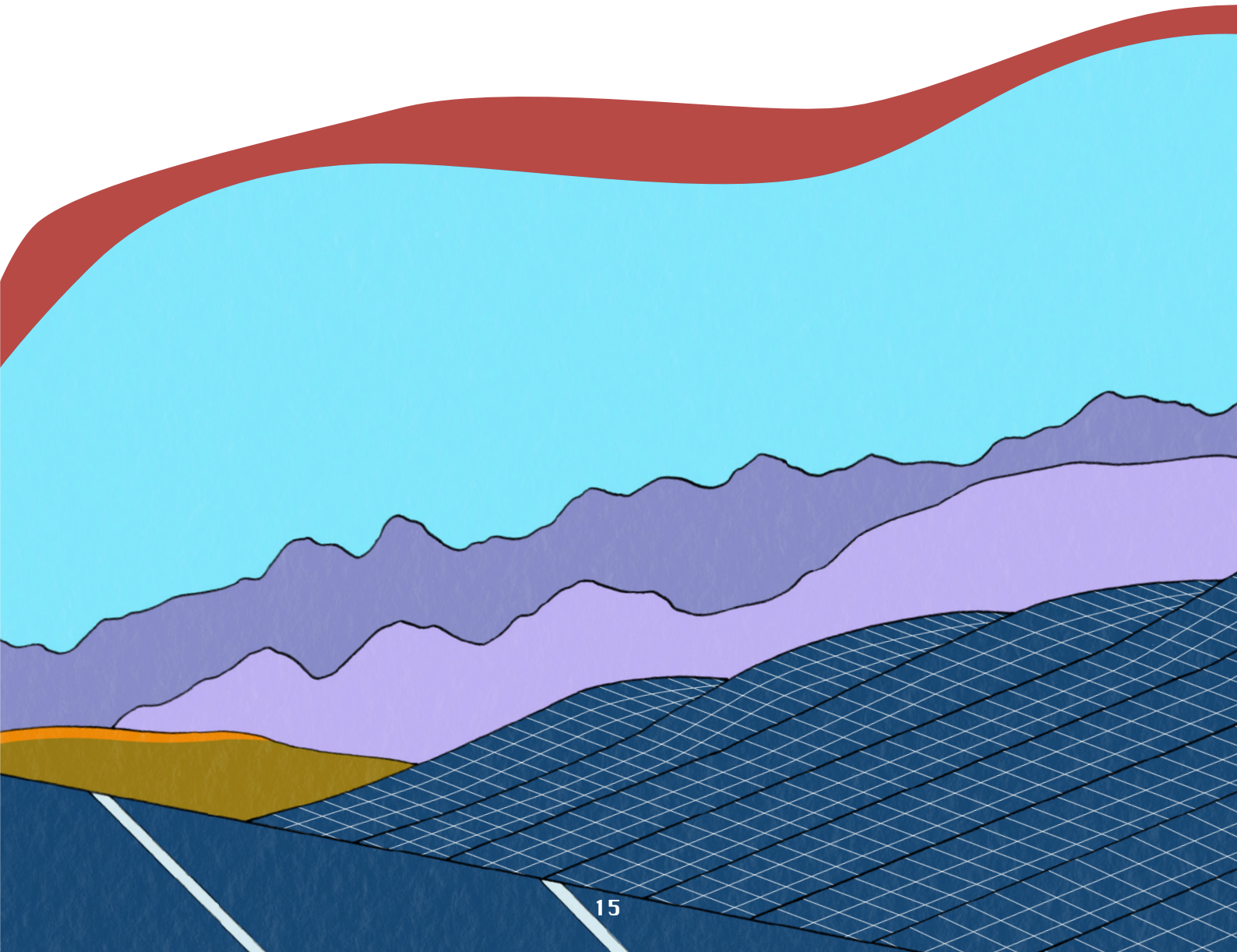
Ensure host communities see direct, lasting advantages. This may include jobs, contracts for local businesses, community subscriptions, or benefit agreements that provide tangible financial and social returns. It is important that these benefits are not viewed as temporary or as “bribes”. Payments to landowners or even local authorities run the risk of not generating actual benefits for local people. Local economic benefits must be both meaningful and institutionalised.

By following these strategies, projects can move beyond simple “acceptance” toward building relationships of trust and delivering genuine value to the communities that host them.

Socio-technical innovations for addressing solar energy injustices

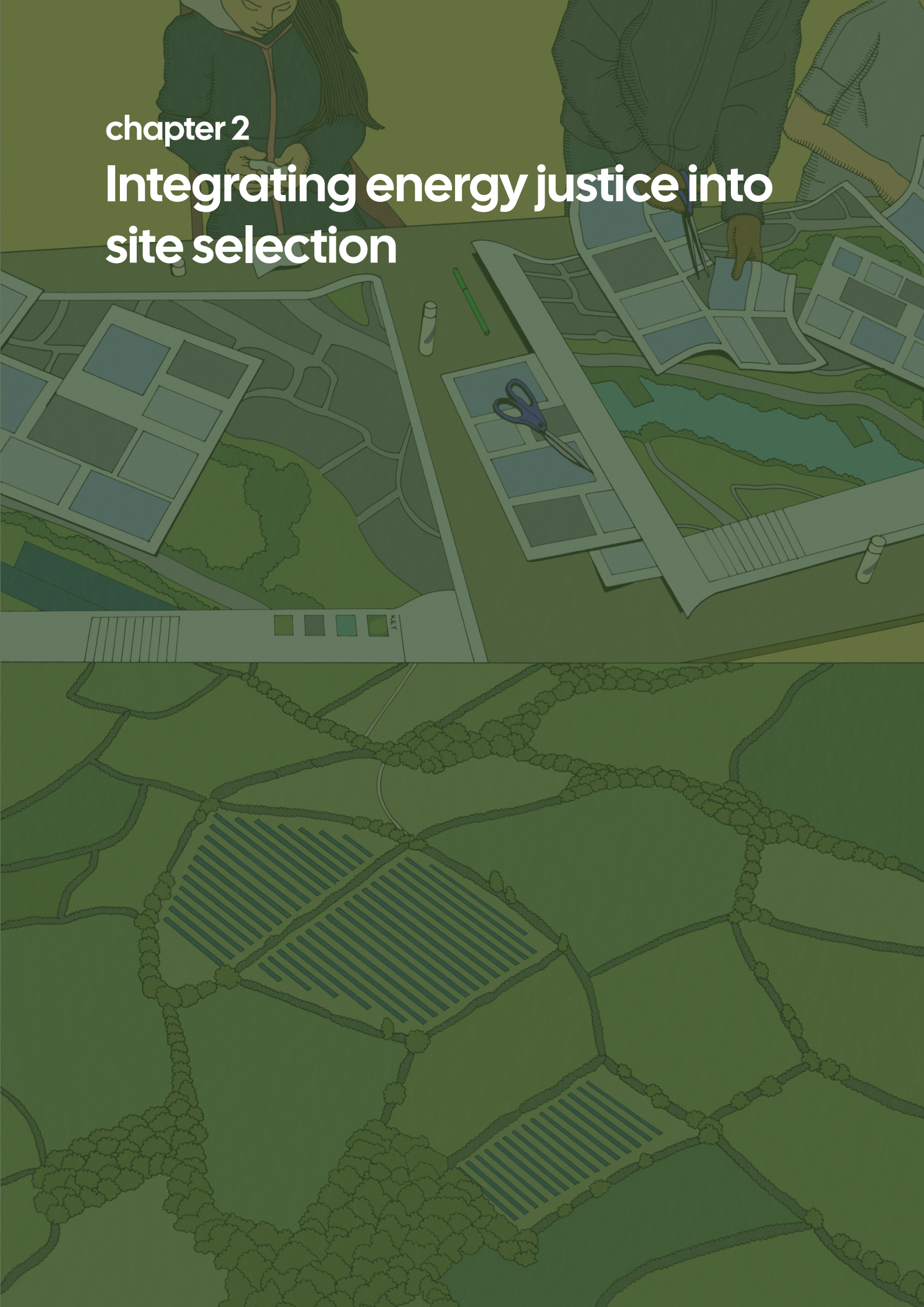
In addition to these general strategies, our review revealed that there is a significant stream of literature focusing on analysing or proposing specific innovative solutions to improve community acceptance, energy justice and the multiple economic, environmental, social and political impacts that large-scale solar plants produce. These studies suggest that innovative solutions can help bridge gaps between planning authorities, developers and communities, with the aim of fostering more sustainable and equitable deployment of solar plants.

There are three areas where various initiatives are proposed and analysed. First, there are those which address issues of site selection, aiming to improve mapping, site evaluation and decision-making by using geographic information systems (GIS) which mobilises local knowledge and values. Second, there are several studies that examine innovative ways to involve residents in project design. Third, there is a growing literature on the concept of "agrivoltaics" as a solution for tensions between agriculture and large-scale solar. However, each of these solutions have their own challenges and limitations, and it is important that initiatives to include communities in spatial planning and development have mechanisms in place to ensure that they do what they promise to do.



chapter 2

Integrating energy justice into site selection



Identifying suitable land for renewable energy development is one of the central challenges of the energy transition. Site selection must balance technical feasibility and economic efficiency with the protection of ecological systems and the well-being of local communities. In practice, conventional siting approaches tend to prioritise areas with high development potential, which often leads to projects being located on land that conflicts with local interests, ecological systems, or existing land uses.

To manage this complexity, developers and planning authorities increasingly rely on geographic information systems combined with multi-criteria decision analysis frameworks (see Box 4). GIS–MCDA tools integrate spatial datasets such as solar irradiation, slope, grid proximity, and land use to identify technically and economically suitable locations for large-scale renewable energy projects. More recent approaches have expanded these criteria to include ecological and cultural information, such as habitats, protected areas, and proximity to cultural heritage sites [52, 53, 54].

Despite these advances, GIS–MCDA tools have done little to prevent siting conflicts. One reason is that they tend to overlook fine-grained, locally specific social factors that are difficult to quantify, dynamic over time, and embedded in lived experience. These social dimensions not only shape community responses to renewable energy projects but also influence how environmental and economic trade-offs are perceived and negotiated.

Box 4. Geographic Information Systems and Multi-Criteria Decision Analysis

Geographic Information Systems (GIS) are powerful tools for mapping and visualizing spatial data, such as land use, terrain, and environmental constraints. However, maps alone do not determine which sites are best suited for renewable energy projects. This is where Multi-Criteria Decision Analysis (MCDA) comes in.

MCDA provides a structured way to compare and weigh different—often competing—factors that influence site suitability, such as sunlight exposure, proximity to infrastructure, land cost, biodiversity, and social acceptance. It translates complex information into an organized framework that helps decision-makers evaluate trade-offs transparently.

Because the process relies on assigning relative importance (or “weights”) to each criterion, MCDA combines both quantitative data and qualitative judgments from experts, planners, and sometimes community members. There is rarely a single “correct” answer; instead, MCDA helps identify a range of reasonable options that best fit local priorities and values.

In renewable energy planning, GIS and MCDA are often used together to visualize these trade-offs in maps that highlight more or less suitable areas. When designed well, GIS–MCDA tools can make planning more transparent and participatory, supporting decisions that balance technical feasibility, environmental protection, and community concerns.

Attempts to address this gap have led many studies to incorporate variables such as population density, distance from settlements, or generalised attitudes toward renewables. However, such approaches risk reproducing historical inequalities if they are not grounded in justice principles. As Sward and colleagues [55] warn, areas characterised by lower income, weaker institutions, or limited political capital may appear more suitable simply because opposition is less organised or land is cheaper. In these cases, social data function as proxies for vulnerability rather than indicators of acceptability [55].

An energy justice perspective helps to make these limitations visible. It highlights that siting practices are never neutral and often rest on implicit assumptions about whose interests matter, what counts as relevant knowledge, and how fairness is understood. Integrating justice into site selection therefore requires more than adding new variables to spatial models. It requires rethinking how spatial planning tools are designed, used, and governed. This chapter explores how recognition, procedural and distributive justice can guide more inclusive and legitimate approaches to renewable energy siting.

Recognising socially meaningful places in site selection

In the context of renewable energy planning, the concept of recognition justice highlights that injustices often stem not only from unequal distributions of benefits and burdens, but from the systematic misrecognition, stereotyping, or exclusion of particular social groups – such as rural residents, Indigenous communities, or land-based professions whose relationships with place differ from those assumed in technocratic planning models. Misrecognition can take many forms: framing local opposition as irrational “NIMBYism”, discounting cultural or affective attachments to land, or privileging expert or market logics over lived experience and cultural meaning.

