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How Is Social Acceptance Reflected in National Renewable Energy Plans? Evidence from Three Wind-Rich Countries

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Abstract: This article contributes to discussions of the social acceptance of renewable energy (RE) by developing an analytical framework that considers three dimensions (community, market, and political-regulator) at three different scales (macro, meso, and micro). This framework is conceived in order to identify those dynamics that are potentially counterproductive to the energy transition and need further policy emphasis, as well as supporting those that demonstrate a positive impact. Using this framework, we critically reflect on the 2010 National Renewable Energy Action Plan (NREAP) policies of three European countries with high wind resources: Denmark, Ireland, and the UK. Within the RE policy landscapes of these three countries lies the contentious issue of social acceptance of wind power. The framework analysis reveals similar policy profiles for each country, characterized by a heavy focus on the market dimension at all scales, an effort to allow private business to steer the transition, and a low focus on the community dimension. In doing so, our research reveals how policy-making processes have privileged the voice of actors who are able to communicate quantifiable data and evidence to support their position, and these actors thereby have greater influence to shape national energy policies.

Keywords: social acceptance; energy policy; transition

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1. Introduction

1.1. Energy Modeling, Planning, and Social Acceptance

Many countries have now embarked on a transition to low-carbon energy systems, primarily motivated by the twin imperatives of greater energy security and climate change mitigation. In the case of EU Member States, this transition is influenced by the European Parliament's vision. In 2009, the EU published the Renewable Energy Directive in an effort to reduce CO_2 emissions. In 2010, Member States submitted National Renewable Energy Action Plans (NREAPs) that outlined their current and upcoming policies to increase their share of renewable energy (RE) and reach the Directive's target of 20% of electricity from RE [1].

Such national energy strategies are informed by large-scale models that seek to address sustainability and climate change goals [2] based on the current understanding of available resources, technological development, and financial viability of different forms of energy infrastructure. So-called 3E (energy, environment, and economics) models are typically linear optimization models and provide the least-cost solution for a future energy system that meets the projected future energy demand subject to the constraints (e.g., carbon budget) and assumptions (future cost curves) given exogenously. At the national level, these models are generally operated by national energy agencies or ministries (or, alternatively, by other experts on their behalf), who will advise governments in the setting of national targets and supporting policies. Therefore, this paper critically reflects on the

3E modeling approach to energy policy and planning by investigating and categorizing the key dimensions of social acceptance. In doing so, this research contributes to the literature discussed below on the issue of social acceptance of RE technologies.

Any targets that may emerge from national energy strategies then rely on other policy instruments, including fiscal tools and spatial planning to stimulate and regulate implementable projects. Spatial planning has particular relevance here, as it is the process that translates the targets into meaningful phenomena at the community level; hence, it is at the local spatial planning level that modeling results are actually reified into tangible outcomes experienced by the population.

Meanwhile, social science researchers [3,4] have emphasized that increased participatory processes and better understanding of local dynamics are necessary in order for populations to better understand global macro visions of large-scale RE deployment and to accept the effects on their local communities. More generally, there is growing evidence that macro-level techno-economic modeling tools used by government agencies offer inaccurate projections for most renewable energy types in the mid- and long-term, due to structural limitations and inconsistencies in the underlying models used [5]. Indeed, the vast majority of macro-level techno-economic modeling tools cannot yet take into account local political and community preferences or dynamics (upcoming). Therefore, researchers have emphasized the importance of social acceptance as a key consideration in the formulation of sustainable and inclusive energy policy and planning [6,7].

This paper aims to contribute to this research on the influence of policies on social acceptance by proposing the development of an analytical framework that addresses the interactions between actors at different scales of the energy and planning sectors. The reasoning is to be able to identify those dynamics that are potentially counterproductive to the energy transition and therefore need further policy emphasis, as well as supporting those that demonstrate a positive impact. We discuss below the European context of RE global and national targets and the particular difficulties raised by onshore wind power, before detailing our proposed analytical framework and applying it to three wind-rich case study countries: Denmark, Ireland, and the UK. Finally, we discuss our aggregated results in a more general EU context and their implications for further wind power deployment.

1.2. Wind Energy and Social Acceptance

Wind energy is a crucial renewable source for Europe. This is reflected in the EU's RE Directive [1] and, consequently, the Member States' NREAPs. Wind energy has one of the lowest life-cycle assessments among energy sources [8], onshore wind has one of the lowest levelized costs among renewables, the cost of offshore wind has decreased rapidly [9], and Europe benefits from numerous places with wind characteristics adapted to harnessing the resource [10]. Onshore wind is currently the second-largest renewable electricity producer in Europe after large hydropower, the latter of which has already reached its full potential [11]. Given that the hub heights of wind turbines gradually increase as the technology matures and that the powering-down effect of turbulence decreases with altitude, there are good technological prospects for continued improvements in turbine efficiency and output from onshore wind farms [12].

However, wind energy, even at large power capacity, has a low power density per unit of surface area and thus requires large tracts of land or off-shore seabed to become a substantial part of national energy portfolios [13]. Even with regular improvements to the technology, the land requirements, combined with policies setting advantageous financial support for developers in several EU countries, have left spatial planning departments to deal with rapidly growing numbers of wind power projects for which they have had to comprehensively assess impacts and feasibility [4]. This has often been undertaken in an adversarial context that has left both developers and host communities dissatisfied, with the former often complaining about the negative effect of delay and uncertainty on investors and the latter regularly concerned about the visual and distributive impacts resulting from wind energy projects. The translational process from RE targets to implementable wind energy projects has therefore met a range of barriers and triggered strong opposition movements among communities across Europe [14–18].

Denmark and the UK have recently distanced themselves from onshore wind power in favor of offshore resource exploitation, officially citing the impacts on local populations [19] and the failure to secure public acceptance [20] as explanations for their decisions. Given the importance of onshore wind to the NREAPs, the cumulative effect of such issues has reduced the overall capacity of this technology and could have significant consequences for national low-carbon energy strategies.

