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Financial participation and compensation schemes in the European wind energy sector: A systematic classification and assessment (2006–2025)

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ABSTRACT

Wind energy is indispensable for achieving European climate targets, yet local resistance continues to delay or block projects. Financial participation and compensation (FPC) schemes are increasingly used to foster local acceptance by redistributing economic benefits to affected communities. While these schemes were initially implemented voluntarily by developers, an increasing number of countries and regions have incorporated them into binding legislation. Existing research suggests that FPC schemes can enhance local acceptance when designed in ways that increase perceived distributive, recognitional and procedural justice. To date, no systematic mapping and assessment of these schemes exists. Such an assessment is, however, essential to identify design blind spots, provide an empirical basis for EU-wide recommendations, and support future research on acceptance. We address this gap by providing a public dataset of regulatory and policy documents adopted in the EU27, Norway, Switzerland, and the United Kingdom between 2006 and 2025. We classify the schemes into four types for systematic comparison: fixed-payment compensation, profit-based compensation, debt-based participation, and equity-based participation. The analysis reveals a clear tendency towards fixed-payment compensation schemes, typically in the form of monetary transfers to host municipalities and local residents. In addition, we assess the schemes through an energy justice framework and contrast the findings with insights from the existing literature. Many schemes leave important justice dimensions underdeveloped, particularly recognitional justice aspects. While the paper focuses on onshore wind, the findings offer transferable insights for other infrastructure projects facing social acceptance challenges, such as large-scale solar photovoltaics, transmission grids or data centres.

List of abbreviations

Art.	Article
CSOP	Consumer Stock Ownership Plan
CZK	Czech koruna
DBP	debt-based participation
DKK	Danish krone
DSO	distribution system operator
EBP	equity-based participation
EIA	Environmental Impact Assessment
EU	European Union
EUR	Euro(s)
EPCI	Public establishment for intercommunal cooperation
FC	fixed-payment compensation
FLH	full load hour
FPC	financial participation and compensation
GBP	Great British Pound
IEA	International Energy Agency
incl.	including
IPCC	Intergovernmental Panel on Climate Change
km	kilometre
kW	kilowatt
kWh	kilowatt-hour
m	metre
max.	maximum
MST	multiple scheme types
MS	Member State
mun	municipality

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Art.	Article
MW	megawatt
MWh	megawatt-hour
MVA	megavolt-amperes
no.	number
NOK	Norwegian krone
OECD	Organisation for Economic Co-operation and Development
PBC	profit-based compensation
RE	renewable energy
reg	region
res	resident
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SMEs	small and medium-sized enterprises
UK	United Kingdom
UN	United Nations
WT	wind turbine

1. Introduction

In its Sixth Assessment Report, the IPCC highlighted large-scale deployment of wind and solar as critical for decarbonising the energy system [1]. Similarly, the IEA, in its roadmap for the global energy sector, identifies wind energy as one of the 'key pillars' for reaching net-zero emissions [2]. However, major barriers to wind farm development include low levels of social acceptance and complex permitting procedures [3], often leading to project delays or, in the worst case, cancellations [4]. Before the globalisation of the wind energy sector [5], in countries such as Germany or Denmark, it was predominantly citizens who initiated wind energy projects through so-called 'citizen wind farms' [6–8]. Yet, the EU-wide shift from feed-in tariffs to market-based mechanisms and tendering processes has diminished citizens' stake amid increasingly fierce competition [9,10]. Today, the primary beneficiaries of wind energy are project developers who succeed in auctions and secure long-term revenues [5,11] as well as landowners, who generate leasing income [12,13]. Citizens near the wind farms, on the other hand, mainly express concerns such as visual intrusion, noise, or the impact on property values [3,14], particularly with ever-increasing turbine heights and rotor diameters [5,15,16].

