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TOWARDS A JUST ENERGY TRANSITION: A PRACTICAL GUIDE FOR INTER- AND TRANSDISCIPLINARY ENERGY PROJECTS

Summary

Achieving a just energy transition requires not only technological innovation but also inter- and transdisciplinary approaches that are socially inclusive and ethically grounded. Renewable energy projects, despite their environmental benefits, can exacerbate existing inequalities if local contexts, ethical concerns, and gender dimensions are overlooked. This paper presents a practical guide developed at the Energy Center of the University of Chile, offering a structured decision-making flowchart to support the integration of interdisciplinary and transdisciplinary perspectives in energy projects. Drawing on fifteen years of field experience, the guide provides actionable tools to align technical, social, environmental, ethical, and gender considerations, fostering inclusive, equitable, and sustainable energy transitions.

Keywords: Just Energy Transition, Transdisciplinary Research, Interdisciplinary Collaboration, Decision-Making Framework

1. Introduction

In the current context of technological development and scientific research, interdisciplinary and transdisciplinary projects have become essential for addressing complex societal challenges. This approach is particularly relevant in the energy sector, where current climate change policies and energy transition efforts, both at the local and global levels, demand a rapid acceleration in technological innovation, regulatory adaptations, and the active involvement of diverse stakeholders to achieve the desired outcomes (Cohen et al., 2020). However, this often leads to the reproduction of existing inequalities, as highlighted by several studies (Dunlap, 2020; Llorente and Conde, 2022; Newell and Mulvaney, 2013; Sovacool et al., 2021; Temper et al., 2020).

While the 2030 Agenda, emphasizes the importance of an equitable energy transition, significant barriers remain for marginalized groups, including Indigenous and rural communities, to participate effectively in decision-making processes and the development of new energy configurations. These obstacles limit their ability to engage meaningfully in the shift toward low-carbon systems, challenging the inclusivity and long-term sustainability of the transition. Within these gaps, interdisciplinary and transdisciplinary approaches can play a critical role in reducing inequalities and promoting a more just transition by integrating diverse perspectives and local knowledge, thus fostering more inclusive and context-sensitive energy solutions (Montedonico et al., 2018).

In this context, the Energy Center at the University of Chile, with over 15 years of experience in interdisciplinary and transdisciplinary projects, has undertaken a reflective process to critically assess its own practices. This effort aims to address the challenges identified in the current literature and to incorporate lessons learned from its own projects, with the goal of proposing a practical guide and decision-making flowchart. These tools are intended to better navigate the interdisciplinary and transdisciplinary challenges associated with a just energy transition.

This paper presents the process, key findings, and the proposed decision-making framework developed as a result of this reflection.

2. Methods

The methodological approach for this study combined qualitative analysis and expert consultation, focusing on the systematic review of inter- and transdisciplinary energy projects conducted by the Energy Center (CEN) at the University of Chile over the past 15 years. This process began with the formation of an interdisciplinary team, including professionals from engineering, social sciences, natural sciences, and design, each with prior experience in inter- and transdisciplinary projects. This team collaboratively defined the analytical framework, drawing on their practical experiences to identify key characteristics, challenges, stakeholder dynamics, and participatory tools used in past projects.

To select the projects for in-depth analysis, a set of 10 criteria was developed, reflecting both the diversity and complexity of energy research. These criteria included the type of project (e.g., technological development, scenario design, roadmap creation), geographic scope (local, regional, national), duration, stakeholder involvement, technological focus, methodologies employed, key concepts, project phases, data collection techniques, and the extent of interdisciplinary and transdisciplinary integration. This initial review identified over 21 potential projects conducted between 2009 and 2024, from which five emblematic cases were chosen for detailed examination.

The selected projects—Esuscon, Isla de Pascua, Ayllu Solar, Landata, and Ñuble Infrastructure—represent a wide spectrum of approaches to energy transition, from community-based solar systems to participatory cartography. Each project was analyzed to extract best practices, critical success factors, and common challenges, with particular attention to the integration of local knowledge and the management of interdisciplinary collaboration. This analysis informed the creation of a decision-making flowchart and a practical guide, aimed at providing energy professionals and project leaders with actionable insights for designing and implementing future interdisciplinary and transdisciplinary energy initiatives.

This methodological framework not only highlights the diversity of contexts and approaches within the CEN's portfolio but also underscores the importance of tailoring project designs to the specific cultural, social, and technological conditions of each setting. The findings from this analysis serve as the foundation for the recommendations presented in the following sections.