1.3. Frameworks for Social Acceptance

A number of frameworks have been proposed to help understand the complexity of social acceptance and its drivers. We review these frameworks to provide an underpinning for the framework we develop in our study. For example, Wüstenhagen et al. [21] suggested that social acceptance of renewable energies is shaped by three dimensions—market, socio-political, and community—thus distinguishing a universal and homogenizing sense of acceptance (often represented by 'positive' national opinion polls) from its representation in policies and the varied reaction of local communities. A second observation was the lack of clarity, mainly within the market sector's outgoing communication, which kept the community level from fully grasping the extent of the energy transition orchestrated in most countries by the market and socio-political dimensions [21]. Sovacool and Lakshmi Ratan [22] elaborated on Wüstenhagen et al.'s [21] model by developing the three dimensions into nine factors that "create conditions where socio-political, community, and market acceptance of renewable electricity technologies will occur" [22]. They listed the sub-criteria shown in Table 1 with the purpose of better guiding the assessment of an energy system and its openness towards a selected technology.

Table 1. Description of Sovacool and Lakshmi Ratan's (2012) framework, Source: (Sovacool and Lakshmi Ratan, 2012).

Dimension	Specific Factors		
Market	Competitive installation/production costs	Mechanisms for information and feedback	Access to financing
Socio-political	Strong institutional capacity	Political commitment	Favorable legal and regulatory frameworks
Community	Prolific community/individual ownership and use	Participatory project siting	Recognition of externalities or positive public image

Fournis and Fortin [23] also developed a framework similar to Wüstenhagen et al.'s by introducing scalar aspects through examining the "collective choices that determine the articulation between technology and society within a specific territory" and discussing the idea of developing the acceptability of technologies instead of seeking acceptance [23]. They built a framework focused on wind power and based on Szarka's [24] concept of social acceptability, adding political and decision-making processes as key factors shaping the degree of acceptance within each dimension/scale: macro, meso, and micro [14,24,25].

Table 1 summarizes the basis on which we build our framework that disaggregates each dimension into three scales. In large part, the rationalities operating at the macro scale relate to that of the market dimension characterized by competition, innovations influenced by investment trends, and path dependency [24]. The usual actors are developers, manufacturers, national to supra-national political authorities, and banking institutions [26], now evolving in a context of market globalization [23,26]. The meso level relates to decisions made by local authorities (e.g., project planning consents) and preferences indicated in national energy policies, thus relating to the socio-political dimension. Common actors are policymakers and authorities holding powers of energy governance [14,27,28]. The micro-level focuses on the individuality that identifies each person's perception of wind energy and thus relates to the community element. Its actors are the individuals who ultimately form the aggregated local opinion towards interest or disinterest, support or opposition, and follow rationalities of cost or benefits of projects for local populations, public health, and place attachment [29,30].

While this does provide us with a useful conceptual frame to understand the complexity of social acceptance/acceptability, it is still unable to capture the whole range of interactions between actors and differing scales. Indeed, in a recent review conducted for the European Commission, Ellis and Ferraro [31] highlighted some of the limitations of social acceptance research and recommended further research with cross-scalar and dimension perspectives [31], with similar points also being made by Devine-Wright et al. [32]. Therefore, our research seeks to improve our understanding of scalar interactions within RE deployment, focusing on the critical question of social acceptance.

Given the role and importance played by energy policies with regard to national planning, there is a need to increase understanding as to how social acceptance issues are captured and expressed. By failing to develop more holistic practices, we risk continually studying isolated cases that, even taken in aggregate, are of limited value for informing policies at the national level. This is because they fail to describe the broader and multifaceted picture of national energy systems, and it is difficult to synthesize these disparate studies into a cohesive picture at the national scale where energy policy is made.

Therefore, this paper aims to contribute to the development of an analytical framework that better incorporates the scalar interactions of social acceptance across different dimensions. The framework is then used to explore the interplay between the different scales by examining how social concerns are integrated into NREAP policies in three countries: Denmark, Ireland, and the UK. From this, it draws implications for the future deployment of wind energy in Europe. These aims are summarized in the following three main questions driving the study:

1. How is social acceptance articulated and responded to in National Renewable Energy Action Plans—i.e., at the macro scale?
2. What are the interactions between various dimensions and scales?
3. What are the implications for future policies and the deployment of wind energy in Europe?

2. Analytical Framework

This study develops and applies an analytical framework that offers insights into the social acceptance of wind power, building on the work of Wüstenhagen et al. [21]. In Wüstenhagen et al. [21], the socio-political dimension is solely focused on matters of acceptance expressed by authorities—for example, expressions of political support towards a green agenda or planning policies. However, adding the aspect of scale provides nuance and gives further insight into the social acceptance of RE technologies [14,24]. The notion of national public acceptance, which Wüstenhagen et al. [21] associated with the socio-political dimension, shifts to the macro-scale of the community dimension in our framework, which represents the national identity or popular perception of energy (see framework description in Table 2). Therefore, we rename the socio-political dimension of Wüstenhagen et al. [21] the 'political–regulatory' (PR) dimension. In Figure 1, each of the three dimensions—community (C), market (M), and political–regulatory (PR)—is displayed at the different scales: macro (1), meso (2), and micro (3). The interpretation of the resulting 3×3 matrix, as applied to renewable energy, is given in Table 2.

Table 2. Analytical framework by dimension and scale. This describes RE policy and development phenomena and processes that occur at different scales and dimensions. This list is illustrative rather than exhaustive and provides a characterization of each element within the matrix.

