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IMPLEMENTATION GAPS IN RENEWABLE ENERGY INTEGRATION: EVIDENCE FROM RURAL PRACTITIONERS IN BULGARIA, ESTONIA, SLOVENIA, AND SPAIN

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ABSTRACT
PURPOSE: This study examines the implementation gaps between renewable energy policies and their practical application in rural agricultural and forestry sectors across four European Union member states. METHODS: Through a mixed-methods analysis of practitioner responses from Bulgaria, Estonia, Slovenia, and Spain, combined with recent policy developments, we identify critical barriers and successful strategies for rural renewable energy integration. RESULTS: The research reveals significant variations in policy effectiveness, with administrative complexity and community acceptance emerging as primary implementation challenges. Financial mechanisms show mixed effectiveness across countries, while energy community development remains constrained by regulatory gaps and local capacity limitations. CONCLUSIONS: The findings indicate that successful implementation requires context-sensitive approaches that address specific regional challenges while maintaining policy coherence at multiple governance levels. The study provides evidence-based recommendations for policymakers at EU, national, and regional levels to enhance renewable energy integration in rural areas.

Keywords: renewable energy policy, rural development, implementation gap, energy communities, agricultural sector, policy effectiveness

INTRODUCTION

The integration of renewable energy in rural agricultural and forestry sectors represents a critical component of the European Union's climate transition strategy. Building on previous research that identified significant policy frameworks and support mechanisms across EU member states (1), this study examines the implementation reality through direct practitioner experiences. While policy frameworks have evolved rapidly since 2023, with new legislation such as the revised Renewable Energy Directive (EU) 2023/2413 and enhanced REPowerEU implementation, the gap between policy design and practical implementation in rural contexts remains poorly understood.

Rural areas possess substantial renewable energy potential, with recent research indicating that rural regions could theoretically produce around 10,000 TWh per year from renewable sources—more than five times the EU's current electricity consumption (2). However, persistent implementation barriers limit the realisation of this potential, particularly in agricultural and forestry sectors where land use conflicts, regulatory complexity, and limited technical capacity create unique challenges.

This research addresses three key questions:

1. What are the primary implementation gaps between renewable energy policies and their practical application in rural contexts?
2. How do policy effectiveness and barriers vary across different EU member states with varying renewable energy maturity levels?
3. What evidence-based recommendations can enhance policy implementation at multiple governance levels?

Policy implementation research has evolved from early top-down models emphasising hierarchical control to more nuanced frameworks recognising the complexity of multi-level governance (3). In renewable energy contexts, implementation gaps often

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emerge from misalignment between policy design assumptions and local implementation realities (4). Recent studies emphasize the importance of "street-level bureaucrats" and local implementers in shaping policy outcomes (5).

Rural renewable energy implementation faces distinct challenges compared to urban contexts. Herbes et al. (6) identified key barriers including limited grid infrastructure, complex land use regulations, and community acceptance issues. Recent research by Soeiro and Ferreira Dias (7) found that energy cooperatives in Southern European countries face additional challenges including market dominance by large utilities and low citizen trust in collective action.

Comparative research across EU member states reveals significant variations in renewable energy policy effectiveness. Capellán-Pérez et al. (8) found that Spain's cooperative model effectively addresses multiple barriers simultaneously, while Wierling et al. (9) documented the economic multiplier effects of community energy models in various European contexts. However, limited research examines implementation experiences from practitioners' perspectives across diverse national contexts.

The revised Renewable Energy Directive (EU) 2023/2413 introduced enhanced provisions for energy communities and simplified administrative procedures. Member states have responded with varying implementation approaches, from Bulgaria's new energy community definitions to Estonia's ambitious 100% renewable electricity target by 2030, although the country has since revised its approach, acknowledging it is unlikely to happen within that timeframe. These rapid policy changes create opportunities to examine implementation challenges in real-time.

METHODS

This study employs a mixed-methods approach combining quantitative analysis of practitioner survey responses with qualitative thematic analysis of open-ended responses. The research design follows a concurrent embedded model (QUAN + qual), where quantitative data provides the primary analytical framework while qualitative insights explain and contextualize quantitative findings.