Many studies highlight the importance of procedural and distributive justice to enhance social acceptance of wind energy projects [17,18]. One way of enhancing procedural justice is by involving citizens in planning from the outset, allowing them to influence various design characteristics, such as turbine height or location [14,19,20]. However, auction-based project selection, combined with increased competitive pressure, leaves limited to no leeway for citizen participation in wind farm design [21,22]. Against this background, financial participation and compensation (hereafter: FPC) schemes have emerged as key policy tools to enhance social acceptance [6,23]. While the form in which FPC schemes are provided varies greatly across countries [24], they typically involve elements of monetary compensation or the issuance of project shares, as explored in this paper.

FPC schemes are well-suited to mitigate the perceived annoyance of local projects. While wind energy certainly does not only impose local burdens but also plays a vital role in reducing CO_2 emissions [25], generating employment [26], and supporting broader economic growth [26], such benefits often remain abstract for host communities and are rarely sufficient to offset local concerns. Numerous scholars [27,28] report that residents regard the CO_2 reduction benefits as distant or intangible compared with the immediate, visible local disruptions; job creation is typically recorded at the national or regional level [29] and may not have local effects either; and tax revenues frequently bypass the host municipality, flowing instead to higher levels of government or company headquarters [30], leaving those most impacted with few tangible returns. Against this background, offering FPC may be necessary to achieve a more tangible and balanced distribution of local burdens and benefits.

Initially, FPC schemes were introduced on a voluntary basis by some developers, particularly in the United Kingdom and Germany [31,32]. More recently, FPC schemes have increasingly been formalised through national and regional regulations and guidelines; a similar trend is emerging at the EU level. This trend reflects recommendations suggesting that institutionalising FPC schemes may reduce public scepticism and perceptions of 'bribery' [31,33] and may be better suited to enhancing local acceptance compared to voluntary schemes [24]. Yet, despite their growing importance, no comprehensive comparison of national and regional schemes across European countries and regions has been conducted.

This paper provides the first systematic legal and policy mapping of FPC schemes across the EU27, Norway, Switzerland, and the UK. The systematic analysis covers 60 active schemes across 19 countries and 21 regions at the NUTS2 level, as of October 2025. Beyond providing a descriptive mapping of scheme legislation in a public dataset [34], the paper develops a systematic analytical typology comprising four FPC scheme types: fixed-payment compensation, profit-based compensation, debt-based participation, and equity-based participation. This typology provides a consistent framework for the classification, comparison, and assessment of FPC schemes across different regulatory contexts.

In addition, the study evaluates each scheme through the lens of energy justice [35], focusing on three dimensions: distributive justice, concerning *what* and *how much* is distributed; recognitional justice, concerning *who* is eligible to receive benefits; and procedural justice, concerning *how* decisions on benefit distribution are made. Through this analysis, the paper assesses which justice dimensions are explicitly addressed within existing schemes and which remain underdeveloped. In doing so, it identifies recurring design patterns as well as structural blind spots across regulatory approaches. The analysis further highlights differences in the degree of 'regulatory density', understood as the extent of textual specificity embedded within individual schemes.

Building on insights from the existing literature, the paper further explores potential associations between specific FPC design features and local acceptance. For nearly two decades, scholars have examined the relationship between FPC schemes and the local acceptance of wind energy projects [36,37]. Existing research suggests that certain scheme designs are more readily accepted by local communities than others [33]. Based on these findings, the study derives evidence-informed recommendations intended to support more coherent and effective FPC scheme design across Europe.

The dataset additionally creates cumulative value for future renewable energy acceptance research. Existing studies have predominantly examined the effects of *hypothetical* FPC schemes on local acceptance within specific countries or regions [38,39]. By contrast, research examining the effects of *actually implemented* regulatory frameworks remains limited. By documenting when and where FPC schemes emerged, the dataset provided in this paper establishes a temporal and spatial basis for future research investigating how real-world regulatory developments shape local acceptance over time.

