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Final Report

Project reference: B2023-01
Applicant's name: Susana Batel
Project title: *An updated framework on community acceptance of renewable energy infrastructures – practical guidelines for solar plants as a case study (CAREsolar)*

1. State of Research.
1.1 Research activities performed, milestones and deliverables accomplished

The CAREsolar project aimed to improve understanding of how people respond to large-scale renewable energy infrastructures and why conflicts may emerge around their deployment. It also aimed to propose practical guidelines for achieving fairer and more acceptable outcomes. To move beyond the notion that opposition is motivated by self-interestedness (the so-called NIMBY explanation), the project synthesised recent academic and grey literature on the social dimensions of solar energy and integrated contemporary approaches from social acceptance, energy justice, and political ecology. The project was organised into three main tasks:

> Task 1 – Systematic literature review: Conduct an updated review of research on community acceptance of renewable energy infrastructures, integrating recent conceptual frameworks, best practices, and empirical findings, with particular attention to large-scale solar in Portugal and Switzerland.
> Task 2 – Expert workshop: Develop and refine a comprehensive framework for understanding social responses to large-scale solar, informed by expert and stakeholder consultation, including a full-day workshop at ETH Zurich.
> Task 3 – CAREsolar Handbook: Create a practical handbook offering guidelines for policymakers, energy companies, and local communities on best practices for fostering community acceptance of large-scale photovoltaics.

To carry out Task 1, we reviewed existing conceptual frameworks and searched for case studies in Portugal and Switzerland. As solar-specific research in these contexts was limited, and global literature showed substantial diversity, we broadened the scope of the review to include other case studies around the world, as well as factors shaping the deployment of large-scale solar at different scales and dimensions. This resulted in an analysis structured around five thematic clusters: (1) institutions, (2) public perceptions, (3) impacts, (4) conflicts, and (5) solutions. Findings from this review were completed in April 2025 (Milestone 1) and directly informed Task 2. A scientific article based on the review is currently under peer review, in the second round of reviews, after a 'Revisions' decision (Milestone 2).

For Task 2, the CAREsolar workshop was held on 3 February 2025 at ETH Zurich. Experts from Switzerland, Portugal, and other relevant countries participated, with sessions organised around the five thematic clusters identified in the literature review. The workshop combined short presentations with group discussions. Audio recordings were transcribed and analysed, and the workshop report was published on the project website (Milestone 3). Plans for a second journal article dedicated solely to the conceptual framework (Milestone 5) were revised; instead, the framework was integrated into the first article, as the discussions and results from the workshop also informed the aims and contents of this first article.

Task 3 involved developing the CAREsolar Handbook, which synthesises insights from Tasks 1 and 2. The handbook begins by addressing the central question – *Why do people oppose large-scale solar projects?* – and then outlines four innovative solution pathways: socially informed site-selection tools, community involvement in landscape design, agrivoltaics, and mechanisms for ensuring local economic benefits. The final version is being reviewed, and the final document will be disseminated to stakeholders and the made available on the CARESolar website in December 2025 (Milestone 4)

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1.2 Findings

Most analytical work for this project was completed through the systematic literature review (Task 1) and subsequently deepened through the expert workshop (Task 2). These activities collectively informed the submitted scientific article and the development of the CAREsolar Handbook (Task 3). Key findings are summarised below, organised by task.

- Task 1: Systematic literature review (see Article 1)
  - This review analysed 255 peer-reviewed studies to understand *why and how conflicts occur, what their impacts are, and what solutions scholars have proposed.*
  - Research on large-scale solar has grown rapidly since 2014, but remains conceptually fragmented across social acceptance, energy justice, and political ecology frameworks.
  - Five major research themes were identified: institutions, public perceptions, impacts, conflicts, and solutions.
  - Institutional drivers – such as planning systems, land acquisition processes, and financing models – play a decisive role in generating both support and opposition.
  - Public responses are shaped not only by proximity or visual factors but by place attachments, identities, historical legacies, and trust in institutions.
  - Socio-ecological impacts include land-use conflicts, biodiversity risks, livelihood disruption, and exclusion from decision-making, particularly in rural and peripheral regions.
  - Conflicts tend to arise from perceived injustices, not NIMBYism, and evolve into organised movements drawing on shared narratives such as territorial marginalisation or “sacrifice zones.”
  - Proposed solutions include participatory spatial planning, community benefit/ownership models, and agrivoltaics, though all require careful governance to avoid reproducing existing inequalities.
- Task 2: Expert workshop
  - Experts validated the five thematic clusters and emphasised the interaction between institutions and public meanings as the central driver of acceptance or conflict.
  - Discussions revealed tensions between social acceptance and energy justice perspectives, particularly regarding the relative importance of emotions, public opinion, project-level variables, and institutional fairness.
  - Comparative insights from Portugal and Switzerland highlighted the influence of political culture, planning laws, and economic context, with notable differences in perceptions of fairness and participation.
  - Participants stressed that effective solutions – such as participatory landscape design – require balancing expert and lay knowledge and creating incentives for developers to engage meaningfully.
  - Supplementing large-scale projects with smaller or medium-sized initiatives (e.g. Renewable Energy Communities) was seen as promising but dependent on supportive governance and reduced bureaucracy.
  - Overall, the workshop reinforced the need for multi-scalar analysis and contributed to a critical, relational conceptual framework linking institutions, cultural meanings, and justice, as highlighted then in Article 1 and the Handbook.
- Task 3 – CAREsolar Handbook
  - The handbook translated research findings into practical guidelines for co-creating just and eventually acceptable solar energy projects.
  - It was aimed at developers, policymakers and local stakeholders, but is also accessible to the general public.
  - A key objective was to provide a nuanced account of the main reasons that large-scale solar projects lead to local opposition. This was done by structuring each chapter around the concept of energy justice.
  - General solutions were outlined, such as improving public engagement strategies.
  - More specifically, four innovations that can help achieve community acceptance through energy justice were described in detail:
    1. Socially informed spatial planning and participatory GIS
    2. Community-centred landscape and project design
    3. Agrivoltaics and multifunctional land-use models
    4. Local economic inclusion and benefit-sharing
  - Integrating the conceptual framework developed in Tasks 1 & 2, the handbook emphasised that any solution must address structural drivers of conflict – especially recognition, procedural and distributive injustices – rather than focus solely on attitudes or communication.

1.3 Problems

- Details about the reasons for the delay in the project were provided in the intermediate report.
- To address this delay, it was decided to integrate the conceptual article (Milestone 5) into the systematic review and to incorporate results from the workshop into the handbook.
- The systematic review is estimated to be published in the first quarter of 2026, and the online version of the handbook will be published in December 2025, while a printed version is estimated to be available in January-February 2026.

2. Annex

2.1. Publications

Please enclose the scientific publications produced in the context of the project.

1. Wallace, R & Batel, S (2026). Uneasy tensions in social responses to large-scale solar: a critical and integrative review of theoretical frameworks, objects of analysis and key research themes (in review).

2. Wallace, R (2025, February 13). CAREsolar at ETH Zurich. Workshop report. https://www.caresolar.eu/blog/workshop

2.2 Documents

1. Wallace, R & Batel, S (2026). Uneasy tensions in social responses to large-scale solar: a critical and integrative review of theoretical frameworks, objects of analysis and key research themes (in review).
2. The CAREsolar handbook. Introduction & Chapter 1 & design mock up

Date and Signature

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