Data was collected through a structured questionnaire administered to renewable energy practitioners in rural agricultural and forestry sectors across four EU member states: Bulgaria, Estonia, Slovenia, and Spain. The questionnaire was designed as a follow-up to previous policy analysis research, targeting practitioners with direct experience in renewable energy project implementation.

The questionnaire comprised 47 questions organised into seven thematic areas:

1. Technology adoption patterns
2. Policy implementation gaps
3. Administrative procedures and barriers
4. Financial support mechanisms
5. Policy integration and coordination
6. Stakeholder engagement
7. Policy recommendations

Descriptive statistics and cross-country comparisons were conducted for closed-ended questions, including effectiveness ratings, ranking questions, and categorical responses. Given the small sample size, analysis focused on identifying patterns and variations rather than statistical significance testing. Open-ended responses were analysed using the Framework Method (10), involving systematic coding, thematic development, and cross-case pattern identification. The analysis followed seven stages: transcription, familiarisation, coding, framework development, application, summarisation, and interpretation.

The study limitations include small sample size, potential selection bias toward practitioners with strong renewable energy backgrounds and limited geographic representation within countries. However, the depth of practitioner knowledge and diversity of country contexts provide valuable insights into implementation realities.

RESULTS

The adoption of renewable energy technologies exhibits distinct regional patterns, reflecting both technological suitability and local socio-economic conditions. All respondents identified Solar PV and Biomass/Biogas as the most successfully adopted renewable energy technologies in their regions **(Table 1).** Wind energy adoption showed variation, with strong adoption in Spain and Bulgaria but limited adoption in Estonia due to community resistance and geographic constraints. Agri-PV (combined agricultural and solar production) emerged as an innovative approach in Bulgaria, Slovenia, and Spain, indicating growing interest in land-use optimisation strategies.

Table 1. *Renewable Energy Technology Adoption Patterns by Country*

Country	Technologies Successfully Adopted
Estonia	Solar PV, Biomass/Biogas
Slovenia	Solar PV, Biomass/Biogas, Agri-PV
Spain	Solar PV, Biomass/Biogas, Wind, Agri-PV
Bulgaria	Solar PV, Biomass/Biogas, Wind, Agri-PV, Hydropower

Source: Own contribution

The policy conflict matrix reveals that food security/agricultural production conflicts are universal (100% of respondents), while biodiversity/nature conservation, landscape preservation, and water management conflicts affect most of cases. Estonia shows the highest conflict intensity across all domains, while Bulgaria reports the fewest conflicts, potentially reflecting earlier stages of renewable energy deployment.

Table 2. *Policy Priority Rankings for Accelerating Rural Renewable Energy Adoption*

Country	Simplified Administrative Procedures	Increased Financial Support	Policy Integration	Energy Communities	Technology Incentives
Estonia	1	2	3	1	3
Slovenia	5	5	4	4	4
Spain	3	1	2	4	5
Bulgaria	1	4	2	3	5

Note: 1=Most Important, 5=Least Important for accelerating adoption
Source: Own contribution

The priority rankings in **Table 2** reveal strong consensus on the importance of simplified administrative procedures (ranked 1 by three countries) and increased financial support (ranked 1-2 by most countries). Energy community support shows moderate priority, while technology-specific incentives consistently rank lower in importance.

Practitioners rated the effectiveness of six policy instruments on a scale from "Very Ineffective" to "Very Effective". Feed-in Tariffs showed mixed effectiveness, with Estonia rating them as "Very Effective" while other countries showed more moderate ratings. This variation reflects different national implementation approaches and market maturity levels. Investment Subsidies were consistently rated as effective across countries, with Slovenia and Estonia providing particularly positive assessments. This finding suggests that direct financial support remains crucial for rural renewable energy adoption.

Tax Incentives' effectiveness varied significantly, with Slovenia rating them as "Very Effective" while Estonia found them "Not Applicable," reflecting different national tax policy approaches. Energy Community Support was generally rated as less effective, with Bulgaria rating it as "Very Ineffective" and other countries showing neutral to moderate effectiveness. This finding highlights the nascent state of energy community development across these countries.

