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Beyond Technical Feasibility: Cross-National Stakeholder Perspectives on Energy Transitions

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Table of Contents

Abstract

We synthesize findings from stakeholder consultations conducted across seven case studies (France, Hungary, Italy, Kenya, Nigeria, Pakistan, and at the EU level) to identify implementation barriers for energy transitions that extend beyond technical feasibility. Through workshops and interviews engaging over 100 stakeholders from government, industry, civil society, and research institutions, we document challenges that are often underrepresented or operationalized only partially in quantitative energy scenarios. Despite the diverse geographical, institutional, and developmental contexts represented, stakeholders demonstrated substantial convergence on eight core barrier categories: social acceptance and behavior, economic and financial costs, governance and policy coherence, political power and vested interests, regulatory and administrative barriers, technology and infrastructure constraints, workforce and skills gaps, and industrial and supply chain bottlenecks. These barriers often operate as interconnected challenges—for instance, high upfront costs for clean technologies may undermine social acceptance among lower-income populations. The findings suggest that practitioners possess a sophisticated understanding of systemic implementation dynamics that formal models currently often underrepresent, and highlight the need to integrate social, political, and institutional factors into energy transition scenarios. Without accounting for these constraints, technically coherent transition pathways may prove difficult to implement, potentially misleading policymakers and eroding public confidence in the feasibility of sustainable energy futures.

1. Introduction

The transition from fossil fuel-based energy systems to renewable and sustainable alternatives has become a central imperative for addressing climate change and achieving sustainable development objectives. This energy transition represents a complex socio-technical transformation requiring coordinated action across multiple sectors and governance levels, with implications that often extend beyond technical system changes to encompass fundamental questions of societal organization and development pathways.

Energy transitions involve multiple interconnected dimensions—technological innovation, economic restructuring, environmental protection, social equity, and governance systems—making them inherently complex processes that require comprehensive analytical approaches.[1] Scenarios have emerged as essential tools for navigating the intricacies of energy transitions by providing plausible future outlooks that guide sustainability transformations through model-based pathways (Wiek et al., 2006; Weyant et al., 1995; Weyant, 2017; Hare et al., 2018). However, classical scenario literature exhibits important limitations in capturing the full complexity of these transitions. While recent synthesis reports emphasize the importance of social, cultural, and political developments (see, for example, Chapter 5 of the WG3 contribution to the IPCC AR6 report; Creutzig et al., 2022), these dimensions often remain weakly integrated in energy transition scenarios (Zens et al., 2024). This underrepresentation of sociopolitical factors—including political resistance, social opposition, governance failures, institutional barriers, and public trust dynamics—risks producing scenarios that, while technically coherent, insufficiently account for real-world implementation challenges (Smith & Mayer, 2018; Cologna & Siegrist, 2020; Sovacool, 2021).

While existing conceptual work has recognized the importance of socio-political dynamics in energy transitions (Geels, 2002; Meadowcroft, 2009; Turnheim et al., 2015; Cherp et al., 2018; Köhler et al., 2019; Cologna and Siegrist, 2020), cross-national syntheses of stakeholder perceptions remain scarce. Our study addresses this gap through a structured stakeholder engagement approach.[2] Through consultations with more than 100 stakeholders across France, Hungary, Italy, Kenya, Nigeria, Pakistan, and the EU level, we document perspectives on implementation barriers that extend beyond traditional scenario dimensions. These consultations capture insights on social impacts, governance challenges, financial constraints, and political obstacles that stakeholders identify as important for transition success. Our multi-country approach reflects the need to understand sustainability challenges across diverse development contexts, recognizing that transition pathways must be adapted to local conditions while addressing global imperatives.

The primary objective of these stakeholder engagements is to identify and synthesize cross-cutting barriers that emerged from these diverse consultations. We view this stakeholder-informed barrier identification as essential for developing more realistic and implementable future scenarios that incorporate the complex social, political, and institutional mechanisms currently often underrepresented in transition feasibility assessments. Our analysis contributes to transition studies

[1] This research is conducted within the SPES (Sustainability Performances, Evidence and Scenarios) project, a Horizon Europe initiative (2022-2026) that develops innovative approaches to measuring and analyzing sustainable human development. The SPES framework identifies energy as a cross-cutting policy field across five analytical pillars: productivity, equity, environmental sustainability, participation & empowerment, and human security. See Biggeri et al. (2023) and https://www.sustainabilityperformances.eu/ for more information.

[2] This stakeholder-focused analysis complements other SPES research examining bottom-up citizen perspectives on environmental sustainability across different global contexts; compare Dokken et al. (2025).

literature, particularly the multi-level perspective on socio-technical transitions (Geels, 2002) and frameworks focusing on the politics of transitions (Meadowcroft, 2009). Empirically documenting how implementation barriers manifest across diverse national contexts further contributes to advancing politically-informed transition analysis (Köhler et al., 2019).

Despite originating from diverse institutional, geographical, and sectoral backgrounds, stakeholders demonstrated notable convergence on several fundamental barrier categories—including social opposition, governance failures, financial constraints, and technological bottlenecks. This convergence suggests these barriers may represent systematic challenges that should be addressed in credible transition strategies, reinforcing the need for scenarios that fully integrate social and political dimensions alongside technical pathways.

The remainder of this study is structured as follows. Section 2 details the methodological approach and technical aspects of the stakeholder engagements. Section 3 synthesizes the primary stakeholder insights regarding implementation barriers across different thematic blocks. Section 4 concludes with discussion of implications for future scenario development and priority areas for future research.

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