	MACRO (1) Global → National	**MESO (2) National → Regional**	**MICRO (3) Regional → Local**
COMMUNITY (C) Social acceptance Reasons for opposition/support Trust towards institutions and actors Distributional and procedural justices Individual perceptions of technologies Aggregated public opinion Cost/benefits for local populations Public health	National energy identity or culture Popular perception "Zeitgeist" National opinion polls	Participatory processes Interaction between local authorities/communities	Energy cooperatives Place attachment Standardized impact studies Social mediation Public engagement Opposition (NIMBYism) Remoteness from decision-making process and places Interest in micro RE Disruption, visibility, smell and sound levels Property ownership
MARKET (M) Tendering, competition, adaptability R&D, innovations Investments and path dependency Green power marketing strategy	Globalization, internationalization strategy National and international opportunities Move to offshore wind Lobbying, influence of companies on policies Funding of R&D Business incentives Support investment Aggregated production/demand Modeling Tax targets	National interests Monopolies on regional grids Modeling Control access to grid Existing national energy production and infrastructures Green power marketing	Move to offshore wind Increasing scale of onshore wind Information meetings Increasing surface of solar and biomass Local employment
POLITICAL–REGULATORY (PR) Policymakers Reliable financial system Collaborative spatial planning system Governance Decision-making mechanisms Legal framework Articulation of interests and strategies	National policies Assumptions on behavior change National political support EU strategies Expressions of political support for RE at national scale	Local authorities Institutionalization of frameworks that foster market and community acceptance Planning policies Invoking participation Consultation Strategic planning National strategy in regional context Expressions of political support for RE at regional scale Actions of local authorities	Siting decisions Compensation measures Local and regional elections

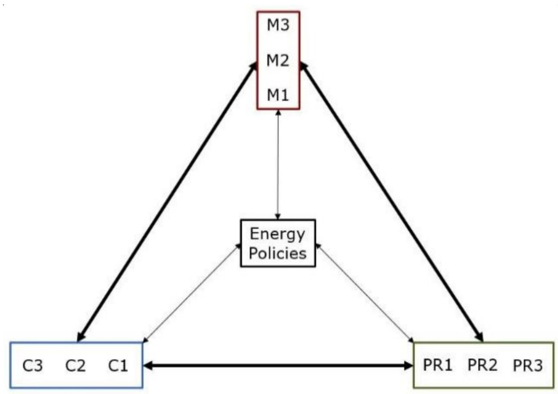

Figure 1. Analytical framework: representation of dimensions and scales of social acceptance. The dimensions are visualized in a triangle, covering the market (m), community (c), and political–regulatory (PR) dimensions. The numbers 1, 2, and 3 represent the macro, meso, and micro (local) scales, respectively (e.g., M3 = local market). The double arrows between each dimension represent the multiple connections between scales, dimensions, and policies.

3. Methodology

3.1. Case Studies

The preliminary case study approach consists of the descriptions of national energy policies in the National Renewable Energy Action Plans (NREAPs) of Denmark, Ireland, and the UK. These three countries are analogous in that they have some of the highest resources of wind energy potential in Europe. This includes having some of the highest amounts of wind energy full-load hours, as calculated by the European Energy Agency using average wind speeds and distributions at heights of 80 m onshore and 120 m offshore [10] (pp. 23–24). Since the appearance of the first turbines connected to the grid and the development of the sector into a large-scale manufacturing activity, this abundance of wind has helped shape the countries' energy sectors, otherwise mostly based on fossil and nuclear energy in the case of the UK and Ireland. Some of the countries' main policies in the past 10 years have been aimed at wind power, such as the Renewable Energy Agreement in Denmark in 2009, the Renewables Obligation Certificates (ROC) in the UK in 2002, and Renewable Energy Feed-in-Tariff (REFIT) in Ireland.

In line with their initial ambition to harness the wind resource, the three countries are signatories to the EU 2009 Renewable Energy Directive [1] and, as such, provided their NREAPs in 2010. NREAPs detail how each country is planning to reach its national targets set by the Directive according to the country's RE potential and agreed by the countries themselves. The basic requirements set by the Directive insist on harmonized values of expected final energy consumption and sectoral 2020 estimated shares of energy from renewable sources in electricity, heating and cooling, and transport. It also requires basic descriptions of the measures and policies set to reach those targets, with a focus on biomass and transfers across Member States. The requirements are not particularly specific, and no details were required concerning the means that each country would develop to increase social acceptance. The NREAP targets are legally binding, but the Directive does not give specific details as to what level of sanctions would be imposed on countries that fail to reach their target by 2020.

Matters of declining social acceptance of RETs in Denmark, Ireland, and the UK, and social opposition to wind power in particular, have increasingly led to delays and cancellations of specific projects [16]. For Denmark, among other factors, these matters have led the government to opt for an energy agreement to create a liberalized energy market [19], while in the UK, onshore wind power is no longer financially supported by the Contracts for Difference bidding scheme launched in 2014 [33]. In Ireland, concern about the impact of large-scale wind energy on the landscape and the lack of community engagement [34,35] has led to the government suggesting that it needs to foster 'energy citizens' [36].

3.2. Coding and Mapping of NREAPs

First, the NREAPs were coded according to the dimensions in Figure 1. This resulted in a list of 46 codes (listed below) that describe the content and purpose of each policy within each NREAP. The coding was developed iteratively through multiple readings of each NREAP to ensure that the entire list of codes was comprehensive across the three NREAPs and categorized according to technology type. Onshore wind is the predominant technology across the three countries, hence the focus of this research.

Each code produced was then associated with a dimension of social acceptance as per the existing literature [21,23] and Figure 1. Several codes were assessed as having linkages with two or all dimensions, represented by the double arrows in Figure 1, e.g., market/political–regulatory. Hence, the codes were placed in the following categories:

- Technology (onshore wind, biomass, solar, offshore wind, biofuel, wave tidal, transport, hydro, electric heating, electric vehicles (EV), combined heat and power (CHP), geothermal, carbon capture and storage (CCS));
- Market (technology development, investments/costs, energy producers, grid, technology costs, industry sector, fuel costs, carbon tax, resource prices, resource import, resource constraint, production costs, energy system costs, energy export)
- Market/political–regulatory (efficiency measures, RE policy and support, energy targets, infrastructures, device's geographical location, service sector, CO_2 emissions and targets, sectors/sectoral, energy demand)
- Political–regulatory/community (local authorities, residential buildings, social benefits, dissemination, population and public behavior, environmental impact)
- Community (interaction with local population, social costs)
- General (incentive, behavior change).

Next, the operative or target scales of each policy were identified according to the information and descriptions of the policies given by the NREAP documents and mapped onto their dimension: C (community), M (market), or PR (political–regulatory) and onto their scale: 1 (macro), 2 (meso), or 3 (micro), based on the descriptions in Table 2.