Administrative procedures remain a critical determinant of renewable energy project viability, often shaping both the pace and feasibility of implementation. **Table 3** highlights cross-country differences in permitting timelines and key regulatory barriers, illustrating how environmental assessments, grid access, and land-use rules create uneven challenges across the studied regions.

Table 3. *Administrative Timelines and Primary Barriers*

Country	Permitting Timeline	Primary Administrative Barriers
Estonia	1-2 years	Environmental impact assessments, Grid connection applications, Community/public consultation requirements
Slovenia	6-12 months	Environmental impact assessments, Land use change permissions, Subsidy/grant application processes
Spain	1-2 years	Environmental impact assessments, Grid connection applications, Subsidy/grant application processes
Bulgaria	3-6 months	Environmental impact assessments, Grid connection applications, Land use change permissions, Building permits

Source: Own contribution

Permitting processes typically require 6 months to 2 years, with significant variation by country and project type. Bulgaria demonstrated the shortest timelines (3-6 months) following recent administrative simplifications, while Estonia and Spain require 1-2 years for most projects.

Environmental impact assessments emerged as the most common barrier across all countries, followed by grid connection applications and building permits. Slovenia and Bulgaria additionally face significant challenges with land use change permissions. Three countries (Estonia, Spain, Bulgaria) reported significant regional variations in regulatory requirements, creating additional complexity for developers and investors.

Direct subsidies and grants ranked highest in effectiveness across multiple countries, with feed-in tariffs showing strong performance in specific contexts. This pattern demonstrates the continued importance of direct financial support in rural contexts. Carbon credit payments consistently ranked lowest across countries, suggesting limited practical implementation or awareness of these mechanisms in rural contexts. Financial support typically covers 21-60% of total project costs, with significant variation by country and project type. Estonia showed lower coverage (0-20%) while Slovenia and Bulgaria achieved higher coverage levels (41-60%).

The degree of integration between energy and agricultural policies varies across EU countries, influencing the extent to which policy objectives are harmonised or come into conflict, visible in **Table 4**. The analysis indicates that policy integration between energy and agriculture remains uneven across the studied countries. All countries report conflicts between renewable energy deployment and other policy priorities.

Table 4. *Energy-Agriculture Policy Integration Assessment*

Country	Integration Level	Primary Policy Conflicts
Estonia	Some coordination but operating largely independently	Biodiversity/nature conservation, Landscape preservation, Water management, Rural tourism/cultural heritage, Food security/agricultural production
Slovenia	Limited coordination with occasional conflicts	Food security/agricultural production, Biodiversity/nature conservation, Landscape preservation, Water management
Spain	Some coordination but operating largely independently	Food security/agricultural production, Biodiversity/nature conservation, Landscape preservation, Water management, Rural tourism/cultural heritage
Bulgaria	Limited coordination with occasional conflicts	Food security/agricultural production, Food security/agricultural production

Source: Own contribution

DISCUSSION

The analysis reveals consistent implementation gap patterns across diverse national contexts, suggesting that certain challenges transcend specific policy designs or national characteristics. Administrative complexity emerges as a universal challenge, even in countries that have recently implemented simplification measures. This finding suggests that administrative simplification requires ongoing attention and cannot be addressed through one-time policy reforms.

Community acceptance represents another consistent challenge, particularly pronounced in Estonia's wind energy development but present across all countries and technologies. This finding aligns with broader European research on renewable energy acceptance (10) and suggests that technical policy solutions alone are insufficient without addressing social and cultural dimensions of energy transitions.

Bulgaria's recent administrative simplifications demonstrate rapid policy learning and adaptation. The reduction of permitting timelines from years to months following 2023 reforms provides a model for other countries facing similar administrative barriers.

Estonia's emphasis on market-based mechanisms and grid integration (Nord Pool) provides long-term investment certainty while maintaining competitive pricing. However, this approach faces challenges with community acceptance and political stability.

Slovenia demonstrates effective balance between financial support and regulatory stability, though the small country size may limit scalability of this approach to larger member states.