The dataset [34] accompanying this paper is publicly available and also accessible via the WIMBY forum,[1] allowing a broad range of stakeholders – including citizens – to comment on and reflect upon existing FPC schemes. These contributions can generate additional insights into how different schemes are perceived in practice and where adaptations may be needed. Based on these objectives, the paper addresses the following research questions:

[1] An open forum accompanies the Horizon Europe project WIMBY (Wind In My BackYard) allowing interested stakeholders to discuss the interactive WIMBY map and other wind energy related issues.

1. How can different FPC schemes be classified within a coherent typology?
2. Which scheme type has been most commonly adopted in Europe?
3. Which countries and regions provide the highest levels of compensation through fixed-payment schemes?
4. Which scheme design aspects are commonly addressed in legislation, and which remain underdeveloped?
5. Which scheme designs are associated with increased local acceptance according to existing literature?

The paper provides the first comprehensive analysis of existing FPC schemes across Europe. Section 2 classifies FPC schemes within a coherent typology (Section 2.1), situates financial participation alongside other forms of renewable energy project participation under EU law (Section 2.2), and explores potential associations between specific FPC design features and local acceptance (Section 2.3). Section 3 outlines the data collection process and methodology. Section 4 presents the results on scheme issuance trends between 2006 and 2025 (Section 4.1) and scheme classification (Section 4.2). Section 5 discusses the results starting with analysing issuance patterns and scheme preferences (Section 5.1), the ranked value of fixed-payment compensation schemes (Section 5.2), and scheme design through the lens of energy justice (Section 5.3). Finally, Section 6 concludes with key findings and policy recommendations.

2. Conceptual framework and literature review

2.1. Definition of FPC scheme types

When it comes to classifying FPC schemes, the literature [40,41] commonly distinguishes between *collective* (e.g., benefiting municipalities) and *individual* (e.g., benefiting individual residents) forms of compensation, as well as between *indirect*, *direct active* and *direct passive* forms of participation. Indirect forms of participation typically include municipal tax revenues or special levies, whereas direct active forms may take the form of cooperatives or limited partnerships, and direct passive forms may involve subordinated loans or savings bonds. However, these classifications have generally been based on a relatively small sample of existing schemes. Building on a review of 60 FPC schemes, this paper introduces a refined classification framework. It distinguishes between financial compensation and financial participation schemes, which can be further divided into four subtypes (see Fig. 1).

In this paper, financial compensation refers to (i) fixed payments, encompassing one-off or recurring monetary payments or in-kind benefits. Its defining feature is that compensation is not linked to profits and does not require active capital investment, making it the simplest mechanism. Compensation payments are typically calculated based on predetermined rates or amounts. In our analysis, we classify production-based compensation as fixed-payment compensation when the rate per kWh or MWh is fixed, even though the amount of kWh or MWh produced is variable, depending on wind conditions. In contrast, when the rate is oriented towards the market price, production-based compensation is classified as (ii) profit-based compensation. Similarly, schemes that link payments to project or company profits or revenue fall under this scheme type. Compensation in results gives the community the right to receive a certain proportion of the overall revenue from the renewable energy development.

In this paper, financial participation schemes require potential beneficiaries to take an active role by investing financially. At the same time, they serve as a complementary source of project finance [42], with (iii) debt-based participation resulting in external capital and (iv) equity-based participation in internal capital. The former may provide relatively predictable interest-based returns through loans or bonds, but not confer decision-making rights. Equity participation, such as the acquisition of project shares, may extend participation in decision-making beyond planning and siting processes to the level of the operating company (except in the case of non-voting stock or preferential shares). Debt-based participation typically carries lower yields, while equity-based participation is rewarded with higher returns to compensate for entrepreneurial risk.[2]

Equity participation and co-ownership serve additional functions: they can operate (i) as a learning device by giving participants direct insight into project operations, (ii) as a motivational device by linking personal benefit to project performance, and as a (iii) transformation device by showcasing how alternative forms of energy production are possible [42,43]. If extended participation in decision-making at the level of the operating company has been granted, it may further reinforce a sense of psychological ownership of the project, which, in turn, can increase acceptance [44]. Finally, mixed forms of financial compensation and participation schemes exist, like share-based profit--sharing, where profits shared are not paid out in cash but deferred in the form of company shares or an initial loan later converted into equity by debt-to-equity swaps [45].