4. National-Level Results and Discussion

The following sections discuss the outcomes of the framework analysis in the context of each country's energy system and policy evolution before reflecting on implications for future policies. The focus is on the period since the launch of the EU Directive in 2009, the adoption of NREAPs in 2010, and the progression up to the present; however, we also build on the countries' recent energy histories and major decisions that have shaped their respective energy systems. A summary of all countries is provided in Figures 2 and 3.

4.1. Denmark

Denmark endeavors to have its heating and electricity sectors fossil-fuel free by 2035 and to be completely fossil-fuel free across all sectors by 2050. The Danish Energy Agency depended heavily on economic optimization energy modeling to create pathways for meeting the ambitious targets for the future energy system [37].

To support these targets, the Danish Energy Agency modeled different scenarios for the years 2020, 2035, and 2050, stating that "the scenarios form a common background for the analyses that were launched with the energy agreement of 22 March 2012" [38]. Four of the modeled scenarios were used to compare different strategies for achieving independence from fossil fuels, while one scenario represented a baseline, least-cost, fossil-fuel-based energy system. While all scenarios included improvements in energy efficiency and a limited amount of solar power, the scenarios generally varied between electricity-based strategies and fuel-based strategies.

	C1	C2	C3	M1	M2	M3	PR1	PR2	PR3
Denmark	0%	18%	4%	16%	28%	23%	0%	4%	9%
Ireland	0%	5%	4%	18%	27%	19%	6%	14%	8%
UK	1%	9%	3%	9%	30%	22%	1%	13%	12%
Total	0%	10%	3%	14%	28%	21%	3%	11%	9%

Figure 2. Distribution of scale and dimension targets among NREAP policies.

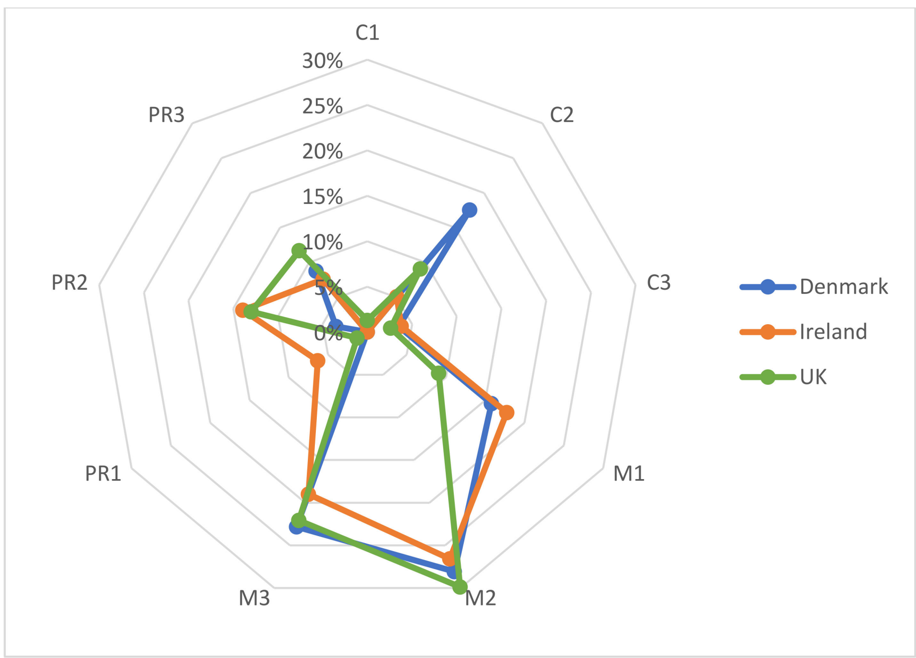

Figure 3. Representation of the focus in terms of scale and dimensions of social acceptance of RE in the NREAP policies of Denmark, Ireland, and the UK.

In particular, the wind scenario describes a strategy that requires large-scale electrification of the transport, heating, and industrial sectors. To achieve independence from fossil fuels, wind capacity would need to be expanded by 400 MW annually between 2020 and 2050. The hydrogen scenario incorporates even more wind than the wind scenario, thus requiring an even more accelerated expansion of wind power. This expansion is assumed to be largely sited offshore, and aging onshore wind turbines would need to be replaced under this scenario.

Despite those official scenarios forecasting a continued increase in onshore wind, the Danish NREAP instead planned a decrease in onshore and overall wind capacity, suggesting that Danish authorities considered that a threshold had been reached and the theoretical higher potential of onshore wind power [39] would not be pursued. Even with this imposed limit for onshore wind, Denmark is still in line to reach its NREAP targets of RE covering 20% of the country's gross energy consumption by 2020 [40]

The conflicting plans described above correspond to the period when the NREAP was introduced in 2010, and this ambivalence is indeed perceivable through the Danish NREAP policies. The results of the framework analysis for Denmark presented in Figures 2 and 3 show an effort toward C3, local community acceptance, in the form of two policies that address common acceptance issues: the option to purchase wind farm shares addresses complaints of unfairness towards the local inhabitants who experience the presence of turbines on a daily basis but do not financially benefit from them, and a compensation plan addresses complaints regarding a decrease in property values claimed to be the result of a wind farm being built in the vicinity [41]. The erosion of public acceptance targeted by those two policies and the overall 2008 Promotion of Renewable Energy Act of which they were a part corresponds to the collapse of the wind cooperatives in Denmark in the early 2000s and their replacement by large-scale wind farm developers and owners [42,43].

These policies and the Promotion of the Renewable Energy Act represented a first in terms of local financial involvement through policies, yet the overall NREAP focus on the community dimension remains low compared to that of market-focused policy incentives. The coding visualization in Figure 3 highlights the high focus on the market sector at both national (M2) and local (M3) scales, with a particular emphasis on supporting the local supply chain of biomass resources.

In this visualization, we can also observe the code C2 for Denmark, which represents policies aimed at including local energy producers, such as farmers and cooperatives, in some of the support schemes more generally aimed at the market sector (M2 and M3). Figure 4 further highlights how these dynamics between local energy producers (C2) and the market levels (M1, M2, and M3) were particularly promoted by the NREAP plans, as well as between the three market levels. Those interactions suggest a marked intent to open incentives to varied business sizes, ensuring that local producers and suppliers were able to benefit from the financial advantages set by the RE targets, thus securing some form of acceptance of future RE plans through local businesses (M3 and, to some extent, C2).