Spain's integrated approach through the National Energy and Climate Plan provides policy stability while maintaining flexibility for regional adaptation. The emphasis on public-private partnerships offers lessons for other countries.

The strong preference for direct subsidies and grants across countries suggests that upfront capital barriers remain more significant than operational support needs. This finding contrasts with theoretical preferences for market-based mechanisms and suggests that rural renewable energy adoption still requires substantial public financial support. The limited effectiveness of carbon credit payments indicates either poor implementation of these mechanisms or limited awareness among rural practitioners. This finding suggests opportunities for enhanced education and support for market-based environmental payment systems.

The consistently low effectiveness ratings for energy community support mechanisms reveal significant implementation gaps in this critical policy area. Despite EU-level emphasis on energy communities as vehicles for rural energy development, practical support mechanisms remain underdeveloped across all countries studied. Energy community development requires more fundamental capacity building and regulatory development than initially anticipated by policymakers.

The prevalence of policy conflicts across countries indicates that renewable energy integration cannot be addressed through energy policy alone. Successful implementation requires coordination across multiple policy domains, particularly agriculture, environment, and land use planning. Spain's more developed coordination mechanisms provide a model for other countries, though the effectiveness of these mechanisms requires longer-term evaluation to assess their impact on implementation outcomes.

POLICY RECOMMENDATIONS

The integration of renewable energy into rural agricultural and forestry systems requires coordinated action across EU, national, and local levels. The EU should provide detailed rural-specific guidance on renewable energy integration, standardising procedures for environmental assessments, grid access, and community engagement. Dedicated support for energy communities—including technical assistance, capacity building, and pilot funding—is essential to translate regulatory frameworks into practice. Stronger cross-sectoral integration is also needed, aligning energy, agriculture, biodiversity, and rural development objectives through joint assessment frameworks.

Member states should pursue administrative simplification, adopting one-stop-shop models and clear efficiency targets, as demonstrated in Bulgaria. Structured community engagement frameworks are crucial, ensuring participation beyond technical consultations, while policy stability mechanisms can balance long-term investment certainty with adaptive flexibility, as in Spain. Innovative financial instruments are also required to address rural-specific constraints such as seasonal cash flows, limited collateral, and high transaction costs.

At the local level, capacity building for municipalities, farmer organisations, and communities should focus on technical expertise, project development, and access to finance. Pilot projects can showcase effective models of renewable energy integration, as seen in Slovenia, while mechanisms to ensure tangible local benefits—jobs, infrastructure, and community ownership—are critical for sustaining public support.

In sum, successful renewable energy integration in rural areas depends on aligning EU guidance, national reforms, and local initiatives into a coherent, multi-level governance framework that balances energy, agricultural, and community priorities.

CONCLUSIONS

This study provides empirical evidence of significant implementation gaps between renewable energy policies and their practical application in rural agricultural and forestry sectors across four EU member states. Despite varying national contexts and policy approaches, consistent challenges emerge around administrative complexity, community acceptance, regulatory gaps, and financial barriers.

The research demonstrates that successful implementation requires context-sensitive approaches that address specific regional and national challenges while maintaining policy coherence across governance levels. Countries showing greater implementation success combine simplified administrative procedures, stable policy frameworks, effective financial

support, and systematic community engagement.

Key findings include:

1) Administrative simplification requires ongoing attention and cannot be addressed through one-time reforms;
2) Energy community development needs substantial capacity building and regulatory support beyond current frameworks;
3) Cross-sectoral policy integration remains underdeveloped despite widespread recognition of its importance;
4) Direct financial support mechanisms show greater effectiveness than market-based approaches in current rural contexts.

Future research should examine longer-term implementation outcomes, particularly for recent policy innovations like energy communities and agri-PV systems. Additionally, broader surveys with larger sample sizes could test the generalisability of findings across diverse rural contexts within and beyond the countries studied.

The evidence presented supports calls for enhanced EU-level coordination and support for renewable energy implementation in rural areas, while recognising the importance of national and regional adaptation to local contexts and needs.

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