2.2. Public participation under EU law

Public participation in renewable energy projects can be analytically divided into three phases: (i) project siting, (ii) project planning and approval, and (iii) the operational phase of the project (see Fig. 2). Participation during the first two phases primarily concerns decisions on project location and design. In contrast, participation during the operational phase is largely confined to financial participation and participation in project operation. In this regard, Art. 15d RED III primarily targets the operational phase when it requires Member States to promote public acceptance of renewable energy projects through the 'direct and indirect participation' of local communities. For example, the European Commission's Guidance [46] identifies, inter alia, the Danish *Green Pool* (ID5), which requires wind farm developers to transfer fixed payments to host municipalities and to involve citizens in fund governance, as an example of good practice. In addition, the European Commission's December 2025 European Grids Package included a legislative proposal requiring renewable energy projects above 10 MW to redistribute benefits to local populations beyond the scope of energy communities [47]. Taken together, these developments reflect the EU's growing emphasis on financial participation during the operational project phase as a mechanism for strengthening public acceptance of renewable energy projects.

At the same time, public participation during the first two project phases has undergone substantial changes under the revised Renewable Energy Directive (EU) 2023/2413 (RED III). While Art. 15d(1) RED III explicitly enshrines public participation at an early stage through the designation of Renewable Acceleration Areas (RAAs), and thus during the project siting phase, participation during the subsequent project-planning and approval phase may be more limited because projects within these areas are generally subject to a two-step screening rather than an automatic Environmental Impact Assessment. Participation during this phase may still occur through environmental assessments conducted pursuant to Directive 2011/92/EU or, where appropriate, through the Habitats Directive 92/43/EEC. Both assessment procedures are subject to two cumulative conditions: first, projects must be 'highly likely to give rise to significant unforeseen adverse effects' that cannot be mitigated; second, Member States must not have exercised their right under Art. 16a(5) RED III to exempt renewable energy projects from such assessments. However, the effectiveness of these mechanisms may be constrained. Under the 'overriding public interest' doctrine (Art. 16f RED III), greater weight is assigned to the contribution of renewable energy projects to climate change mitigation than to potential negative

[2] This is also reflected in the weaker position of shareholders in insolvency procedures.

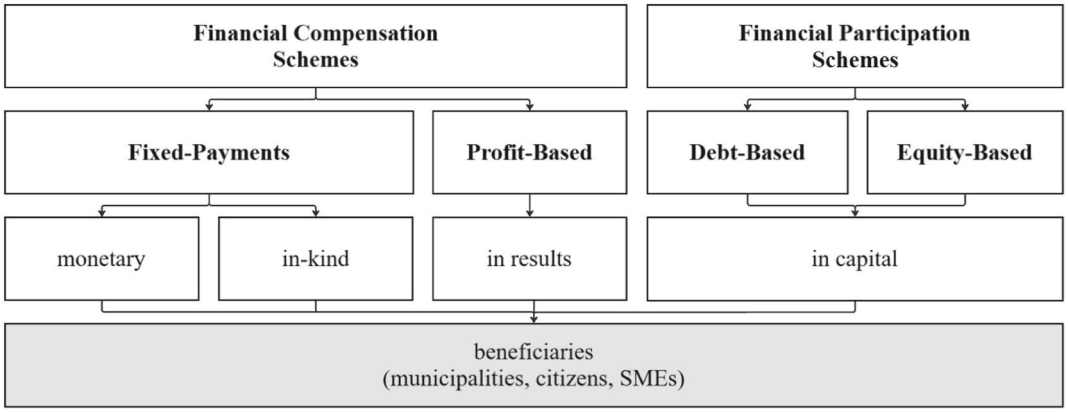

Fig. 1. Four FPC scheme types used across Europe.