	C1	C2	C3	M1	M2	M3	PR1	PR2
C2	0							
C3	0	0						
M1	0	3	0					
M2	0	4	0	6				
M3	0	5	1	0	8			
PR1	0	0	0	0	0	0		
PR2	0	0	0	1	0	0	0	
PR3	0	0	1	0	0	0	0	0

Figure 4. Interactions between two codes within the Danish NREAP.

Yet, this C2 and M3 involvement is now likely to change, at least for local wind and solar PV producers, with the enactment of the new Energy Agreement in June 2018, which officializes the plan of strictly decreasing the number of onshore wind turbines. It plans to do so by establishing a strict reduction plan, which sees the forced interruption of new turbine supply if the plan is not followed satisfactorily. Furthermore, the main change consists in the introduction of a new bidding system whereby developers (onshore and offshore wind and solar PV) have to bid for the lowest possible electricity sale price [19]. This move is likely to limit wind cooperatives' access to the medium-scale turbines they could usually afford and prioritize large corporate actors of the wind sector (M1) [42]. The future Danish wind sector will thus comprise offshore sites and a limited number of large-scale onshore installations. Besides the decreasing costs of offshore wind [9], the main motivations cited in the Energy Agreement for this new strategy are the inconveniences felt by the local community (C3) near wind farms and the impact on their properties.

As previously mentioned, we note that focus on C3 was relatively low in the NREAP policies, with, for example, no mention of policies targeting employment opportunities (the topic is briefly mentioned in the overall NREAP), which are known to generate community support towards the industries bringing employment [44,45]. Additionally, the efforts put towards creating dynamics between C2, M3, and the overall market sector in the NREAP now seem in jeopardy in the new bidding context for local onshore wind and solar PV producers.

This evolution is also perceived through changes made to the political–regulatory sector. In an effort to concede more involvement to municipalities (PR3), the sitting authority was transferred to local municipal authorities [46]. They then often pursued a "conflict-avoidance" strategy and, along with scrappage incentives, the move was made in favor of fewer, larger turbines, placed away from residents [47]. This organization is further established in the NREAP with a relative focus on PR3, as encouraged by the EU Directive [1], and the effort to distribute energy governance is perceivable. Under the new Energy Agreement, municipalities will retain this authority, but the ultimate decision on the bidding proposals (which will have to have previously secured planning permission) will be centralized to the Danish Energy Agency at PR1 level.

The recent evolution of the Danish wind sector shows the discreet but growing impact of the community dimension on national decisions. Indeed, when the supporting community (C3 and C2) environment deteriorated due to increasing turbine sizes and the proliferation of company-owned wind farms [48], the discontent expressed to local authorities in charge of spatial planning eventually reached the level of national political parties, who decided to act by avoiding the issue and prioritizing offshore wind. Looking at this context in the light of the present NREAP policy analysis, the high policy focus on market implementation, even if purposefully stretched to local businesses (M3) and citizen producers (C2), was not sufficient to ensure a constructive dialogue between the community and authorities beyond the opposition voices, as illustrated in Figure 4 by the lack of interactions between authority (PR) and community (C) elements.

4.2. Ireland

Ireland has 2020 targets of reducing non-ETS emissions (relative to 2005) through a 20% saving in energy consumption and achieving 16% of national energy supply from renewables, including 40% of energy generation [49]. These targets were agreed upon in the EU Directive 2009/28/EC, and the pathways for achieving the targets are set out in Ireland's NREAP [50]. This NREAP used demand forecasts from SEAI (2009) [51] and gross final consumption estimates based on the output from the Economic and Social Research Institute of Ireland's macroeconomic model for Ireland: HERMES [52]. The NREAP set out a number of pathways for achieving these targets, with large-scale onshore wind making a major contribution to the 40% renewable target, heavily dependent on a strengthening of the transmission system across the island of Ireland. Subsequent to the publication of the NREAP, the Environment Research Institute, University College Cork, developed an energy-systems optimization model—the Irish TIMES model [53]—which facilitated the development of alternative pathways for the achievement of Ireland's energy targets, provided a reassessment of policies for renewable energy, and explored the implications of potential higher emissions targets.

These projections have been continually reviewed by the Sustainable Energy Authority Ireland (SEAI), which advises the government on issues related to energy and the transition to a low-carbon economy. It has established an Energy Modeling group and regularly publishes progress reports on the achievement of targets [49] and revised projections [54].

This led to a range of support mechanisms for wind development, based on the feed-in-tariff model and supported by a Wind Energy Roadmap [51], which speculated that with favorable developments in policy and infrastructure, Ireland had the potential to develop an export-driven wind market by 2030, amounting to 2.5% of all EU electricity demand and the country contributing 5% of Europe's entire wind energy generation. The baseline scenario of this 2010 roadmap report is presented as a benchmark to evaluate the impacts of the policies presented as part of the NREAP plan and targets published in the same year [51] (p. 3). The roadmap was heavily influenced by economic projections and assumptions of infrastructure development, and while public engagement is acknowledged as an issue, it is treated as a background facilitator rather than a constraint on the deployment of wind energy projects. The framework analysis we conducted on the NREAP policies (see Figure 2) indeed shows that the level of focus on the public influence (C3) within the NREAP was similarly treated as a minor element compared to the share of policy focus given to market actors at all scales (M1–3).

Reflecting this policy focus on supporting the market sector, this roadmap led to a rapid expansion of large-scale wind projects, followed by a growing sense of opposition from host communities (C3). This situation triggered very little response from the wind industry and the government, exemplified by the lack of updates on outdated planning guidelines published in 2006. The NREAP policies coded PR2–3 addressed the need for planning guidelines able to support RE development, although, as of 2017, revised planning guidelines were still in draft forms. This lack of concrete response while wind farms are being built creates a loop of growing dissatisfaction directed at both authorities (PR1–3) and the industry (M1–3). This struggle to bring forward concrete plans to regulate developments and address public concerns, associated with minimal policy support for community-owned energy projects (C2), conveys an image of passive authorities predominantly in support of corporate actors (M1–2) and unresponsive to community developments and concerns.

