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Bridging Regional Divides in Decarbonization: Firm Strategies, Policy Tensions, and Structural Trade-offs in Portugal

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The transition to a low-carbon economy is shaped by structural tensions and trade-offs that impact firms, regions, and policymakers. A central challenge is balancing regional equity, industrial specialization, and technological innovation in decarbonization policies (Markard & Rosenbloom, 2022). This study critically examines these tensions by analysing firm-level decarbonization strategies within the Portugal 2020 (PT2020) program, revealing how economic structures shape sustainability transitions and the effectiveness of policy interventions.

Employing a multi-method approach—combining natural language processing (NLP), systematic literature review, and firm-level data analysis— we identified a subset of 278 projects related to decarbonization (approximately 10%) from the 2,793 firms funded by PT2020 between 2020 and 2023 through EU Structural Funds, and classified these projects. Findings highlight a geographically uneven transition, where urban-industrial hubs like Porto lead decarbonization efforts, while peripheral regions struggle with structural barriers (Grillitsch & Hansen, 2019). The most common decarbonization pathways—demand reduction (43.5%) and electricity decarbonization (36.5%).

The results underscore the spatial concentration of decarbonization investments, reflecting regional disparities in industrial capacity, policy support, and firm-level capabilities. Established firms in core regions are more likely to engage in decarbonization, benefiting from stronger innovation ecosystems and financial resources, while smaller firms and peripheral regions face structural constraints (Neffke et al., 2018; Vale et al., 2024). The Lisbon metropolitan area, despite being a highly developed region, receives less PT2020 funding due to its classification under EU cohesion policy, reinforcing uneven regional participation in sustainability transitions.

The structural trade-offs of decarbonization emerge clearly in the relationship between industrial productivity, regional CO₂ emissions, and investment patterns. Firms in high-emission regions show greater engagement in decarbonization, likely driven by regulatory pressures and sectoral exposure to environmental policies (Bento et al., 2021). However, industrial CO₂ intensity does not consistently predict investment in decarbonization, suggesting that high-polluting industries access alternative funding streams beyond PT2020 (Markard et al., 2023).

Moreover, urbanization does not show a strong correlation with decarbonization investments, challenging assumptions that urban areas inherently lead in sustainability transitions. Instead, sectoral and industrial composition appears to be a more significant determinant (Vale et al., 2024a). These insights align with the multi-scalar perspective in sustainability transitions, highlighting the need for context-specific policies that account for regional economic structures (Coenen et al., 2021).

These findings align with IST'25's focus on tensions in sustainability transitions, particularly the trade-offs between speed, depth, and inclusivity in structural change. Rapid decarbonization efforts risk exacerbating regional inequalities, as wealthier regions and industries accelerate their transitions, leaving peripheral areas struggling with technological and financial constraints (Lawhon & Murphy, 2012; Rodríguez-Pose & Bartalucci, 2024).

This study contributes to the broader debate on sustainability transitions, revealing how regional and industrial structures mediate decarbonization efforts. The uneven distribution of PT2020-funded projects, combined with sectoral trade-offs and policy asymmetries, underscores the need for place-sensitive strategies.