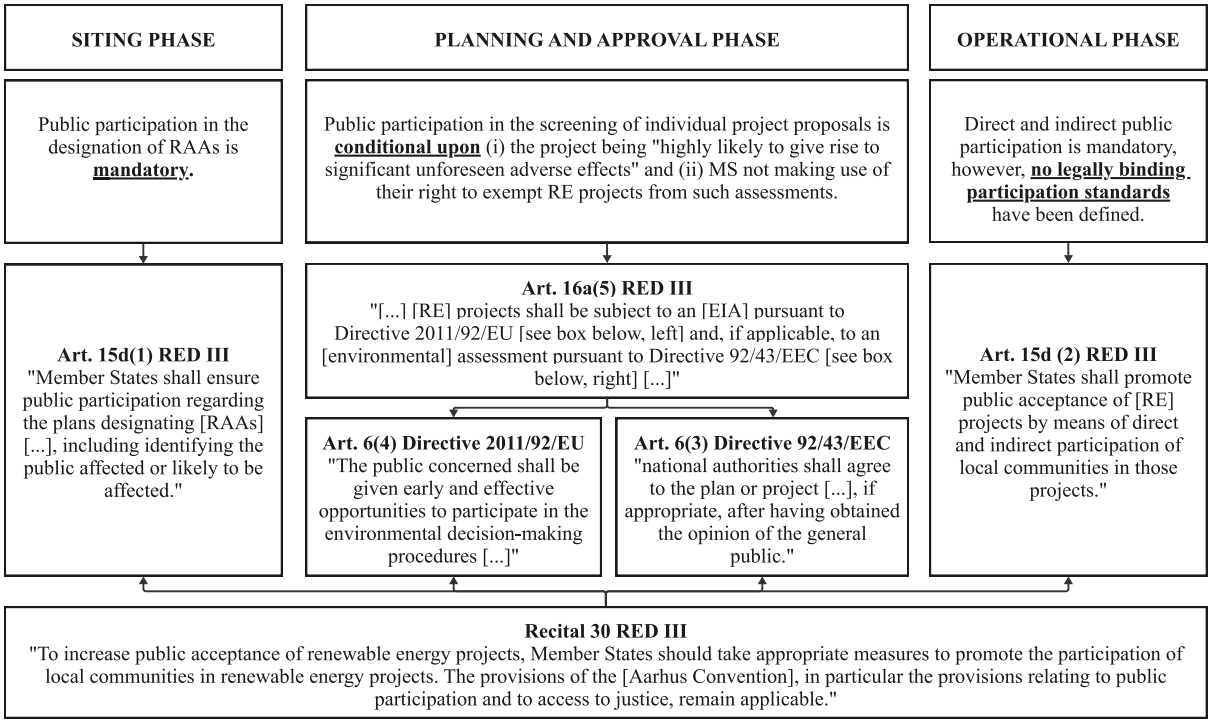

Fig. 2. Public participation in three project phases as defined under RED III.

environmental harms. This presumption may support a derogation under the Habitats Directive, thereby limiting its practical effect.

Against this background, public participation rights during the planning and approval phase appear to have become more conditional and potentially more limited. Despite the EU's reaffirmation of its commitment to public participation in environmental decision-making under the Aarhus Convention (recital 30 RED III), legal scholars warn that inadequate implementation into national law may weaken participation opportunities within the above-mentioned two-step screening process [48]. The tension between *environmental protection* through participatory decision-making, on the one hand, and the accelerated approval of renewable energy projects that contribute to *climate change mitigation* through streamlined procedures, on the other, thus becomes increasingly visible. Consequently, drawing on Hall [49], Devis (2025) [50] characterises this development as potentially marking the 'beginning of a paradigm shift away from the EU's traditional preventive approach to environmental protection' towards a 'stable regime for addressing climate change'. This development aligns with the EU's increasing emphasis on financial participation, which may serve as an alternative mechanism for strengthening legitimacy and fostering public acceptance of renewable energy projects without slowing project approval procedures.