3. Preliminary results

3.1. Integration of Inter- and Transdisciplinary Approaches in CEN Projects

The Energy Center (CEN) of the University of Chile has actively integrated inter- and transdisciplinary approaches into its projects since its inception. This integration has been essential for addressing the complex challenges of energy transitions, requiring diverse expertise and local knowledge. The preliminary results from the selected projects reveal several key findings.

CEN projects have consistently engaged professionals from a wide range of disciplines, including electrical and mechanical engineering, agronomy, anthropology, sociology, natural resource engineering, architecture, geography, and journalism. This interdisciplinary collaboration has enabled the creation of comprehensive research outputs, reflecting the multifaceted nature of energy challenges. Additionally, the projects have incorporated transdisciplinary methodologies, focusing on community participation and the integration of local knowledge. Techniques such as participatory cartography, dream mapping, and boundary objects have been used to reduce information gaps and foster informed decision-making among local actors. For example, the Rapa Nui (2015) and Landata (2023) projects utilized 3D and 2D cartography, respectively, to capture local energy needs and cultural contexts, supporting more contextually appropriate energy solutions.

Despite the success of these participatory methodologies, budget and time limitations remain significant barriers. Many CEN projects operate within tight financial and temporal constraints, often limiting the depth and scope of interdisciplinary and transdisciplinary approaches. For instance, the typical duration of projects ranged from 6 months (e.g., the Landata project) to 5 years (e.g., the Esuscon project in Huatacondo), with shorter timelines often restricting community involvement and reducing the long-term impact of the solutions developed. Projects like Esuscon, Isla de Pascua, and Ayllu Solar highlight the need for flexible and context-specific methodologies. The Ayllu Solar project, for example, adopted a co-construction approach, which, while innovative, also revealed challenges related to gender inclusion and local leadership. This project underscored the importance of early diagnostics to identify and address potential biases in project design and implementation.

A consistent finding across projects is the critical role of small, interdisciplinary teams in leading participatory processes. These teams often act as knowledge brokers, bridging technical and local knowledge to co-create solutions with communities. Establishing such teams from the project outset is essential for maintaining momentum and ensuring the effective integration of diverse perspectives.

Effective data management and knowledge transfer have emerged as key challenges. While projects have utilized a range of dissemination tools (e.g., digital repositories, educational booklets, videos), the lack of standardized protocols for information sharing has sometimes hindered the long-term impact and scalability of project outcomes. Future projects should prioritize the creation of structured data management plans to ensure the continued use of project findings by local and external stakeholders

3.2. Recommendations for Future Projects
Building on the insights gained from this analysis, we have developed a decision-making flowchart for interdisciplinary and transdisciplinary energy projects. This flowchart synthesizes the lessons learned from the projects reviewed, providing a structured approach to guide the planning and execution of future initiatives. It includes four main stages: Analysis of Pertinence, Preliminary Design, Project Development, and Evaluation and Feedback. The guide and decision-making flowchart aim to provide practical tools for energy project teams and leaders to address the interdisciplinary and transdisciplinary challenges associated with a just energy transition.

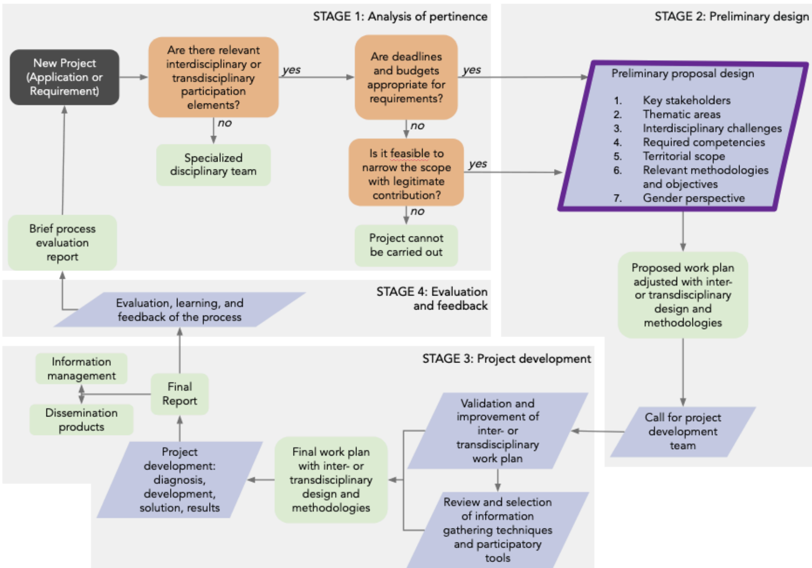

Fig. 1: Decision flowchart for an interdisciplinary and transdisciplinary project in the energy sector (Source: own elaboration)

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