GIS–MCDA frameworks are particularly prone to recognition deficits because spatial data are inherently reductive. Landscapes are represented through abstract variables such as slope, irradiation, or land use, while cultural meanings, symbolic places, and lived attachments and practices remain invisible. Communities whose values cannot easily be translated into quantitative indicators risk being marginalised from spatial decision-making processes.

Integrating recognition justice into site selection therefore requires expanding both the data inputs and the epistemic assumptions of GIS-based methods. One entry point is participatory and qualitative GIS, which allows communities to map places of cultural significance, heritage viewsheds, or areas central to local identity. Another is pluralising knowledge sources by combining expert datasets with community-generated or ethnographic information. In recognition-oriented approaches, local knowledge shapes not only validation but the structure of criteria, thresholds, and priorities within the model.

Recognition justice also involves reflexivity. How siting problems are framed – whether in terms of cost efficiency, environmental impacts, or social acceptance – determines whose knowledge is prioritised and legitimised. From this perspective GIS–MCDA can be treated as a device for mediating between different epistemic communities. This reframing shifts the emphasis from identifying "optimal sites" to co-producing siting rationales that are socially intelligible and contestable.

Without recognition, participatory processes risk becoming tokenistic and distributive analyses risk perpetuating inequities by misrepresenting who matters and what matters to affected groups. When recognition is integrated, spatial planning can avoid technically suitable but socially disruptive sites and produce outcomes that better align with lived experience and symbolic geographies of energy transitions.

Addressing the spatial distribution of costs and benefits

Distributive justice in renewable energy siting concerns how the benefits and burdens of development are distributed across space, between people, communities, and regions. In the context of GIS–MCDA, it asks not only where projects *can* be built, but where they *should* be built. This spatial perspective emphasises that siting choices are not simply technical optimisations but moral and political decisions that shape who gains and who bears the costs of large-scale solar.

Spatial distributive justice thus reframes GIS–MCDA as a *normative* rather than merely descriptive exercise: one that makes explicit whose interests are represented, which impacts are valued, and according to what principles benefits and burdens are allocated. Lehmann and colleagues [56] state that a distributive justice-oriented approach to spatial planning for large-scale renewable energy technologies requires asking three sets of questions:

1. Who are the recipients of spatial distibutive justice?

What are the spatial entities between which local benefits and burdens of RES infrastrictures are distributed (individuals vs. territorial communities)?

What is the spatial scale at which spatial entities are compared (local vs. regional vs. national vs. supra-national)?

2. Which local benefits and burdens are to be distributed in space?

Whis RES infrastructures are considered?
Which types of local benefits and burdens of siting RES infrastructures are considered?

Which metric is used to measure and aggregate local benefits and burdens (direct measures or proxies like installed capacity, land areas orccupied)?

3. What is the principle of spatial distributive justice?

Which principle of distributive justice is applied?

Which operationalization is chosen for the principle of distributive justice?

Thus, integrating spatial distributive justice into GIS-MCDA frameworks requires clarifying who counts as a recipient of justice, what benefits and burdens are being distributed, and according to which principles distributive fairness is defined.

Recipients may be understood as individuals – residents directly affected by visual impacts or loss of income – or as collective territorial entities such as municipalities or regions that gain revenues or infrastructure. Analyses focusing on individuals reveal detailed inequalities but require granular data rarely available at national scales, while assessments between territorial units better align with governance and data structures but risk concealing internal disparities.

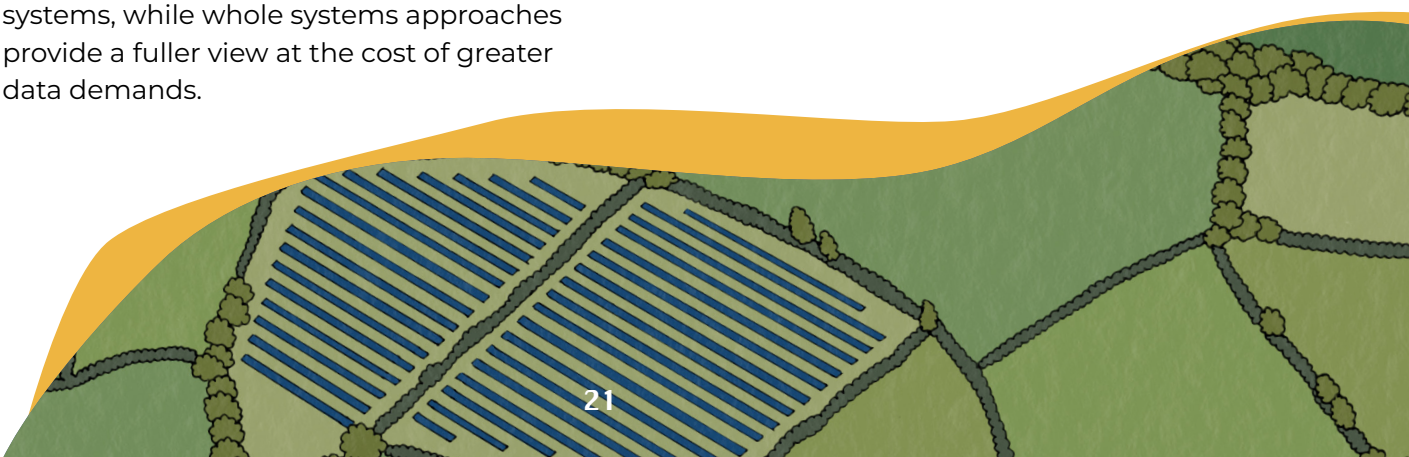
Scale further complicates matters: local studies highlight concentrated project-level injustices, whereas national or supranational assessments capture broader regional patterns but may obscure localised harm. Multi-scalar approaches are therefore needed to situate local effects within wider spatial distributions of costs and benefits.

Renewable energy deployment can produce both benefits – such as employment, local socio-economic, tax income, and improved infrastructure – and burdens, including ecological disturbance, land-use change, and aesthetic or cultural loss. These accrue differently depending on ownership models, fiscal regimes, and local governance capacities. Determining the analytical scope is crucial: focusing on a single technology simplifies modelling but may miss cumulative effects across energy systems, while whole systems approaches provide a fuller view at the cost of greater data demands.

Measuring distributive outcomes also presents challenges. Although direct indicators like tax flows or job creation would best represent impacts, they are seldom available consistently across regions. Consequently, studies often rely on proxies such as installed capacity or occupied area, which enable mapping but risk oversimplifying social realities. Similarly, assigning weights and monetising qualitative criteria and non-market impacts like ecological, landscape or heritage loss can raise community concerns about what is being sacrificed in reductive technical analyses. This points towards how distributive justice assessments need to be integrated with considerations of procedural and recognition justice.

Three normative principles guide ideas of fair spatial distribution. A basic-needs approach emphasises minimum protection, ensuring no community bears undue burdens or lacks essential benefits, though it may constrain efficiency. Equality seeks uniform outcomes – equal access to benefits or exposure to harms – but can conflict with the uneven geography of renewable resources. Equity introduces proportional fairness, distributing benefits and burdens according to need, ability, or consumption, and underpins differentiated planning and compensation schemes. Yet the flexibility of equity also introduces ambiguity, as different proportionality rules yield divergent conclusions.

Across these principles, an essential requirement is normative transparency: clearly articulating whose justice is being pursued, by what criteria, and at what scale [56].



Embedding participation in site selection processes

In renewable energy siting, procedural justice concerns whether affected communities are genuinely involved in shaping how spatial assessments are conducted and how their results inform policy decisions. Historically, most GIS–MCDA tools have been expert-driven, relying on datasets, criteria, and weights defined by planners, engineers, or consultants. While these tools aim to increase objectivity and efficiency, they often reinforce technocratic decision-making by excluding local forms of knowledge.

This exclusion can undermine trust and legitimacy, particularly when communities perceive siting decisions as imposed from above. When residents encounter spatial models only at the end of the process, they have little opportunity to question assumptions, challenge trade-offs, or influence outcomes. Procedural injustice thus arises not from the use of modelling per se, but from how modelling processes are insulated from democratic engagement [57].

Participatory GIS approaches directly address these shortcomings by embedding participation within the analytical process itself. Public Participation Geographic Information Systems allow communities, stakeholders, and decision-makers to co-produce the data layers that inform spatial suitability analyses. Participation becomes a method of knowledge production rather than a post hoc consultation exercise.

Through workshops, participatory mapping, and iterative scenario development, participatory GIS transforms GIS–MCDA into a platform for dialogue and negotiation (see Box 4). Participants can define criteria, explore alternative weightings, and visualise how different values or land-use priorities alter spatial outcomes. This enhances transparency and enables mutual learning, as communities gain insight into technical constraints while planners better understand local priorities.

Integrating procedural justice in this way does not guarantee consensus, but it can produce decisions that are perceived as more legitimate and accountable. By opening the “black box” of spatial modelling, participatory GIS helps align site selection with democratic principles and supports longer-term acceptance of renewable energy projects.

Box 5. The public participation GIS scenario approach to large-scale solar siting

Rösch and Fakharizadehshirazi [57] developed a participatory GIS–MCDA process to guide local decisions on large-scale solar energy siting. Their PPGIS scenario approach integrated technical modelling with structured community engagement, producing both spatial insights and governance benefits.

The process began with goal setting and scoping in collaboration with municipal authorities to ensure political and institutional buy-in. A social site characterisation identified relevant stakeholder groups — including farmers, conservationists, administrators, and local citizens — whose knowledge and concerns would shape subsequent analyses.

Two participatory workshops formed the backbone of the approach:

> **Workshop 1:** Participants collectively defined, clustered, and weighted land-use restrictions and suitability criteria, addressing issues such as soil protection, biodiversity, and visual landscape quality. These criteria were then formalised into GIS models and combined using the Analytic Hierarchy Process (AHP) and sensitivity analysis to create multiple land-use scenarios.
>
> **Workshop 2:** Ten representative scenarios were reviewed, debated, and refined. Participants assessed trade-offs and feasibility, exploring how different weighting of criteria affected outcomes.

This iterative dialogue turned the GIS model into a shared decision-support platform, fostering learning, negotiation, and trust among participants. The resulting maps highlighted sites with broad consensus — such as car parks, brownfields, and transport corridors — while deprioritising areas of high ecological or agricultural value.

Beyond spatial outputs, the project yielded institutional outcomes: the municipality retained the PPGIS tool and datasets for future use, embedding participatory decision-making within its planning practice.