2.3. FPC schemes and local acceptance

Studies show that the impact of FPC schemes on local acceptance depends strongly on their design [24,51,52], and particularly on how they are perceived in terms of justice. Contemporary justice research commonly distinguishes between three interrelated dimensions of justice [53]: distributive justice, which concerns the allocation of resources and impacts [54]; recognitional justice, which addresses whose interests are acknowledged or excluded and how marginalised groups can be empowered [54]; and procedural justice, which focuses on fairness in decision-making processes and recognises that distributive injustices often stem from procedural inequalities [54]. Community benefits and financial participation intersect with all three dimensions [54].

To better understand the relevance of justice dimensions in this context, it is useful to briefly clarify the underlying concept of justice. Philosophically, 'justice' concerns how individuals are treated in situations where competing claims to freedom, opportunities, or resources must be reconciled [55]. In the context of wind energy projects, these claims often relate to the rights of affected municipalities and citizens to participate in, or be compensated for, local developments. A further distinction is commonly drawn between equality and equity. The Aristotelian principle of *formal equality* – 'treat like cases alike' – requires individuals of equal status to be treated equally, whereas *proportional equality* or equity recognises that unequal treatment may be justified when individuals differ in relevant respects [56]. Within FPC schemes, proportional treatment may, for example, justify higher compensation shares for residents living closer to a wind park, as they bear greater annoyance.

The distinction between equality and equity also informs the question of whether compensation should primarily be directed towards communities as collective entities or towards individual residents. A broad body of literature indicates that community benefits are often better suited to increasing local acceptance than individual benefits [20,24,51,52,57]. This finding has frequently been linked to the importance of more collective or 'selfless' motivational factors in shaping positive attitudes towards wind farms. However, the frequently observed preference for community benefits may also relate to the greater leverage achieved when larger sums are pooled into collective projects rather than dispersed as small payments among numerous recipients. For example, Macdonald et al. (2017) [51] found that when project-level awards were capped at EUR 1,000, many respondents favoured establishing larger community funds capable of financing projects with more visible collective benefits. The type of projects supported through such collective 'wind money' also matters: Aitken (2010) [31] observed that participants frequently believed funds should be invested in energy efficiency or renewable energy initiatives rather than in less strategic short-term activities.

An important exception to the general assumption that collective compensation is preferred over individual compensation is provided by the study of Vuichard et al. [58], conducted in 2015 and 2017. While respondents in Italy and Switzerland preferred compensation directed towards municipalities (community compensation), respondents in Ukraine favoured financial compensation for residents (individual compensation). Furthermore, research highlights that citizens often emphasise cheaper electricity – clearly an individual benefit – as a desirable form of local compensation [14,33,52]. The existing evidence therefore suggests that the relationship between different forms of compensation and local acceptanfce is context-dependent.

Against this background, it becomes evident that a universally applicable FPC scheme design for a country, let alone for an entire continent, does not exist. Even within a single municipality, citizen preferences may differ depending on multiple factors, including personal values, socio-economic background, previous experiences, perceived justice dimensions, local power dynamics, and levels of trust in project developers [59]. Nevertheless, although citizens may prefer different FPC scheme types, certain design elements may contribute to increasing acceptance across different resident groups. Concrete examples, derived from existing literature, are provided in Section 5.3.

3. Data collection and methodology

3.1. Web-based document search and expert interviews

This paper identified FPC schemes that were either enshrined in regulations or recommended in guidelines issued by public authorities. The focus was on schemes governing onshore wind energy in the EU27, Norway, Switzerland, and the United Kingdom. Documents were identified through systematic web searches based on predefined keywords (see Fig. 3). Keywords were divided into primary, secondary, and tertiary terms. Searches were conducted using at least one term from each level in combination. Keywords were refined iteratively during the screening process to improve the precision of search results. To increase the number of search results, keywords were translated into at least one of the main languages spoken in the analysed countries and regions.