Looking at the levels of focus on the community dimension, there is no mechanism to address the impacts of RE projects once built, as implemented in Denmark (see Section 4.1), but two policies address the need for dissemination of information on renewable energy to the public (C3). Concerning the support for locally owned projects (C2), Figures 2 and 3 show that it is proportionally lower than in the sets of policies within the British and Danish NREAPs.

Concerning the interactions supported by the NREAP policies and displayed in Figure 5, the most frequent connections are similar to those observed in the Danish and British policy sets among market levels M1–3. However, while the Danish and British NREAPs displayed a significant focus on connecting local project developers (C2) with market-supporting policies, this connection appears much lower in the Irish case.

	C1	C2	C3	M1	M2	M3	PR1	PR2
C2	0							
C3	0	2						
M1	0	1	0					
M2	0	3	1	10				
M3	0	3	1	4	9			
PR1	0	0	0	3	2	0		
PR2	0	1	1	3	6	2	3	
PR3	0	2	1	0	2	3	0	4

Figure 5. Interactions between two codes within the Irish NREAP.

Following the 2010 roadmap and NREAP analyzed here, the situation of growing local discontent (C3) appeared to reach a crisis point in 2013, which witnessed an increased level of political activity around opposition to onshore wind (e.g., through a private member's bill seeking to extend setback distances) and an extremely negative reaction to the first major proposal for wind energy for export. This was a 3000 MW project proposed for the Irish Midlands, which would solely serve the UK energy market and would hence be part of the M1 category. This fact, coupled with the rather audacious attitude of the developer, led to a major acceptance crisis that, for a while at least, appeared to make the whole wind energy sector toxic (see [35]).

This, in turn, prompted a deeper reflection within the government, which responded with an energy white paper (in 2015) that recognized the social dimension of the energy transition and acknowledged that this could not be secured without the engagement of 'energy citizens' (C3), a term coined in the white paper to mark these efforts to involve the population within energy plans [36]. While this is yet to be translated into new legislative measures, meaning that it is not yet known what form of support towards C2 and C3 will be proposed, its influence has been felt in the revision of the Energy Support System. Indeed, any proposals in 2019 will now be required to offer a proportion of ownership of new renewable projects to local communities (C3), based on the Danish model's Option to Purchase Shares Scheme [41].

4.3. United Kingdom

A variety of integrated assessment models have contributed to the shaping of the British energy system—from the 2008 first Carbon Budget covering 2008–2012 to the fifth, and latest, 2016 edition covering 2028–2032. It was also previously shaped by a series of Energy White Papers. The Department of Energy and Climate Change (DECC) and the University College London Energy Institute, both affiliated to the ETSAP-TIAM modeling network, collaborated with the ETSAP range of models such as UK MARKAL, TIAM-UCL, and the latest version, the UK TIMES model [55,56].

In 2010, the introduction to the UK NREAP document stated the country's need to radically increase RE production as it "had been blessed with a wealth of energy resources" [57] (p. 4). Following this statement, the UK stated its target of a 31% share of renewable energy production by 2020 [57] (p. 12) and its main supporting policy tools: the Renewable Obligation (RO) scheme, the Feed-In Tariff (FIT) scheme, and the Renewable Heat Incentive (RHI) [57] (pp. 15, 16). However, since the publication of the NREAP document in 2010, the UK has experienced a period of intense political change, which has resulted in strong alterations to the country's energy policies.

The government announced in 2014 that the overall RO scheme would end in March 2017 [33,57] but onshore wind would stop in April 2016 [58]. These decisions constituted parts of the government's plan to end subsidies for renewable technologies that it considered mature. The RO scheme was replaced by the bidding system "Contract for Difference" (CfD), where developers compete to submit the lowest installation price and acquire a 15-year contract [59,60]. A precedent to the Danish bidding system discussed in Section 4.1, this prioritized corporate actors (M1) with economies of scale, as opposed to smaller local businesses (M3) and cooperative organizations (C2). Meanwhile, our analysis highlights that the 2010 NREAP was significantly market-focused (see Figures 2 and 3), although with a stronger emphasis on the involvement of smaller businesses (M2 and M3) in the RE sector in general. The first round of CfD auctions took place in 2014 and included all renewable technologies present in the UK, while the second round, in April 2017, did not include any capacity of onshore wind [61].

In August 2015, the government announced that the Feed-In Tariff scheme, a key policy for local energy producers and cooperatives (C2), would see its prices reduced, and the scheme finally closed down in January 2016 [62]. Faced with strong opposition from both actors of the market sector (M1–3) and C2 [63] (p. 6), the scheme was retained but with heavily limiting measures added. The third policy, the Renewable Heat Incentive (RHI), also partly aimed at and supportive of prosumers (C2), was also threatened with early closure for solar thermal. Reactions to the consultation [64] showed significant public and stakeholder support for this technology from C2 and market actors, and the tariff was maintained at the same level [65] (p. 32).

Thus, in both those cases where authorities had a legal duty to consult on policies [66], significant public and stakeholder (C2 and M1–3) reactions altered official plans of early policy modification or closure. These reactions illustrate the interest from stakeholders, including prosumers (C2), in engaging in the energy sector and taking advantage of support incentives, but it also demonstrates that such involvement requires a certain level of regulatory stability. This engagement comes despite low levels of interaction created through policies between prosumers (C2) and M/PR elements, as observed in Figure 6, suggesting that those dynamics and C2 engagement, which support energy transition, are not being adequately explored and/or supported by policies.

	C1	C2	C3	M1	M2	M3	PR1	PR2
C2	1							
C3	1	2						
M1	0	0	0					
M2	0	2	0	6				
M3	0	3	0	2	8			
PR1	1	1	1	0	0	0		
PR2	0	0	0	0	6	0	0	
PR3	0	1	1	0	4	2	0	6

Figure 6. Interactions between two codes within the UK's NREAP.

In fact, while the 2014 share of 17.8% of electricity produced from renewables [67] (p. 23) is in accordance with the 2010 plan of doubling the share by 2020, the 2015 progress study by the EU Commission expected the UK to have difficulties in reaching its targets and recommended a review of its energy policies [40] (p. 5). The International Energy Agency also considers that the sudden changes in energy policies are creating uncertainty and are decreasing the country's attractiveness among investors [68].