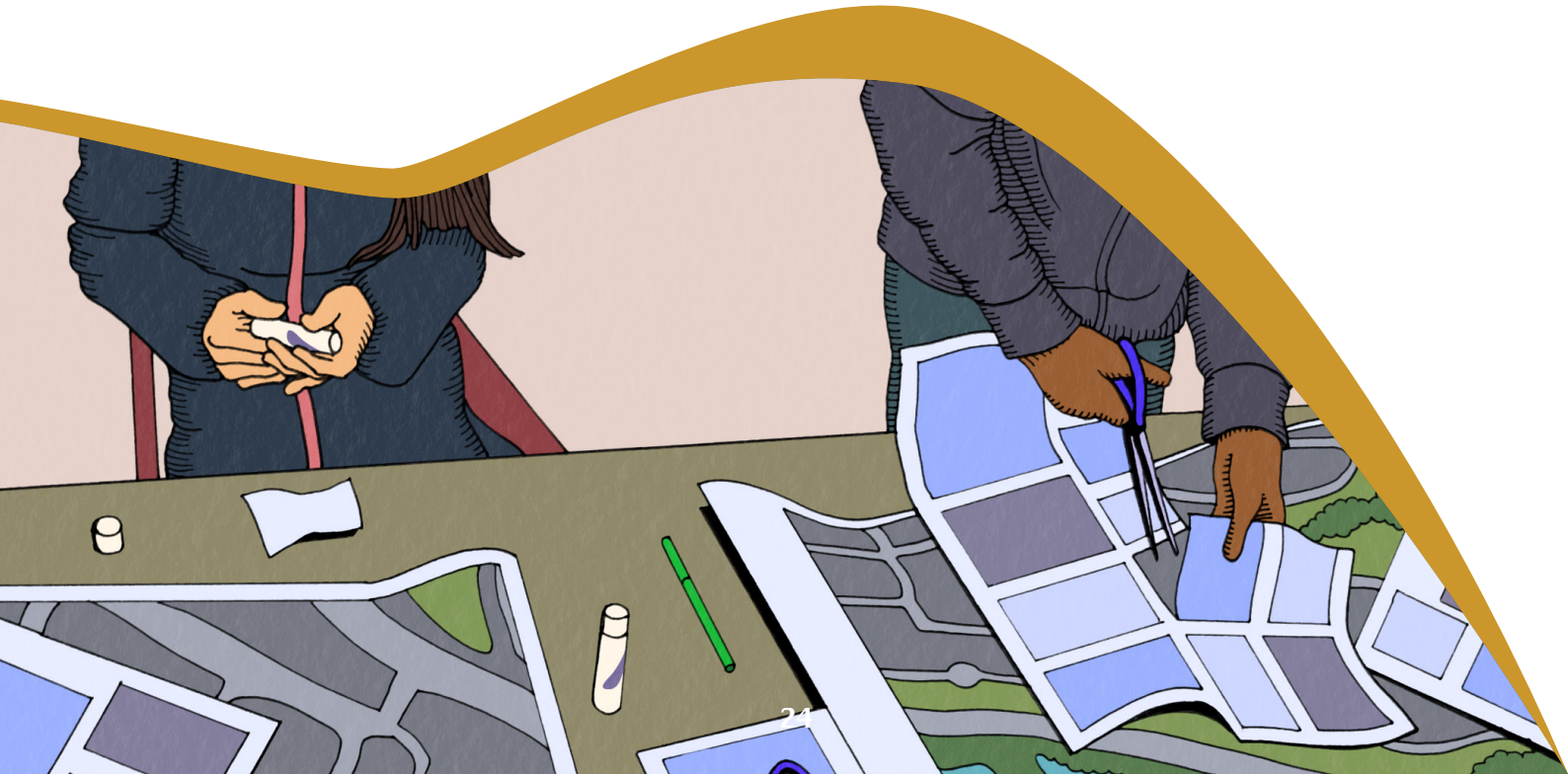
The novelty of the approach lies in its transdisciplinary design — merging technical precision with participatory governance. By embedding community values directly within spatial analysis, the PPGIS scenario method bridges the gap between scientific assessment and democratic legitimacy, offering a replicable model for socially robust renewable energy siting.

Conclusion

Integrating energy justice into renewable energy site selection requires a fundamental shift in how spatial planning tools are understood and used. GIS–MCDA frameworks are powerful, but they are not neutral. They encode assumptions about value, knowledge, and fairness that shape where renewable energy is developed and how its impacts are distributed.

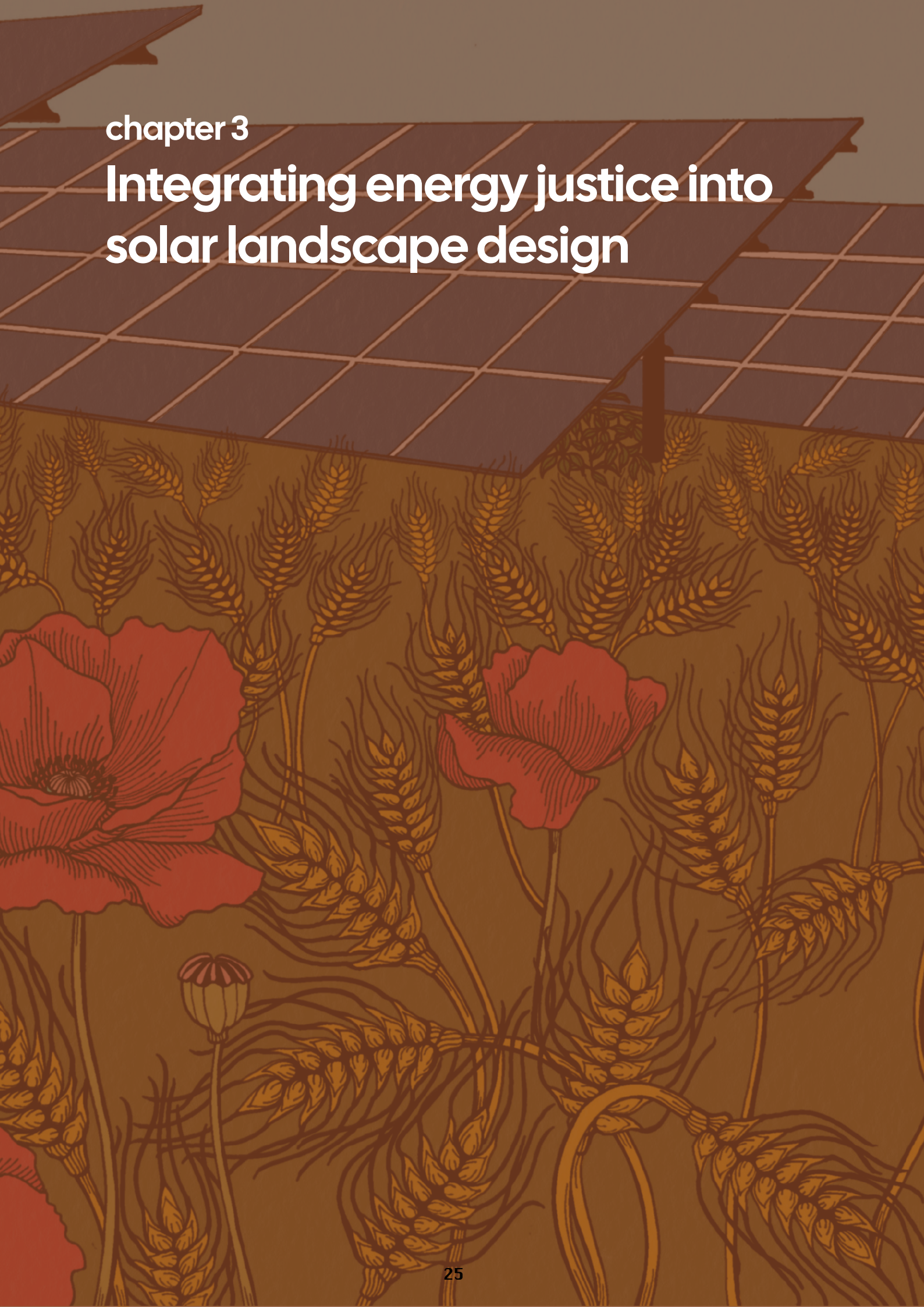
Procedural justice calls for opening spatial modelling to meaningful participation and democratic scrutiny. Distributive justice requires transparency about who benefits and who bears the costs, at what scale, and according to which principles. Recognition justice demands that territories be understood not as empty spaces but as ecologically, socially and culturally meaningful places.

Together, these perspectives show that socially just siting is not achieved by adding more data alone. It depends on reconfiguring site selection as a deliberative, reflexive, and inclusive process. When GIS–MCDA tools are embedded within such frameworks, they can support renewable energy deployment that is not only efficient, but also more legitimate and aligned with the diverse realities of energy landscapes.



chapter 3

Integrating energy justice into solar landscape design



Large-scale solar power plants are increasingly reshaping rural and peri-urban landscapes. While solar energy is often assumed to be visually less intrusive than other renewable technologies, a growing body of research shows that people frequently object to the appearance, scale, and spatial footprint of large solar installations, particularly as projects increase in size. Perceptions of landscape change have consistently been shown to influence local acceptance and are often associated with claims of "NIMBYism". However, scholars caution that such reactions should be analysed rather than dismissed, as they frequently reflect legitimate concerns about place, identity, and fairness [58].

These concerns point to a broader understanding of energy infrastructure as part of an energy landscape, where technical systems intersect with ecological processes, social practices, and cultural meanings. From this perspective, the design of solar power plants is not merely a technical optimisation exercise but a spatial and social intervention. Several scholars argue that landscape design has been insufficiently integrated into solar development, despite its potential to shape public perceptions and outcomes [59].

Participatory approaches to landscape design have emerged as a response to these challenges. Drawing on landscape architecture and environmental planning, they seek to involve local communities directly in shaping how solar power plants look, function, and relate to their surroundings. This chapter examines how participatory landscape design can contribute to procedural, distributive, and recognition dimensions of energy justice.

Recognising place-based values through participatory design

Participatory landscape design is closely linked to recognition justice because large-scale solar projects often affect places with strong cultural, historical, and symbolic significance. Social concerns frequently revolve around place attachment, cultural identity, and the erosion of traditional practices [60, 61, 62, 13].

Co-design processes create opportunities for residents to articulate what matters to them, including emotional ties to land, local ecological knowledge, and collective memories shaped by previous experiences of industrial or environmental change. By explicitly inviting these perspectives into the design process, participatory approaches validate forms of knowledge that are often marginalised in conventional energy planning.

Recognition justice also involves navigating tensions between local values and broader societal concerns. Participatory design can risk prioritising local preferences at the expense of biodiversity goals or climate objectives championed by conservation groups or national planners [63]. Landscape architects can play an important mediating role here by translating different forms of knowledge into shared spatial visions, yet they are often excluded from renewable energy planning processes.

More broadly, participatory landscape design reflects a shift away from framing local resistance as irrational or obstructive. Instead, it recognises community responses as grounded in legitimate concerns about identity, history, and spatial justice. This recognition is essential for building trust and social legitimacy, particularly in contexts shaped by long-standing territorial resentment and historical inequalities [64, 51, 27].

Embedding communities in solar landscape design processes

Procedural justice has been a persistent challenge in large-scale solar development. Project design is typically driven by techno-economic considerations, such as maximising energy output, minimising costs, and meeting grid connection requirements. Local communities usually enter the process late, often through minimal statutory consultation linked to environmental impact assessments, when key design decisions have already been made.

This pattern of exclusion is widely documented. Planning systems frequently privilege technical and expert knowledge over local perspectives, producing what has been described as a "scientific-bureaucratic" model of energy governance [65, 16]. Exclusion is particularly visible in rural contexts, where communities often experience long-standing political and economic marginalisation, intensifying distrust toward developers and planning authorities [31]. Procedural injustice may also arise in subtler forms, such as unresolved stakeholder conflicts or limited engagement that gives the appearance of participation without meaningful influence [66].

Accountability further complicates participation. Large-scale solar projects often involve multiple actors, including developers, utilities, and financial asset managers, making it unclear who is responsible for ensuring meaningful community involvement or sustained engagement over time [16, 67].

Participatory landscape design offers a way to intervene earlier and more substantively in these processes. Rather than engaging communities only after siting and layout decisions are fixed, co-design approaches invite residents to participate in shaping project layouts, identifying sensitive views, proposing mitigation measures, and discussing how solar infrastructure can be integrated into existing land uses. This aligns with insights from landscape architecture, which emphasise the design phase as a critical moment of transition where social, ecological, and technical concerns can be explored together [68].

Box 6. Using a full-scale prototype to enhance participatory solar landscape design

Enserink and colleagues [69] developed an innovative participatory design approach by creating a full-scale prototype of a solar power plant. Rather than relying solely on maps or simulations, this life-sized installation allowed local stakeholders to physically experience what a solar project would look and feel like in their landscape.

The process began by co-designing the prototype with community members. Once built, it allowed participants to directly see the scale, visual impact, and spatial footprint of the planned solar installation.

This hands-on approach fostered deeper understanding. It broke down status-quo bias by letting residents experience the project's potential impacts firsthand, leading to more informed dialogue. It also built trust, as stakeholders felt their input on layout and mitigation measures was grounded in a shared tangible reference.

The result was not just more informed local feedback, but also greater acceptance, as residents saw their concerns addressed through the prototype experience. This case demonstrates that full-scale prototyping can be a powerful tool in participatory landscape design, bridging the gap between abstract planning and lived experience.

Research shows that early participation can positively influence acceptance by increasing perceptions of fairness and enabling residents to experience a sense of agency over changes to their environment. Co-design can also improve design quality by incorporating local knowledge that might otherwise be overlooked, such as informal paths, habitat corridors, or agricultural practices. Visual and experiential tools, including three-dimensional visualisations and full-scale prototypes, can help participants understand complex design proposals and reduce resistance linked to status quo bias (see Box 6).