The web-based search was complemented by oral exchanges with 18 national and cross-national wind energy experts working in administration, project development, or consultancy (see Appendix Table A1). Interviews were part of the Horizon Europe project WIMBY and primarily focussed on the ten countries covered by the project. Meetings lasted between 30 and 60 min on average and were conducted between July 2024 and December 2024. Experts were identified through professional networks, public institutional affiliations, and recommendations from other interviewees, and were approached via email. At the beginning of each online meeting, participants were asked about the duration and nature of their professional experience in the wind energy sector to ensure eligibility. The interview was divided into three sections, of which questions on existing regulations and/or guidelines governing FPC schemes fell in the first section. The consultations followed a semi-structured verification approach: experts were presented with the FPC schemes identified through desktop research, where available, and asked to verify the accuracy and completeness of the information. The consultations primarily served to validate and complement the document analysis rather than to generate a standalone qualitative dataset.

3.2. Dataset construction and decision-tree classification

As of October 2025, the identification process yielded 51 documents (regulations and guidelines), of which five were in planning (France [60]; Saxony Anhalt [61] and Bavaria [62], Germany; Basque Country, Spain [63]; Sweden [64]). Given the uncertainty surrounding their actual implementation, we have not considered them in our analysis. Two had been repealed (Denmark [65] and Italy [66]). The analysis of the remaining 44 documents revealed 60 relevant FPC schemes (see Appendix Table A2). At the time of analysis, 52 schemes were enshrined in regulations, and eight were set out in guidelines. Overall, the dataset covers schemes across 19 countries and 21 regions (NUTS2 level) in Europe with formally published and active regulations and guidelines. In the case of Walhain (Wallonia, Belgium), the scope extends down to the municipal level. Given the high number of municipalities in Wallonia (262) that may issue schemes and the objective of this paper to provide a cross-European rather than a country-specific analysis, Walhain was selected as an illustrative municipal example in the dataset.[3]

Of the 60 relevant FPC schemes, 50 could be assigned to one of the four types, while ten schemes allowed developers to choose among multiple compensation or participation schemes.[4] To capture this flexibility, these ten schemes were assigned to all four types. The classification process followed a decision-tree approach:

[3] We chose Walhain as an exemplary municipality because it was the first municipality in Wallonia to introduce such a scheme and, according to a parliamentary discussion, it 'risked becoming a precedent case' for other municipalities [181]. Indeed, our review of ten additional municipal regulations governing FPC schemes in Wallonia revealed strong similarities in both wording and scheme design to Walhain's scheme [182–191]. These schemes generally provide between EUR 15,000 and EUR 17,000 per wind turbine with an installed capacity of 5 MW, closely corresponding to the EUR 17,000 applied in Walhain. Against this background, we consider Walhain to be well suited to be an illustrative case for other municipalities that have likewise introduced such schemes.

[4] An example is the financial participation law of Lower Saxony, which rules: 'an additional offer must be made within one year after commissioning, whereby the developer is free to choose between various options.' (ID20).

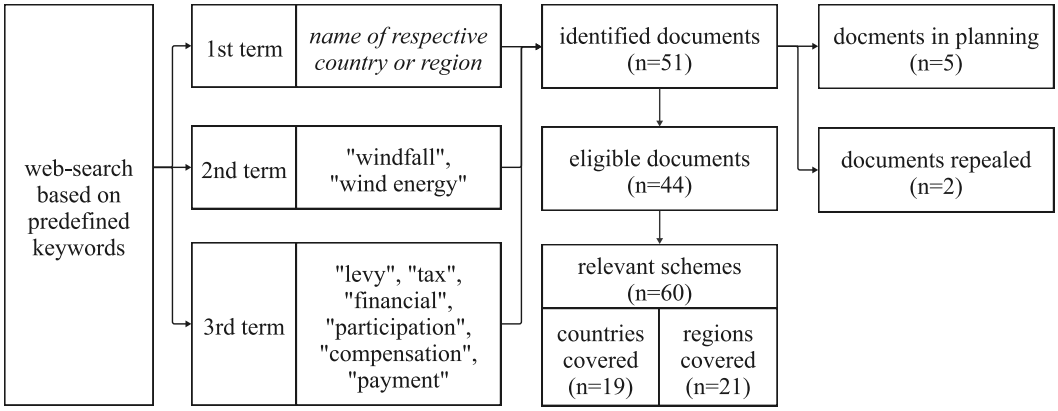

Fig. 3. Definition of search terms and selection of eligible documents.