The decisions concerning onshore wind discussed above were announced in the ruling Conservative Party's 2015 manifesto, citing the fact that "onshore windfarms often fail to win public support" at C3 level as a key reason for the decision [20] (p. 57). Concerning community acceptance at C3 level, the British NREAP back in 2010 presented two policies aimed at supporting dissemination of information to the local community (C3) regarding RE projects: "information/ad campaigns" targeted "public consciousness" and intended to motivate "the public to act on climate change through take up of renewable energy", while GPWind—good practice in reconciling wind energy with environmental objectives and community engagement—aimed to gather information on wind power from Member States to "positively address environmental issues and the concerns of local communities" [57]. Assessing the impacts of those two policies would require a detailed analysis of the means committed; however, since the British ruling party cited issues of low C3 acceptance as the official reason for halting subsidies for onshore wind [69], this would point to a partial failure of these two policies aimed at increasing awareness.

Put in the context of the overall set of NREAP policies, as displayed in Figures 2 and 3, we observe that those two policies are the only tools aimed at the micro-scale of the community (C3), besides financial incentives targeting prosumers (C2). Furthermore, we observe in Figure 6 that those two C3 policies do not engage any of the interactions otherwise created by the UK NREAP. Since C3 was a key governmental concern, we assume that the British government had a deeper understanding of the situation and the means that should be allocated to those two policies. Yet, their seemingly negative outcome suggests that more consideration ought to be given to adapting community-focused policies to their actual target and its characteristic diversity instead of relying on 'one-size-fits-all' policies with general wording and purposes. Furthermore, rather than stand-alone C3 policies (as illustrated by Figure 6), they could benefit from better integration into already established policy-induced dynamics.

In terms of the political–regulatory dimension, it is mainly addressed for the alleged necessity of further structuring planning guidelines towards the facilitation of RE project development. Planning rule adequacy is one of the areas in which the EU Directive asked all Member States to add focus prior to releasing NREAPs. In the case of the UK, this request came at the same time as the publication of a discussion among experts in the field of planning research regarding whether planning was actually the cause of the alleged difficulties experienced by developers in gaining planning consent for wind farm projects. These experts argued that planning authorities had actually been fulfilling their duties as per official guidelines, and they voiced their concerns over "the way that the concept of sustainability has been used over the last decade to justify pro-market solutions through the planning system" [14]. It is debatable, seeing the heavy market focus observed in the NREAP policies, evolving towards more opportunities for large businesses (M1), and the limited emphasis on PR and C, whether this warning was fully comprehended by the current authorities.

5. Aggregated Results and Discussion

In the findings from each country, we particularly observe that the micro and meso, or local and regional, scales of the market dimension are the main focus of the policies in each case-study country.

The distributions of codes associated with dimensions and scales of social acceptance within NREAP policies are represented in Figure 2, and more illustratively as web graphs in Figure 3. The results for Denmark, Ireland, and the UK show a significant likeness. We observe:

- A prevalence of the market codes, in particular from the national to local scale (M2 and M3).
- A larger focus on community as energy producers (C2), compared to community at national and local individual levels (C1 and C3), which have very low mention rates.
- Medium mention rates for political–regulatory codes at the regional and local scale or among local authorities (PR2 and PR3).

The representation of aggregated interactions in Figure 7 gives an overview of the dynamics that are predominantly enabled by NREAP policies. While results per country are detailed and discussed in Sections 4.1–4.3 below, we can observe in this aggregated representation:

- A prevalent link between M2 and M3, suggesting that, globally, market-supporting policies are designed to include and potentially prioritize local companies, An intentional broad approach to market dynamics and opportunities
- A significant link between M codes and C2, which suggests an effort to include local energy producers and prosumers into financially supporting incentives otherwise aimed at elements of the market dimension

	C1	C2	C3	M1	M2	M3	PR1	PR2
C2	1							
C3	1	4						
M1	0	4	0					
M2	0	9	1	22				
M3	0	11	2	6	25			
PR1	1	1	1	3	2	0		
PR2	0	1	1	4	12	2	3	
PR3	0	3	3	0	6	5	0	10

Figure 7. Heat-map representation of aggregated code interactions within NREAP policies for Denmark, Ireland, and the UK, highlighting interactions between two codes within the same policy.

The selected approach of three case-study countries has been useful to explore policy dynamics in their national contexts. The findings are synthesized in a more holistic form adapted to the larger context of the EU arena and its role of overseeing decarbonization targets. Thus, results from the framework analysis (see Table 2) are compiled and presented in Figure 8 as an illustrated summary of the interactions identified in each case study.

1. PR1 to Policies: Government/energy agencies decide on a policy formulated following targets set by the EU.
2. Policies to PR2–3: National policies instruct regional authorities on what to prioritize.
3. PR2–3 to M2–3: Regional and local authorities collaborate with regional and local companies.
4. C3 to PR1–3: Elections shape local to national socio-political systems; can object to planning project.

5. PR1 to C1: Past/current energy systems; dissemination of information; government actions influence the national identity.
6. Policies to C2: National energy policies orchestrate possibilities for cooperatives and local production.
7. Policies to C3: Effects of PR1 through energy policies at the local community level.
8. C1 to C2–3: National identity affects individual opinions.
9. C3 to C2: Local support (or opposition) of local producers and cooperatives.
10. M1–3 to C3: Impact of wind farms from local to international developers at local level C.
11. Policies to M1–3: Policies set incentives and R&D priorities that affect energy companies from the local to international scales.