At the same time, participatory design is not a silver bullet. Its benefits can be undone by decisions taken at other stages of project development, and developers often lack incentives to invest in lengthy and uncertain participatory processes. Policy innovations can help address these challenges by strengthening assessment criteria to include qualitative societal goals, incentivising participatory approaches, and designing engagement processes that allow discussion of both local and broader societal concerns.

Shaping the distribution of impacts through landscape design

Participatory landscape design is not primarily a mechanism for distributive justice, but it can influence how the benefits and burdens of solar development are experienced. Design choices affect who bears visual, ecological, and social impacts, and who benefits from improved landscape quality, ecosystem preservation or restoration, or local amenities. Through co-design, communities can influence layouts, buffers, and mitigation measures that reduce aesthetic and ecological burdens on specific groups or places. Participatory processes can also support the development of multi-functional solar landscapes that combine energy production with biodiversity enhancement, recreation, or continued agricultural use. Such approaches help avoid critical trade-offs between renewable energy provision and other ecosystem critical functions, which is a key condition for sustainable energy landscapes [70].

Participatory design can also play a role in addressing past distributive injustices. In one documented case, a developer used co-design to respond to a community's earlier experience of nuisance from a landfill [63]. By accommodating community demands in the solar project design, the developer sought to rebuild trust and ensure cooperation, illustrating how procedural, distributive, and recognition dimensions of justice are closely intertwined.

Nevertheless, participatory design cannot compensate for structural inequalities related to land ownership, planning regimes, or financial incentives. These require broader policy and institutional reforms. Design processes can, however, contribute to reducing perceived inequities at the project level and create conditions under which broader benefit-sharing arrangements become politically and socially feasible.

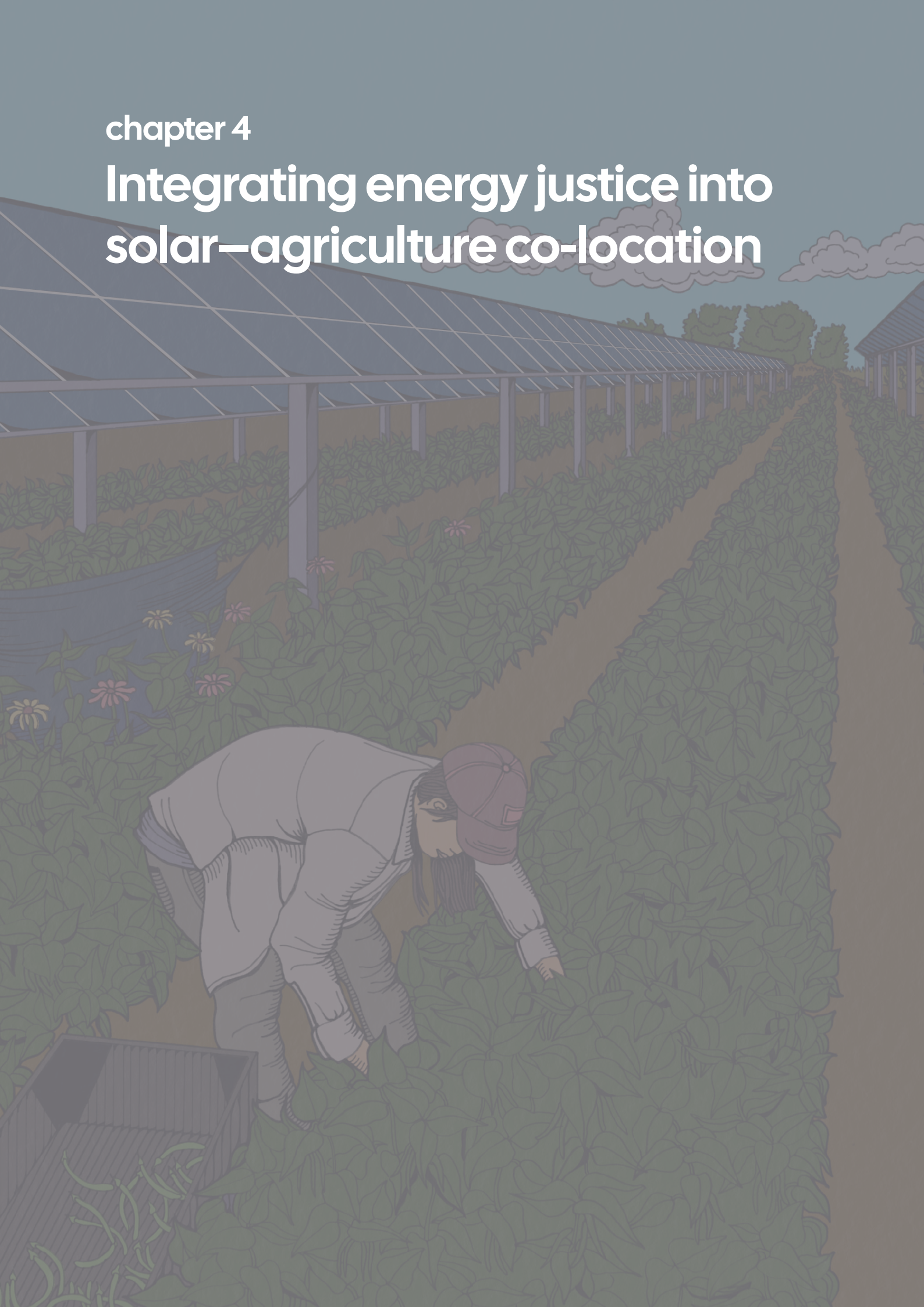
Conclusion

Participatory landscape design offers a meaningful pathway for addressing justice-related challenges in solar development. Its strongest contribution lies in procedural justice, by enabling earlier, more inclusive, and more transparent involvement in design decisions. At the same time, it supports recognition justice by valuing local knowledge, identities, and relationships to place, and it can contribute to distributive justice by shaping how benefits and burdens are experienced at the project level.

However, participatory design is most effective when embedded across the entire project life cycle, from site selection through design, construction, and operation. It should not be treated as a stand-alone solution or a substitute for broader institutional reform. When aligned with transparent planning systems, accountable governance, and equitable benefit-sharing mechanisms, participatory landscape design can help reconcile solar deployment with the landscapes it transforms, strengthening both social acceptance and energy justice.

chapter 4

Integrating energy justice into solar–agriculture co-location



Large-scale solar deployment increasingly intersects with contested land uses, particularly agriculture. Conflicts over land, landscape change, and perceived injustice have emerged as major barriers to social acceptance. In response, growing attention has turned to strategies that enable the co-location of solar energy generation with other land uses, rather than replacing them. Among these, agrivoltaics has gained prominence as a potential solution to land-use conflict and social opposition.

Agrivoltaic systems combine solar photovoltaic installations with agricultural production. Research suggests that such systems can improve land-use efficiency while simultaneously addressing energy and food production goals [71, 72]. In environmental terms, agrivoltaics has been shown to reduce heat stress on crops, conserve soil moisture, and limit water evaporation, particularly in arid regions, sometimes maintaining or even increasing yields [73].

Beyond technical performance, agrivoltaics is increasingly framed as a socially innovative approach. By enabling dual land use, it is often presented as a way to diminish land-use conflicts, diversify agricultural income, and create opportunities for shared benefits between energy developers and rural communities [74, 75, 76]. Several studies suggest that agrivoltaics can reduce local opposition to solar development, particularly where farmers benefit economically and agricultural traditions are preserved [77, 78]. Nature conservation groups have also identified agrivoltaics as a potential means of balancing renewable energy goals with biodiversity concerns [79].

However, empirical evidence also suggests that agrivoltaics should not be seen as a cure-all. Communities continue to express concerns about visual impacts, wildlife disturbance, and fairness, even when they value agrivoltaics' multifunctionality [80]. Environmental benefits alone do not guarantee acceptance, particularly in regions shaped by legacies of land financialization or extractive development [81]. As with conventional solar projects, the legitimacy of agrivoltaics depends on how projects are governed, how decisions are made, and how benefits are distributed. While agrivoltaics hold promise as a justice-oriented land-use strategy, this promise can only be realised if justice principles are embedded in design, governance, and policy frameworks from the outset [82, 83].

Recognising agricultural livelihoods and land-based identities

Agrivoltaics brings recognition justice to the forefront by directly affecting agricultural livelihoods, land-based identities, and the cultural meanings attached to rural landscapes.

In contexts where solar development is perceived to threaten farming traditions or local economies, agrivoltaics can serve as a form of recognition by affirming agriculture as a legitimate and valued land use. This recognition is central to agrivoltaics' appeal as a strategy for resolving land-use conflict and preserving local identities.

However, recognition justice is deeply shaped by land ownership and control. In some countries, agrivoltaics projects are implemented by entities other than the farmers who own or work the land. In Japan, for example, a majority of agrivoltaics installations are managed by third parties, raising concerns that projects may proceed without proper recognition of agricultural landholders' rights [94].

Technical design decisions can further undermine recognition. Panels may be installed too low for farm machinery, spaced too narrowly, or positioned in ways that limit crop growth, forcing changes in cultivation practices or crop types. In

some cases, less labour-intensive crops are introduced, agricultural quality declines, or farming ceases entirely. These dynamics highlight tensions between farmers' property rights and agriculture as a public good.

Recognition justice therefore requires clear regulatory frameworks that define landholder rights, lease terms, and agricultural standards. Collaboration between developers and farmers, supported by appropriate policy safeguards, can help ensure that agrivoltaics respects local knowledge, cultural practices, and long-term agricultural viability. Renewable Energy Communities (see Box 7) may also play a role by enabling collective negotiation and strengthening farmers' bargaining power.

Box 7. Community Renewable Energy

Community renewable energy refers to a broad set of initiatives in which citizens, local organisations, or municipalities play an active role in the ownership, governance, or benefit-sharing of renewable energy projects. Rather than being driven solely by commercial developers, these projects aim to deliver local social, economic, and environmental value, such as community reinvestment, energy affordability, local control, or strengthened democratic participation [87, 88].

In recent years, new legal and institutional models have emerged to support collective participation in renewable energy. One prominent example is the European Union's introduction of the concept of Renewable Energy Communities (RECs), legal entities that enable citizens, local authorities, and small enterprises to jointly participate in the production, consumption, and management of renewable energy.

RECs can take organisational forms such as cooperatives, associations, or municipal–community partnerships. Their activities may include owning or co-owning renewable energy installations, facilitating local energy sharing, engaging in project development, or reinvesting revenues into community services, energy poverty alleviation, or further renewable projects.

While most documented RECs operate small to medium-scale projects, there is growing evidence of hybrid ownership and partnership models in larger solar developments [89]. In several European contexts, cooperatives or municipal energy companies have taken minority ownership stakes in ground-mounted solar parks, allowing local members to participate financially and institutionally in projects developed with private firms [90, 87]. Although these arrangements do not always meet the formal definition of RECs, they illustrate how community-based entities can act as collective intermediaries between developers, farmers, and local authorities [91, 92].

In the context of agrivoltaics, such models suggest a potential role for RECs in negotiating lease conditions, supporting farmer participation in governance, and anchoring a share of project benefits locally, even where projects remain partly privately owned [86, 94, 82].

Embedding farmers and communities in agrivoltaics decision-making

Despite its agricultural context, agrivoltaics projects are typically developed through governance structures like those used for large-scale solar projects. These structures tend to prioritise developers, investors, landowners, and public authorities, while excluding farmers, residents, and local communities from meaningful participation.

Research emphasises that agrivoltaics requires deep engagement with agricultural knowledge. Decisions about panel height, spacing, shading patterns, crop selection, and machinery access have long-term implications for agricultural viability. When farmers are excluded from design processes, systems may prioritise electricity production at the expense of farming, leading to deteriorating soil quality, reduced yields, or the abandonment of agricultural activity altogether.

Meaningful procedural justice in agrivoltaics therefore requires early and sustained involvement of farmers and local communities throughout the project life cycle. Farmer co-design has been identified as essential for understanding local crop varieties, historical yields, and land management practices [84]. Inclusive decision-making can also help anticipate long-term agricultural system change rather than treating farming as a secondary or temporary land use.

Despite these insights, exclusion remains common. Residents and farmers often bear negative impacts such as visual change or altered land use, while decision-making power remains concentrated among agricultural organisations, investors, and local authorities. This exclusion, combined with cultural concerns and uncontrolled landscape transformation, continues to drive opposition and perceptions of injustice [83].

Designing agrivoltaics to share benefits more equitably

Agrivoltaics can offer new revenue streams for farmers, improve income stability, and create opportunities for profit-sharing and co-benefits within agricultural regions. At the same time, there is a risk that these benefits can be unevenly distributed. Large landholders and farmers are often best positioned to participate in agrivoltaics projects. Smaller farmers, tenants, and landless agricultural workers may be excluded, while differences in investment capacity can exacerbate existing inequalities within rural communities. Leasing arrangements may also reduce farmers' control over their land, particularly where developers retain operational authority over panel infrastructure [38].

To address these risks, distributive justice approaches to agrivoltaics emphasise structured benefit-sharing. Suggested mechanisms include compensation for neighbouring agricultural properties, local benefits for host municipalities, and regional benefits for the broader agricultural area hosting projects [82]. Community benefit schemes, diversified ownership models, and Renewable Energy Communities have been identified as potential vehicles for more equitable distribution of economic gains.

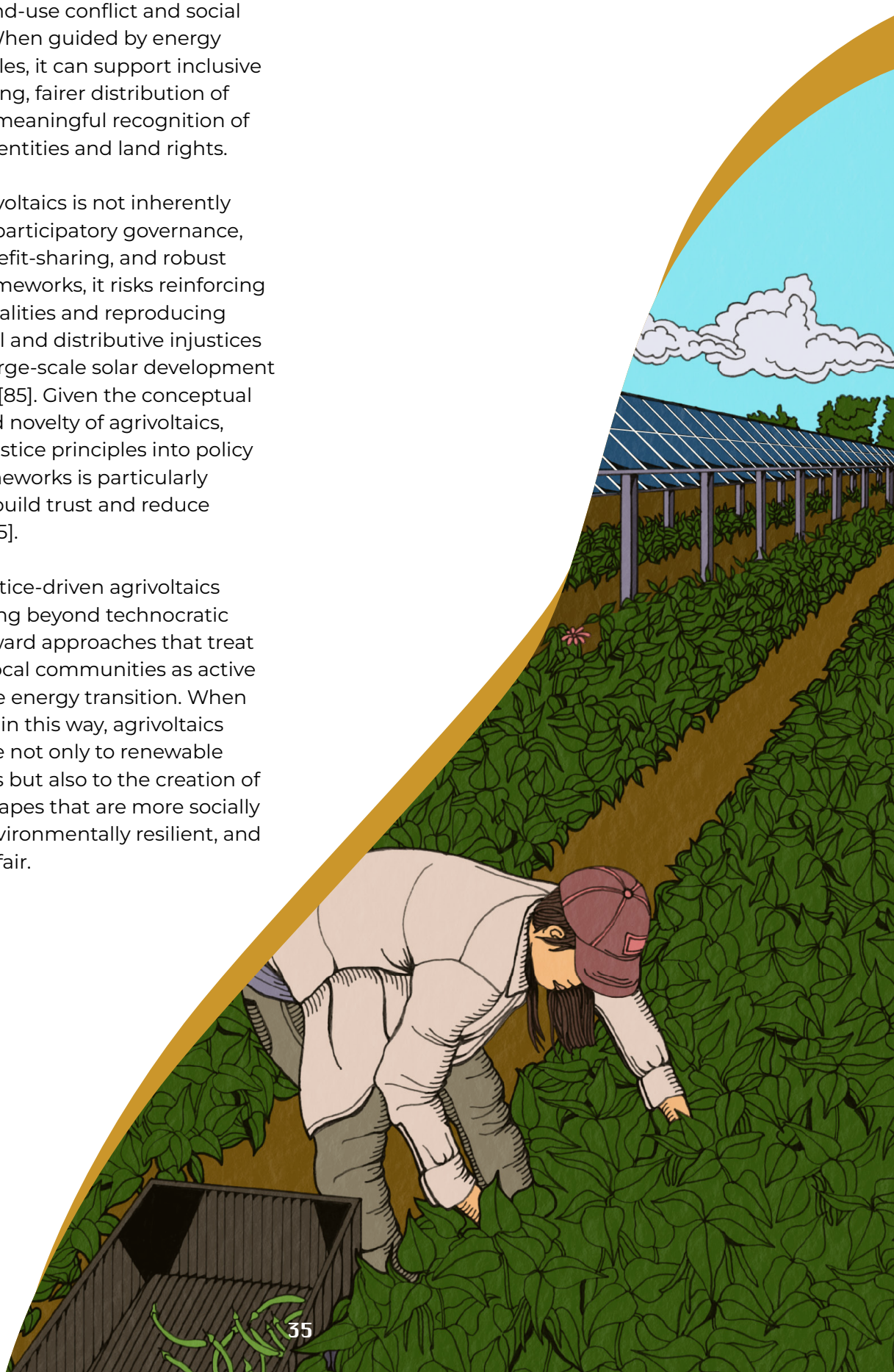
Distributive justice also extends beyond financial considerations. Visual impacts, ecological disturbance, and changes to landscape character may impose burdens on residents who receive no direct benefits. Designing agrivoltaics as multifunctional landscapes that preserve ecosystems and local amenities can help mitigate these burdens, but only if such goals are explicitly prioritised.

Conclusion

Agrivoltaics holds significant promise as a strategy for integrating renewable energy into agricultural landscapes while addressing land-use conflict and social acceptance. When guided by energy justice principles, it can support inclusive decision-making, fairer distribution of benefits, and meaningful recognition of agricultural identities and land rights.

However, agrivoltaics is not inherently just. Without participatory governance, equitable benefit-sharing, and robust regulatory frameworks, it risks reinforcing existing inequalities and reproducing the procedural and distributive injustices observed in large-scale solar development more broadly [85]. Given the conceptual ambiguity and novelty of agrivoltaics, embedding justice principles into policy and legal frameworks is particularly important to build trust and reduce uncertainty [95].

Ultimately, justice-driven agrivoltaics requires moving beyond technocratic regulation toward approaches that treat farmers and local communities as active partners in the energy transition. When implemented in this way, agrivoltaics can contribute not only to renewable energy targets but also to the creation of energy landscapes that are more socially legitimate, environmentally resilient, and economically fair.



chapter 5

Pathways toward fairer and more socially acceptable solar development

This handbook set out to understand why large-scale solar projects often encounter social opposition and how the concept of energy justice can help explain and respond to these challenges. Drawing on a systematic review of social science research, it has shown that opposition is rarely a simple rejection of renewable energy. Instead, it reflects deeper concerns about how solar development is planned, whose values and livelihoods are acknowledged, and how benefits and burdens are distributed across space and society.

Across the preceding chapters, three cross-cutting insights have emerged. First, conflicts around solar energy are often shaped early, particularly through site selection and spatial planning processes (Chapter 2). Second, project design matters: how solar installations are integrated into landscapes and with existing land-uses strongly influences perceptions of fairness and legitimacy (Chapter 3). Third, technological innovations such as combining solar PV plants with agriculture are by themselves insufficient. To achieve fair and acceptable outcomes novel socio-technical arrangements require sustained participation throughout the project life cycle and a detailed analysis of the socio-economic impacts on stakeholders (Chapter 4).

Building on these insights, this concluding chapter introduces pathways that recur across the literature but which we have not yet explicitly addressed: repurposing brownfield land, shifting toward medium-scale solar projects, and expanding public or municipal ownership of solar infrastructure. It then brings these pathways together through the concept of community renewable energy as a means of integrating energy justice across site selection, design, co-location, and long-term governance.

Repurposing brownfield land

One prominent pathway to more just, sustainable, and acceptable solar power plants is the use of previously disturbed or developed land, such as abandoned mining sites, industrial areas, and degraded landscapes. Brownfield sites are often attractive from an industry perspective because they can offer existing infrastructure, road access, and reduced pressure on undeveloped land. They are also frequently presented as a way to reduce conflicts associated with agricultural land, conservation areas, or culturally valued landscapes.

However, research cautions against treating brownfield sites as socially neutral. These landscapes often reflect histories of extraction, environmental harm, and socio-economic marginalisation. Repurposing projects can reproduce or intensify injustice if they are used to sidestep rehabilitation responsibilities or ignore the lasting social, political, and ecological impacts of previous industrial activity [96, 97]. In justice terms, the key risk is that a site becomes “available” in spatial models precisely because it has already been sacrificed.

Seen through the lens of Chapter 2, brownfield repurposing raises questions of recognition justice. If justice-oriented siting requires making socially meaningful places visible, then it must also take seriously the meanings attached to damaged places. This implies approaches that integrate historical legacies and local knowledge into site selection processes, rather than relying solely on indicators of disturbance or land value.

Hybrid approaches that repurpose fossil fuel sites while engaging local labour and identity illustrate both the promise and limits of this pathway. Egler and Barbieri [98] describe such “hybrid energy initiatives” as potentially bridging political and cultural divides by linking renewable

development to place-based narratives of equity and transition, while also warning that justice-oriented discourse does not guarantee just outcomes in practice. For brownfield solar to contribute to a just transition, its governance must be as carefully designed as its siting.

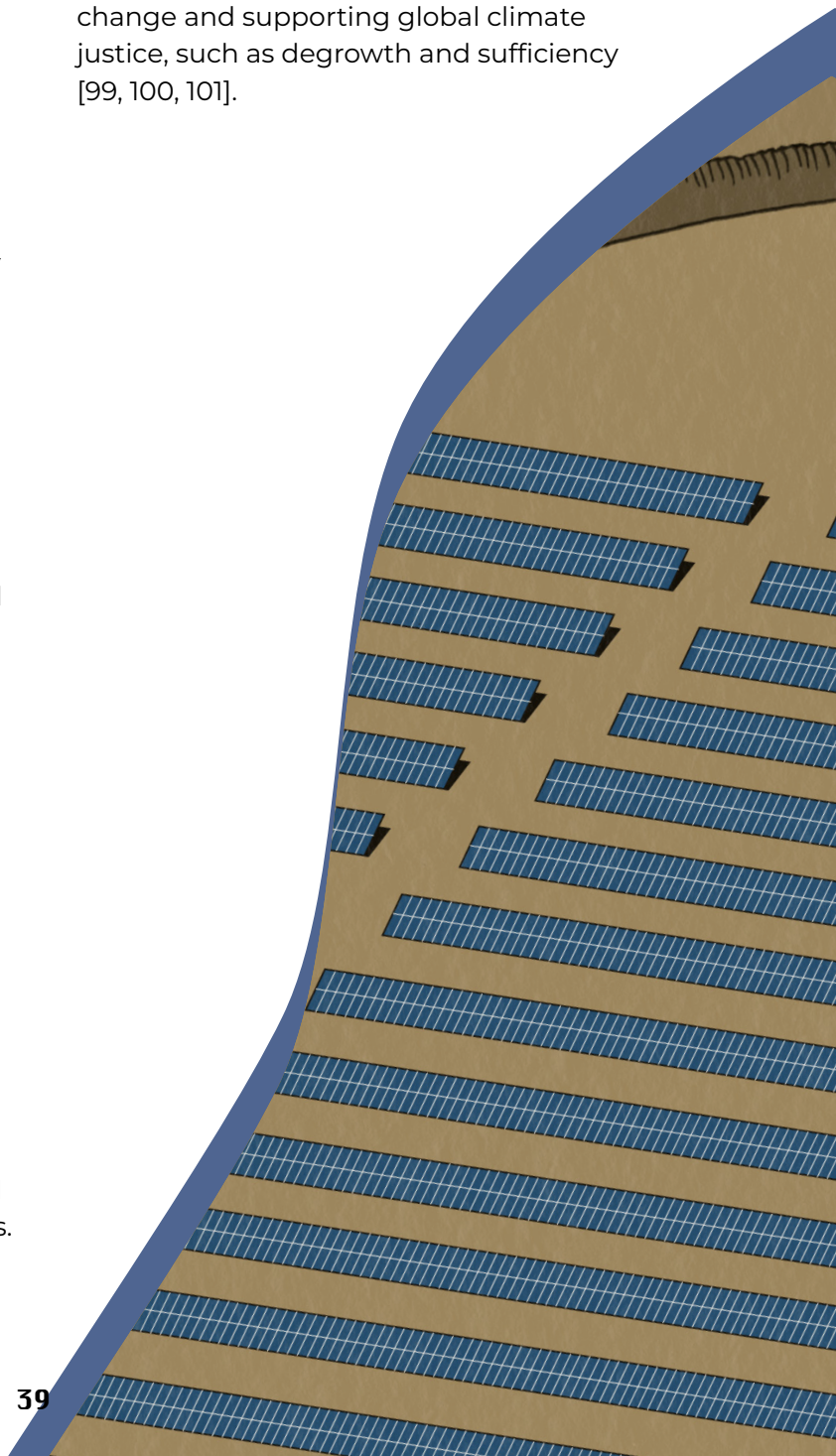
Medium-scale solar

A second pathway concerns project scale. Much of the literature implicitly contrasts two dominant models: very large utility-scale projects, and small distributed rooftop systems. Yet scale matters for acceptance and justice, and the middle of this spectrum is often underexplored.