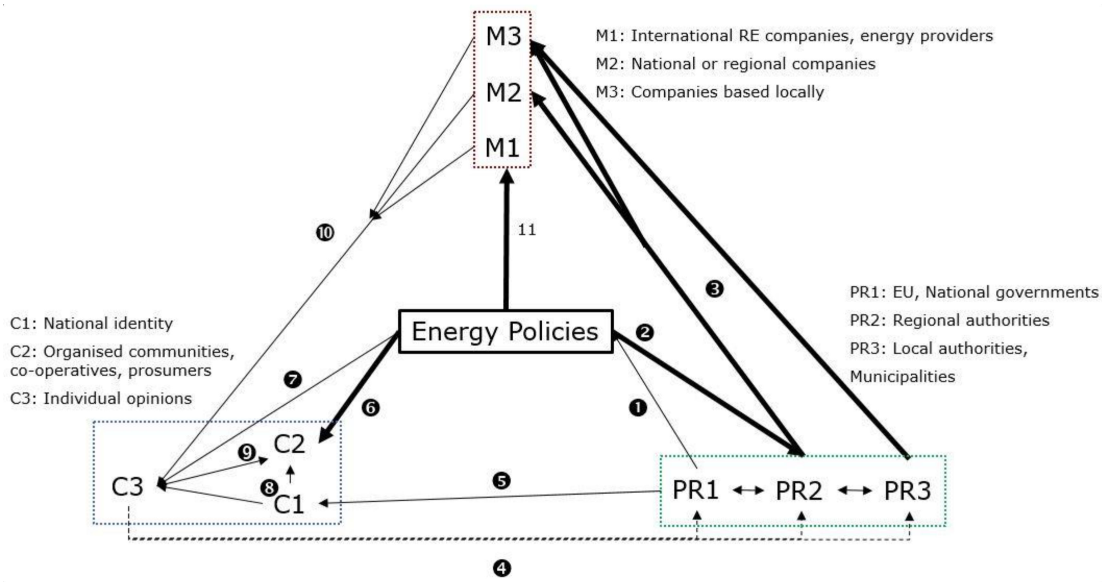

Figure 8. Analytical framework: representation of dimensions and scales of social acceptance with extended representation of dynamics between dimensions and scales—bold arrows represent interactions generally addressed by NREAP policies.

Figure 8 highlights the finding that there are dynamics between the scales within each of the dimensions: Our analysis reveals that the scale aspect is an important consideration within energy policy formation in that different dimensions are emphasized in different scales. For example, the policies are more heavily influenced by market and policy regulation dimensions than by community considerations. When considering the community scale (and social acceptance), C2 is more heavily considered in policymaking in our sample countries—even in Ireland, where it is lower—whereas C1 and C3 are not; however, the C1 and C3 scales do have some influence on C2. The local scale is not necessarily difficult to target, but our analysis indicates that the policymaking process generally engages this scale through the market and political–regulatory dimensions.

For example, a change in acceptance at the C3 level can directly influence PR1, whereby a newly elected national government with a skeptical party line toward wind power can draw upon specific—even isolated—incidences of local (C3) opposition to inform and justify a change in 'national acceptance'. Indeed, this is what occurred in the UK following the election of the Conservative-led government in 2010. Similarly, in the case of Denmark, a change in national government in 2001 pushed an explicitly pro-market reform agenda. As such, they were not opposed to an expansion of wind power per se, only to the provision of subsidies to wind power or indeed any subsidized technology. However, given the prevalence of community-owned wind farms backed by FITs, this change in the PR1 had a material impact on the C2 and C3 levels of social acceptance.

In all three countries, the level of wind power planning (PR2) had a major influence on the social perception and acceptance of wind power at all community levels, given the rapid growth of proposal development and investment in the early 2000s. This growth led to various conflicts and controversies, which were only resolved—or even given a chance to be discussed—by the planning authorities (level PR2). While the planning authorities were themselves officially neutral on the issue of whether a specific project should be given approval—i.e., they operate against a rule-based set of criteria—their decisions (either for or against) influenced the wider social acceptance of wind (either for or against). These outcomes can be seen as an unintended consequence of the role and importance of planning authorities in approving specific projects.

Research into social acceptance of RETs has often concluded that dynamics occurring at the micro- or local scale are being left out of top-down policy discussions and decision-making processes. This is shown to be partially true in our sample for the C and PR dimensions, but we observe a clear policy focus on the micro-scale of the market sector, for which monetary incentives are easily calculated. This predominance of market criteria suggests that addressing the micro-scale is not, per se, the issue for policymaking; rather, it is the fact that the non-market aspects are inherently difficult to quantify and compare. Thus, considering the very limited focus on the micro-scale of the community dimensions (C3), the challenge seems to be to propose policy tools adapted to dynamics that cannot be addressed solely financially or quantitatively. In short, the linear connection between techno-economic quantitative modeling and energy policies is the primary explanation for the high focus on market criteria across scales.

6. Conclusions: Implications for Future Policies and the Development of Wind Energy in Europe

This study builds on recent developments in the field of research on the social acceptance of renewable energy. The existing literature notes that social acceptance is achieved when a technology has secured market, socio-political, and community acceptance. We show the importance of including scale considerations, as cross-scalar dynamics vary within each of the three dimensions, and as a consequence, dynamics between those dimensions cannot be studied as between homogeneously constituted elements. As such, we provide a comprehensive framework that addresses the need for a more exhaustive cross-scalar analysis of energy policies, especially considering the recent impacts of community acceptance and the difficulty that policies have in addressing it.

The broader point to emerge from the findings is that specific changes in any one or more of the nine components in the social acceptance framework can influence another—i.e., there is a dynamic (non-linear) causal relationship between all aspects of the framework. From our analysis, it became clear that governments (including political and technical decision makers) in our three case study countries do not focus much on community aspects of social acceptance; it would appear that the broader definition of social acceptance, as defined in the literature, is not widely understood in these top-down forums. To a large extent, this reflects the influence of techno-economic models, which privilege the economic or 'market' criteria. Furthermore, full social acceptance is something that likely needs to be formally orchestrated given the dynamics we see between the nine spatial-dimensional components in our framework.

In this article, we present our analytical framework for social acceptance as a 'proof of concept', applied in three wind-rich countries. We recognize that the three case study countries are similar in that wind power is the primary RE technology, where questions of social acceptance (in particular for onshore wind) are a major concern. As such, this reveals a limitation in our study. However, we hypothesize that our findings and conclusions hold true for other countries, as well as other RE technologies as they come to scale, and that this broadly corresponds to the findings of related research that also emphasize the importance of contextual determinants [70]. As such, it is important that all the aspects —dimensions and scales—discussed in this article are considered by national authorities responsible for energy policy and planning as a complement to inputs from traditional 3E modeling.

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