Large-scale solar power plants can deliver rapid capacity expansion and economies of scale, but they are also more likely to intensify land-use conflicts. Moreover, they often concentrate decision-making power among developers, investors, and central authorities.

Medium-scale solar projects offer an alternative that aligns closely with the innovations discussed in this handbook. They are large enough to contribute meaningfully to decarbonisation but small enough to be more responsive to local planning contexts, landscape sensitivities, and governance arrangements.

In site selection terms, medium-scale projects can widen the range of feasible locations, making it easier to avoid socially and ecologically sensitive areas identified through justice-oriented mapping. In design terms, smaller footprints can make participatory landscape integration more practical and visible, increasing the plausibility of genuine co-design rather than tokenistic consultation. In land-use terms, medium-scale projects may also be easier to combine with multifunctional and co-location strategies, including agrivoltaics. From a distributive standpoint, medium scale can reduce tensions by limiting the spatial concentration of burdens and making benefit-sharing arrangements more tangible at the municipal or community level. From a procedural standpoint, governance structures and environmental restrictions are often less complex, lowering barriers to meaningful participation. This does not imply that large-scale solar should be abandoned, but it does suggest that diversification of scale can be a practical justice strategy, particularly in densely populated or culturally sensitive landscapes. Moreover, medium scale-solar projects fit better with societal visions aimed at tacklin climate change and supporting global climate justice, such as degrowth and sufficiency [99, 100, 101].



Public ownership

A third pathway concerns ownership and control. As the distributive justice discussion throughout this handbook indicates, conflicts are rarely resolved through siting alone. They also depend on how pecuniary flows and decision-making authority are organised. The spatial distribution of benefits and burdens depends not only on where infrastructure is sited, but on how revenues are redistributed through institutional parameters such as ownership structures, tax schemes, and market regulation [56]. This makes ownership a central justice issue.

Public ownership is frequently identified as one way to address justice concerns associated with privately driven solar development. Municipalised solar can strengthen procedural justice by embedding decision-making within democratically accountable institutions, potentially increasing transparency and alignment with local priorities. It can strengthen distributive justice by enabling revenues to be reinvested locally, for example in public services, energy poverty alleviation, or further renewable energy projects. It may also create stronger institutional incentives to pursue careful siting, landscape-sensitive design, and sustained engagement rather than a narrow focus on speed of delivery.

At the same time, public ownership alone does not guarantee just outcomes. Municipal capacity varies widely, and public authorities may still prioritise technical or financial objectives over inclusive engagement. The key lesson from the preceding chapters is that justice depends not only on who owns a project, but on whether governance arrangements provide meaningful participation and clear accountability over time.

The literature on community and shared ownership provides additional models that sit between private development and fully public ownership. Community ownership of utility-scale PV can increase local economic benefits and project control, including through co-owned structures that combine community-based entities with corporate partners. Financial support for underserved communities and integration with energy efficiency initiatives are essential if solar development is to contribute to energy equity [102].

Community benefit agreements can improve support when benefits meet locally experienced needs but can undermine trust when they are perceived as inadequate or misaligned with local priorities [103, 104]. Shared ownership and participatory governance models often increase support when people perceive they have a genuine stake in both process and outcomes [34, 105]. Community-based organisations can be crucial intermediaries but they require capacity-building institutional support to play this role effectively [106, 107].

Towards community-centered solar development

The scholarly literature increasingly points toward community renewable energy as a framework capable of bringing these strategies together across the project life cycle. In the European Union, community energy has been formalised through the legal concept of Renewable Energy Communities, whereas similar practices in the United States are framed as “community solar.” Though these socio-technical arrangements are often associated with decentralised rooftop systems in urban contexts, it is also possible that they can be developed at larger sizes and with ground-mounted solar PV in rural areas.

However, community renewable energy is not a single technology or project type. It is a governance approach that can connect the justice interventions discussed across the handbook. It can strengthen justice in site selection by mobilising local knowledge and values, ensuring that socially meaningful places, including historically burdened sites, are recognised from the outset. It can support participatory landscape design by enabling communities to co-create projects that reflect local identities, land uses, and landscape preferences, reducing the risk that engagement is reduced to a procedural formality. It can also make co-location strategies such as agrivoltaics more viable by embedding cross-sector cooperation between energy and agricultural actors within a shared governance structure.

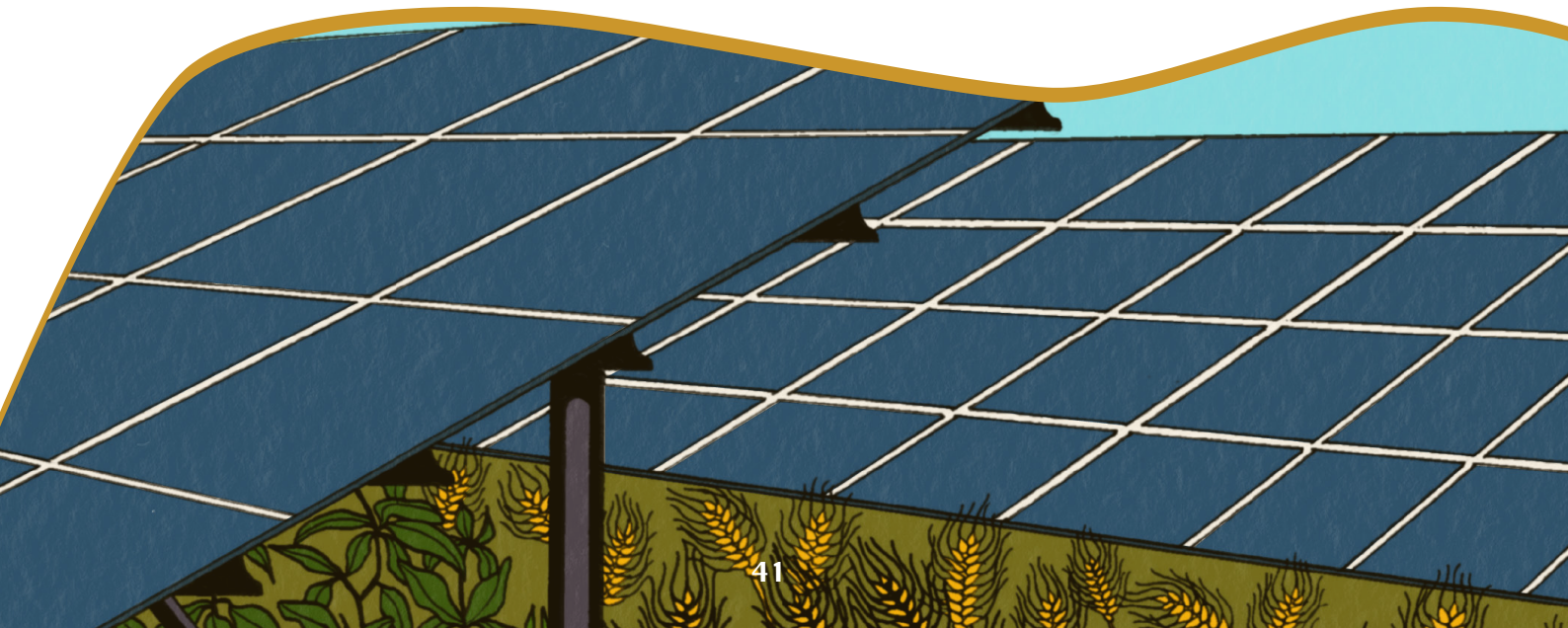
Crucially, community renewable energy can also address distributive justice through the co-location of energy production and consumption, shared ownership, profit-sharing, and local control over revenues, providing a means to connect solar generation to broader social goals such as affordability, resilience, and sufficiency. This matters because, as discussed throughout the handbook, social acceptance cannot be achieved through communication and mitigation alone. It depends on whether communities experience solar development as something done with them and for them, rather than to them [108].

Concluding reflections

Taken together, the pathways outlined in this chapter point toward a broader shift in how solar PV is conceived and governed. Rather than treating social acceptance as a hurdle to overcome, an energy justice perspective reframes it as a question of legitimacy, inclusion, and shared benefit.

Repurposing brownfield land, promoting medium-scale projects, expanding public ownership, and developing multifunctional and agrivoltaic landscapes each offer promising pathways to energy justice and social acceptance. Their transformative potential is greatest, however, when they are embedded within community-oriented governance structures that enable sustained participation and collective control over the lifetime of these infrastructures and communities. Community renewable energy offers a way to connect siting, design, co-location, ownership, and long-term governance so that justice becomes a continuous feature of solar development.

As solar PV continues to expand, the challenge is not only to build more capacity, but to do so in ways that are fair, inclusive, and durable. Integrating energy justice across the full project life cycle can help solar development contribute not only to decarbonisation targets, but to more democratic and socially legitimate energy systems.



Bibliography

[1] International Energy Agency. (2024). *Massive global growth of renewables to 2030 is set to match entire power capacity of major economies today, moving world closer to tripling goal.* Retrieved from https://www.iea.org/news/massive-global-growth-of-renewables-to-2030-is-set-to-match-entire-power-capacity-of-major-economies-today-moving-world-closer-to-tripling-goal

[2] Stock, R., & Sareen, S. (2024). Solar aporias: on precarity and praxis in interdisciplinary research on solar energy. *Energy Research & Social Science, 116*, 103661.

[3] Carlisle, J. E., Kane, S. L., Solan, D., & Joe, J. C. (2014). Support for solar energy: Examining sense of place and utility-scale development in California. *Energy Research & Social Science, 3*, 124–130.

[4] Zander, K. K., Mathur, D., Mathew, S., & Garnett, S. T. (2024). Public views about the world's largest proposed solar farm in remote Australia. *Energy Policy, 191*, 114197.

[5] Nilson, R. S., & Stedman, R. C. (2022). Are big and small solar separate things?: The importance of scale in public support for solar energy development in Upstate New York. *Energy Research & Social Science, 86*, 102449.

[6] Cousse, J. (2021). Still in love with solar energy? Installation size, affect, and the social acceptance of renewable energy technologies. *Renewable and Sustainable Energy Reviews, 145*, 111107.

[7] Rodríguez-Segura, F. J., Osorio-Aravena, J. C., Frolova, M., Terrados-Cepeda, J., & Muñoz-Cerón, E. (2023). Social acceptance of renewable energy development in southern Spain: Exploring tendencies, locations, criteria and situations. *Energy Policy, 173*, 113356.

[8] Campos, I., Brito, M., & Luz, G. (2023). Scales of solar energy: Exploring citizen satisfaction, interest, and values in a comparison of regions in Portugal and Spain. *Energy Research & Social Science, 97*, 102952.

[9] Lucchi, E., Adami, J., & Stawinoga, A. E. (2023). Social acceptance of photovoltaic systems in heritage buildings and landscapes: Exploring barriers, benefits, drivers, and challenges for technical stakeholders in northern Italy. *Sustainable Energy Technologies and Assessments, 60*, 103544.

[10] Naspetti, S., Mandolesi, S., & Zanoli, R. (2016). Using visual Q sorting to determine the impact of photovoltaic applications on the landscape. *Land Use Policy, 57*, 564–573.

[11] Navrátil, J., Martinát, S., Krejčí, T., Klusáček, P., & Hewitt, R. J. (2021). Conversion of post-socialist agricultural premises as a chance for renewable energy production. Photovoltaics or biogas plants?. *Energies, 14*(21), 7164.

[12] Siamanta, Z. C. (2017). Building a green economy of low carbon: the Greek post-crisis experience of photovoltaics and financial 'green grabbing'. *Journal of Political Ecology, 24*(1), 258–276.

[13] Sánchez Contreras, J., Matarán Ruiz, A., Villodres Ramírez, L., Jiménez Martín, C., Gámez Rodríguez, G., Martín Pérez, R., & Campos-Celador, Á. (2024). Energy Colonialism in Europe: A Participatory Analysis of the Case of Granada (Spain). *Land, 13*(2), 144.

[14] Crowe, J. A., & Li, R. (2020). Is the just transition socially accepted? Energy history, place, and support for coal and solar in Illinois, Texas, and Vermont. *Energy Research & Social Science, 59*, 101309.

[15] Gamper-Rabindran, S., & Ash, J. (2024). “Farming the sun” or “coal legacy”? Social perspectives on solar energy projects in Appalachia. *Energy Research & Social Science, 117*, 103656.

[16] Dunlap, A. A., Sovacool, B. K., & Novakovic, B. (2024). “Our town is dying”: Exploring utility-scale and rooftop solar energy injustices in Southeastern California. *Geoforum, 156*, 104120.

[17] Stock, R., & Sovacool, B. K. (2024). Blinded by sunspots: Revealing the multidimensional and intersectional inequities of solar energy in India. *Global Environmental Change, 84*, 102796.

[18] Barragan-Contreras, S. J. (2022). Procedural injustices in large-scale solar energy: a case study in the Mayan region of Yucatan, Mexico. *Journal of Environmental Policy & Planning, 24*(4), 375–390.

[19] Ki, J., & Yun, S. J. (2024). Local versus outsider developers: Impact on development duration and its’ implications for community acceptance of solar PV plants in South Korea. *Energy Policy, 193*, 114272.

[20] Nicholls, J. (2020). Technological intrusion and communicative renewal: The case of two rural solar farm developments in the UK. *Energy Policy, 139*, 111287.

[21] Avila, S., Deniau, Y., Sorman, A. H., & McCarthy, J. (2022). (Counter) mapping renewables: Space, justice, and politics of wind and solar power in Mexico. *Environment and Planning E: Nature and Space, 5*(3), 1056–1085.

[22] Roddis, P., Carver, S., Dallimer, M., Norman, P., & Ziv, G. (2018). The role of community acceptance in planning outcomes for onshore wind and solar farms: An energy justice analysis. *Applied Energy, 226*, 353–364.

[23] Hussain, M. M., Concetti, C., Toke, D., Thomas, K., Duffy, P., & Vergunst, J. (2025). “Here comes the sun”: Determinants of solar farm planning at local authority level in England. *Energy Research & Social Science, 120*, 103916.

[24] Schram, W., Akerboom, S., Lelieveldt, H., & Kramer, G. J. (2024). Government versus the people–The mismatch in value use to assess solar farms in the Netherlands. *Energy Research & Social Science, 107*, 103344.

[25] Shokrgozar, S., & Girard, B. R. E. (2024). “The companies are powerful, people are weak”: India’s solar energy ambitions and the legitimation of dispossession in Rajasthan.

[26] Bessette, D. L., Hoen, B., Rand, J., Hoesch, K., White, J., Mills, S. B., & Nilson, R. (2024). Good fences make good neighbors: stakeholder perspectives on the local benefits and burdens of large-scale solar energy development in the United States. *Energy Research & Social Science, 108*, 103375.

[27] Brás, O. R., Ferreira, V., & Carvalho, A. (2024). People of the sun: Local resistance and solar energy (in) justice in southern Portugal. *Energy Research & Social Science, 113*, 103529.

[28] Stock, R. (2022). Triggering resistance: Contesting the injustices of solar park development in India. *Energy Research & Social Science, 86*, 102464.

[29] Wallace, R., Schwemmlein, K., & Batel, S. (2025). Solar industrialization, ‘sacrifice zones, ‘and new environmental movements: emerging discourses of commonality and critique in Portugal’s energy transition. *Sustainability Science*, 1–20.

[30] Bessette, D. L., Rand, J., Hoen, B., Nilson, R., White, J., Hoesch, K., & Mills, S. B. (2025). Missing the mark: Avoiding community misengagement in large-scale solar development. *Energy Research & Social Science, 127*, 104338.

[31] Batel, S., Valquaresma, A., & Alba, M. (2024). Rural communities' energy metabolisms in Portugal: Between territorial injustices and far-right populism. *Journal of Rural Studies, 111*, 103425.

[32] Mayer, A. (2025). Visibility, Land Use, Social Norms, and Partisanship in Support for a Hypothetical Solar Facility in Non-Metropolitan Michigan. *Society & Natural Resources*, 1–26.

[33] Hess, D. J., Seo, H., & Belletto, K. (2025). Strengthening local siting authority for utility-scale solar: effects on regulatory decisions and public opposition. *Climatic Change, 178*(3), 38.

[34] Stadelmann-Steffen, I., & Dermont, C. (2021). Acceptance through inclusion? Political and economic participation and the acceptance of local renewable energy projects in Switzerland. *Energy Research & Social Science, 71*, 101818.

[35] Nilson, R. S., & Stedman, R. C. (2023). Reacting to the rural burden: understanding opposition to utility-scale solar development in upstate New York. *Rural Sociology, 88*(2), 578–605.

[36] Sütterlin, B., & Siegrist, M. (2017). Public acceptance of renewable energy technologies from an abstract versus concrete perspective and the positive imagery of solar power. *Energy Policy, 106*, 356–366.

[37] Capellán-Pérez, I., De Castro, C., & Arto, I. (2017). Assessing vulnerabilities and limits in the transition to renewable energies: Land requirements under 100% solar energy scenarios. *Renewable and Sustainable Energy Reviews, 77*, 760–782.

[38] Spangler, K., Smithwick, E. A., Buechler, S., & Baka, J. (2024). Just energy imaginaries? Examining realities of solar development on Pennsylvania's farmland. *Energy Research & Social Science, 108*, 103394.

[39] Ghosh, D., Bryant, G., & Pillai, P. (2023). Who wins and who loses from renewable energy transition? Large-scale solar, land, and livelihood in Karnataka, India. *Globalizations, 20*(8), 1328–1343.

[40] Cantoni, R., & Rignall, K. (2019). Kingdom of the Sun: a critical, multiscalar analysis of Morocco's solar energy strategy. *Energy Research & Social Science, 51*, 20–31.

[41] Stock, R., & Birkenholtz, T. (2024). Tracking the sun: exposing India's solar dispossessions. *Globalizations*, 1–20.

[42] Crawford, J., Bessette, D., & Mills, S. B. (2022). Rallying the anti-crowd: Organized opposition, democratic deficit, and a potential social gap in large-scale solar energy. *Energy Research & Social Science, 90*, 102597.

[43] Stock, R. (2021c). Illuminant intersections: Injustice and inequality through electricity and water infrastructures at the Gujarat Solar Park in India. *Energy Research & Social Science, 82*, 102309.

[44] Dunlap, A., Sovacool, B. K., & Novaković, B. (2025). 'A Dead Sea of Solar Panels:' solar enclosure, extractivism and the progressive degradation of the California desert. *The Journal of Peasant Studies, 52*(3), 539–573.

[45] Gerhardt, C. (2017). Germany's renewable energy shift: Addressing climate change. *Capitalism Nature Socialism, 28*(2), 103–119.

[46] Thapar, S., Sharma, S., & Verma, A. (2018). Analyzing solar auctions in India: Identifying key determinants. *Energy for Sustainable Development, 45*, 66–78.

[47] Sareen, S. (2022). Drivers of scalar biases: Environmental justice and the Portuguese solar photovoltaic rollout. *Environmental Justice, 15*(2), 98–107.

[48] Christophers, B. (2022). Taking renewables to market: Prospects for the after-subsidy energy transition: The 2021 Antipode RGS-IBG Lecture. *Antipode, 54*(5), 1519–1544.

[49] Kennedy, S. F., & Stock, R. (2022). Alternative energy capital of the world? Fix, risk, and solar energy in Los Angeles' urban periphery. *Environment and Planning E: Nature and Space, 5*(4), 1831–1852.

[50] Sareen, S. (2022). Legitimating power: Solar energy rollout, sustainability metrics and transition politics. *Environment and Planning E: Nature and Space, 5*(3), 1014–1034.

[51] Jacroux, E., & Freshour, C. (2024). Struggles over solar in the United States: Oppositional coalitions and the limits of territorial resentment. *Energy Research & Social Science, 113*, 103532.

[52] Dias, L., Gouveia, J. P., Lourenço, P., & Seixas, J. (2019). Interplay between the potential of photovoltaic systems and agricultural land use. *Land Use Policy, 81*, 725–735.

[53] Oudes, D., & Stremke, S. (2021). Next generation solar power plants? A comparative analysis of frontrunner solar landscapes in Europe. *Renewable and Sustainable Energy Reviews, 145*, 111101.

[54] Fernandez-Jimenez, L. A., Mendoza-Villena, M., Zorzano-Santamaria, P., Garcia-Garrido, E., Lara-Santillan, P., Zorzano-Alba, E., & Falces, A. (2015). Site selection for new PV power plants based on their observability. *Renewable Energy, 78*, 7–15.

[55] Sward, J. A., Nilson, R. S., Katkar, V. V., Stedman, R. C., Kay, D. L., Ifft, J. E., & Zhang, K. M. (2021). Integrating social considerations in multicriteria decision analysis for utility-scale solar photovoltaic siting. *Applied Energy, 288*, 116543.

[56] Lehmann, P., Gawel, E., Meier, J. N., Reda, M. J., Reutter, F., & Sommer, S. (2024). Spatial distributive justice has many faces: The case of siting renewable energy infrastructures. *Energy Research & Social Science, 118*, 103769.

[57] Rösch, C., & Fakharizadehshirazi, E. (2025). Public participation GIS scenarios for decision-making on land-use requirements for renewable energy systems. *Energy, Sustainability and Society*, *15*(1), 18.

[58] Ioannidis, R., & Koutsoyiannis, D. (2020). A review of land use, visibility and public perception of renewable energy in the context of landscape impact. *Applied Energy, 276*, 115367.

[59] Bevk, T., & Golobič, M. (2020). Contentious eye-catchers: Perceptions of landscapes changed by solar power plants in Slovenia. *Renewable Energy, 152*, 999–1010.

[60] Moore, S., & Hackett, E. J. (2016). The construction of technology and place: Concentrating solar power conflicts in the United States. *Energy Research & Social Science, 11*, 67–78.

[61] Pasqualetti, M. J., Jones, T. E., Necefer, L., Scott, C. A., & Colombi, B. J. (2016). A paradox of plenty: Renewable energy on Navajo Nation Lands. *Society & Natural Resources, 29*(8), 885–899.

[62] Rignall, K. E. (2016). Solar power, state power, and the politics of energy transition in pre-Saharan Morocco. *Environment and Planning A: Economy and Space, 48*(3), 540–557.

[63] Enserink, M., Van Etteger, R., & Stremke, S. (2024). The life and death of good intentions? Unravelling participatory design processes of three Dutch solar power plants. *Energy Research & Social Science, 114*, 103620.

[64] Argenti, N., & Knight, D. M. (2015). Sun, wind, and the rebirth of extractive economies: renewable energy investment and metanarratives of crisis in Greece. *Journal of the Royal Anthropological Institute, 21*(4), 781–802.

[65] Yenneti, K., & Day, R. (2015). Procedural (in) justice in the implementation of solar energy: The case of Charanaka solar park, Gujarat, India. *Energy Policy, 86*, 664–673.

[66] Van de Graaf, T., & Sovacool, B. K. (2014). Thinking big: Politics, progress, and security in the management of Asian and European energy megaprojects. *Energy Policy, 74*, 16–27.

[67] Sareen, S., Dodge, A., Nakakaawa-Jjunju, C., & Nabaasa, B. (2024). Scales of accountability: Solar mini-grids and clean energy for all in Uganda. *Energy Research & Social Science, 118*, 103805.

[68] Enserink, M., Van Etteger, R., Van den Brink, A., & Stremke, S. (2022). To support or oppose renewable energy projects? A systematic literature review on the factors influencing landscape design and social acceptance. *Energy Research & Social Science, 91*, 102740.

[69] Enserink, M., Van Etteger, R., & Stremke, S. (2023). Seeing is believing, experiencing is knowing: The influence of a co-designed prototype solar power plant on local acceptance. *Solar Energy*, *262*, 111739.

[70] Stremke, S., & Picchi, P. (2017). 26. Co-designing energy landscapes: application of participatory mapping and geographic information systems in the exploration of low carbon futures. *Handbook on the Geographies of Energy*, 368.

[71] Vezzoni, R. (2025). Farming the sun: the political economy of agrivoltaics in the European Union. *Sustainability Science*, 1–16.

[72] Rösch, C., & Fakharizadehshirazi, E. (2024). The spatial socio-technical potential of agrivoltaics in Germany. *Renewable and Sustainable Energy Reviews, 202*, 114706.

[73] Barron-Gafford, G. A., Pavao-Zuckerman, M. A., Minor, R. L., Sutter, L. F., Barnett-Moreno, I., Blackett, D. T., ... & Macknick, J. E. (2019). Agrivoltaics provide mutual benefits across the food–energy–water nexus in drylands. *Nature Sustainability, 2*(9), 848–855.

[74] Ketzer, D., Schlyter, P., Weinberger, N., & Rösch, C. (2020). Driving and restraining forces for the implementation of the Agrophotovoltaics system technology–A system dynamics analysis. *Journal of Environmental Management, 270*, 110864.

[75] Taylor, M., McDonnell, N., Davies, P., & Trück, S. (2025). Scaling agrivoltaics: planning, legal, and market pathways to readiness. *Sustainability Science*, 1–19.

[76] Goldberg, Z. A. (2023). Solar energy development on farmland: Three prevalent perspectives of conflict, synergy and compromise in the United States. *Energy Research & Social Science*, *101*, 103145.

[77] Pascaris, A. S., Schelly, C., Burnham, L., & Pearce, J. M. (2021). Integrating solar energy with agriculture: Industry perspectives on the market, community, and socio-political dimensions of agrivoltaics. *Energy Research & Social Science, 75*, 102023.

[78] Wagner, J., Bühner, C., Gölz, S., Trommsdorff, M., & Jürkenbeck, K. (2024). Factors influencing the willingness to use agrivoltaics: A quantitative study among German farmers. *Applied Energy, 361*, 122934.

[79] Hilker, J. M., Busse, M., Müller, K., & Zscheischler, J. (2024). Photovoltaics in agricultural landscapes: “Industrial land use” or a “real compromise” between renewable energy and biodiversity? Perspectives of German nature conservation associations. *Energy, Sustainability and Society, 14*(1), 6.

[80] Biró-Varga, K., Sirnik, I., & Stremke, S. (2024). Landscape user experiences of interspace and overhead agrivoltaics: A comparative analysis of two novel types of solar landscapes in the Netherlands. *Energy Research & Social Science, 109*, 103408.

[81] Seay-Fleming, C., Swanson, T., & Gerlak, A. (2025). For what and for whom? A political ecology of agrivoltaics in the Southwestern United States. *Sustainability Science*, 1–15.

[82] Taylor, M., Pettit, J., Sekiyama, T., & Sokołowski, M. M. (2023). Justice-driven agrivoltaics: Facilitating agrivoltaics embedded in energy justice. *Renewable and Sustainable Energy Reviews, 188*, 113815.

[83] Tomasi, S., Pellegrini, C., Gaspari, F., Vitale, S., Martí, M. M., Gras, A., & Gantioler, S. (2025). Agrivoltaics as a win-win for rural regions? Energy and environmental justice perspectives across Italy, Spain, Belgium, and the Netherlands. *Energy Research & Social Science, 129*, 104369.

[84] Moore, S., Graff, H., Ouellet, C., Leslie, S., & Olweean, D. (2022). Can we have clean energy and grow our crops too? Solar siting on agricultural land in the United States. *Energy Research & Social Science, 91*, 102731.

[85] Hu, Z. (2024). Doomed in the agrivoltaic campaign? The case of Chinese smallholder agriculture in the deployment of agrivoltaic projects. *Energy for Sustainable Development, 83*, 101562.

[86] Bauknecht, M. (2025). Energy security through decentralized energy system: Electricity self-sufficient village using agrivoltaics?. *Energy Reports, 14*, 1523–1528.

[87] Bauwens, T. (2016). Explaining the diversity of motivations behind community renewable energy. *Energy Policy, 93*, 278–290.

[88] Walker, G., & Devine-Wright, P. (2008). Community renewable energy: What should it mean?. *Energy Policy, 36*(2), 497–500.

[89] Bauwens, T., Huybrechts, B., & Dufays, F. (2020). Understanding the diverse scaling strategies of social enterprises as hybrid organizations: The case of renewable energy cooperatives. *Organization & Environment, 33*(2), 195–219.

[90] Huybrechts, B., & Mertens, S. (2014). The relevance of the cooperative model in the field of renewable energy. *Annals of Public and Cooperative Economics, 85*(2), 193–212.

[91] Creamer, E., Eadson, W., van Veelen, B., Pinker, A., Tingey, M., Braunholtz-Speight, T., ... & Lacey-Barnacle, M. (2018). Community energy: Entanglements of community, state, and private sector. *Geography Compass, 12*(7), e12378.

[92] van Veelen, B. (2020). Caught in the middle? Creating and contesting intermediary spaces in low-carbon transitions. *Environment and Planning C: Politics and Space, 38*(1), 116–133.

[93] Devine-Wright, P. (2005). Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy: An International Journal for Progress and Applications in Wind Power Conversion Technology, 8*(2), 125–139.

[94] Koga, H., Bouzarovski, S., & Petrova, S. (2025). Energy democratisation through agrivoltaics? the territorialisation dynamics of community-based energy governance in Japan. *Sustainability Science*, 1–17.

[95] de Falco, M., Sarrica, M., Scognamiglio, A., & Fasanelli, R. (2025). What does Agrivoltaics means? A study on social representations shared by experts and the press in Italy. *Energy Research & Social Science, 119*, 103918.

[96] Matanzima, J., Schramm, K., Uhrmann, H., Heberle, F., Vonderau, A., Weber, T., ... & Werner, T. (2026). Repurposing mines for renewable energy: Socio-environmental implications for local communities in Australia and Germany. *Energy Research & Social Science, 131*, 104508.

[97] Mariotti, E., & Engström, J. (2025). Transforming abandoned mines into solar farms: a pathway to renewable energy development and sustainable land use. *Environmental Research: Energy, 2*(1), 015013.

[98] Egler, M., & Barbieri, L. (2024). Prefiguring energy futures: Hybrid energy initiatives and just transitions in fossil fuel regions. *Energy Research & Social Science, 118*, 103830.

[99] Kunze, C., & Becker, S. (2015). Collective ownership in renewable energy and opportunities for sustainable degrowth. *Sustainability Science, 10*(3), 425–437.

[100] Dablander, F., Hickey, C., Sandberg, M., Zell-Ziegler, C., & Grin, J. (2025). Embracing sufficiency to accelerate the energy transition. *Energy Research & Social Science, 120*, 103907.

[101] Boudet, H., Hazboun, S., Haggett, C., & Batel, S. (2025). Going slow to go fast: public response and engagement in renewable energy projects. *Nature Reviews Clean Technology*, 1–13.

[102] Heeter, J., & Reames, T. (2022). Incorporating energy justice into utility-scale photovoltaic deployment: A policy framework. *Renewable Energy Focus, 42*, 1–7.

[103] van den Berg, K., & Tempels, B. (2022). The role of community benefits in community acceptance of multifunctional solar farms in the Netherlands. *Land Use Policy, 122*, 106344.

[104] Trandafir, S., Thomas, P., Bidwell, D., & Rezendes, R. (2023). Community benefit agreements for solar energy: Examining values, preferences and perceived benefits in the United States using a discrete choice experiment. *Energy Research & Social Science, 106*, 103305.

[105] Azarova, V., Cohen, J., Friedl, C., & Reichl, J. (2019). Designing local renewable energy communities to increase social acceptance: Evidence from a choice experiment in Austria, Germany, Italy, and Switzerland. *Energy Policy, 132*, 1176–1183.

[106] Knox-Hayes, J., Chandra, S., Chun, J., Gowda, S., Karmakar, I., & Winer, R. (2023). The geographies, typologies, and trends of community-based organizations for solar energy in the United States. *Energy Research & Social Science, 106*, 103311.

[107] Grimley, M., Shastry, V., Kânoğlu-Özkan, D. G., Blevins, E., Beck, A. L., Chan, G., & Rai, V. (2022). The grassroots are always greener: Community-based organizations as innovators of shared solar energy in the United States. *Energy Research & Social Science, 90*, 102628.

[108] Kinder, J. B. (2021). Solar infrastructure as media of resistance, or, indigenous solarities against settler colonialism. *South Atlantic Quarterly, 120*(1), 63–76.

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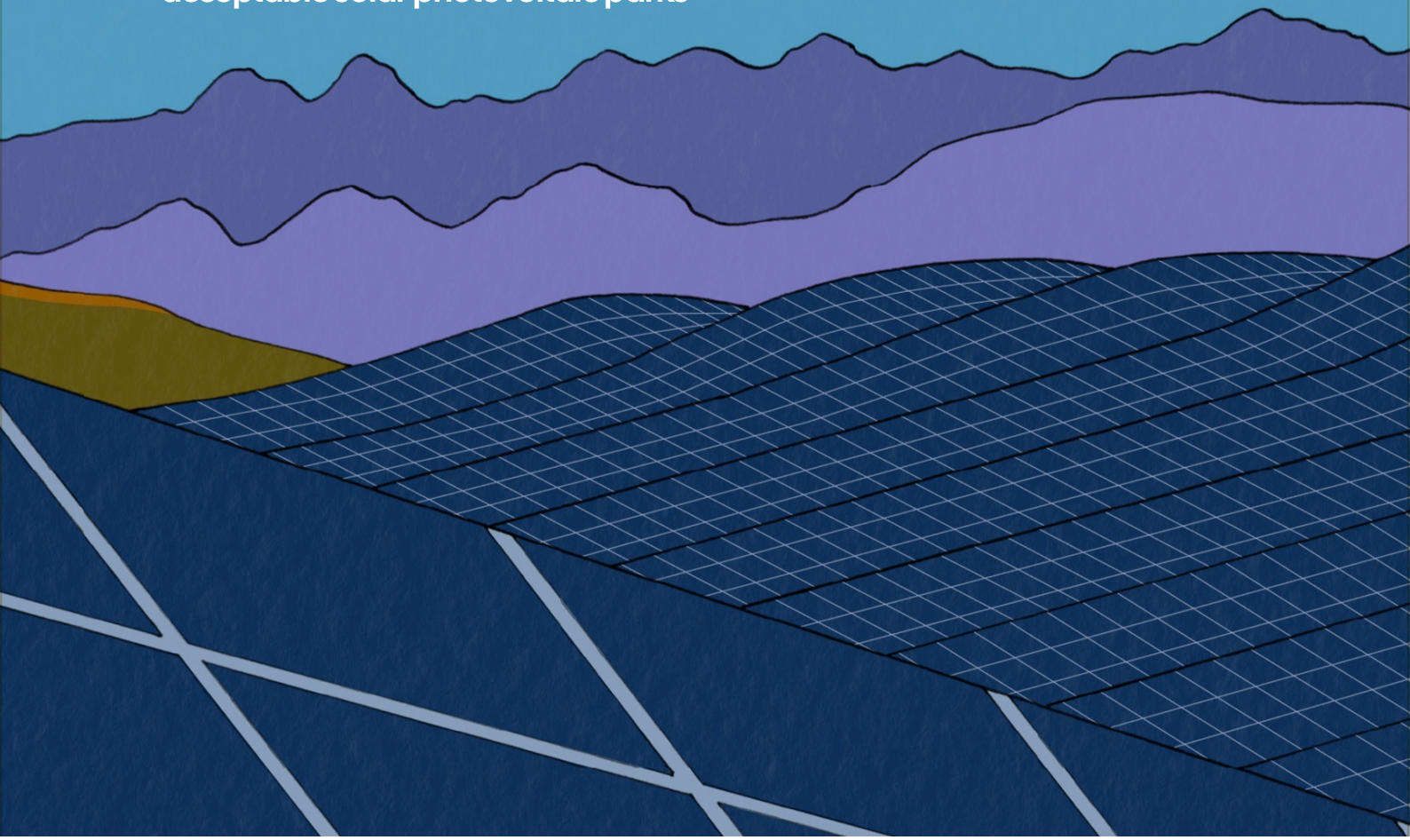

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