1. Can beneficiaries participate through project co-ownership? If yes: Equity-based participation.
2. If not, can beneficiaries participate through project investments? If yes: Debt-based participation.
3. If not, do beneficiaries receive a share of project profits or revenues? If yes: Profit-based compensation.
4. If none of the above applies: Fixed-payment compensation.
5. Schemes that allow for the use of multiple schemes were defined as multiple scheme types.

3.3. Assessment framework for FPC schemes

3.3.1. Level of enforceability

Schemes that must be offered are always enshrined in regulations and impose a mandatory obligation on developers. By contrast, schemes that may be offered can appear either in regulations or in guidelines. When set out in guidelines, such schemes are inherently non-binding. When they are established through regulations, their legal status depends on the wording of the provision. In particular, terms such as *shall* or *must* indicate mandatory requirements, whereas *may* or *can* generally signal discretionary provisions. Regulations that impose legally binding obligations represent the highest level of enforceability (level 1). By contrast, provisions using discretionary language, as well as provisions that allow developers to choose among multiple scheme types, establish conditional or optional requirements and therefore represent a lower level of enforceability (level 2). Finally, FPC schemes that remain vague fail to define minimum standards, irrespective of their formal legal status, possess limited practical enforceability because developers retain substantial discretion regarding the content and scope of implementation. Such schemes therefore represent the lowest level of enforceability (level 3). A comprehensive overview of the level of enforceability for each FPC scheme is provided in Appendix Table A4. The nine schemes not included in the Appendix were classified as level 3 schemes.

3.3.2. Compensation value

This paper develops a ranking of fixed-payment compensation schemes applied across countries and regions based on the monetary amounts offered. To ensure better comparability across fixed-payment compensation schemes, the calculations are based on a standardised hypothetical wind farm configuration applied uniformly across all cases. The hypothetical wind park consists of five 140-m hub height turbines with an installed capacity of 5 MW per turbine. To ensure comparability, all compensation amounts were converted into annualised equivalents over a 20-year operating period. A 20-year period was chosen because it reflects the typically assumed technical lifespan of a wind farm [67].

A limitation of this comparison is that electricity generation depends on wind conditions, which vary across countries and regions.[5] To standardise production-based schemes, annual generation of a 25 MW onshore wind farm was estimated using capacity factors for Germany (20.1%), the Czech Republic (24%), Lithuania (24%), Norway (24%), the Netherlands (26.2%) and Ireland (28.2%), based on data for 2022 [68] and 2023 [69]. Full load hours (FLH) were calculated as 24 h × 365 days multiplied by the country-specific capacity factor. In addition, a sensitivity analysis was conducted by recalculating compensation values and rankings under relative capacity-factor changes of ± 5%, ± 10%, and ± 15%. Calculation steps are reported in Appendix Table A3, original formulas in Appendix Table A4, and all EUR values rounded.

Schemes that did not define minimum standards (IDs 16, 21, 25, 40, 43), that could not be calculated theoretically (IDs 40,[6]41[7]), that served as penalty payments, meaning that they would only be used if the wind park developer fails to meet its obligations (IDs 24, 27, 31), or that merely operated as an alternative to another fixed-payment compensation scheme (ID28), were excluded from the ranking. It should be highlighted that the purpose of the analysis is not to estimate actual project profitability or country-specific economic outcomes. Rather, the standardised model serves as a comparative benchmark for assessing the formal monetary structure of compensation schemes across jurisdictions.

3.3.3. Scheme design

The analysis of the justice aspects of each FPC scheme was based on a comprehensive text analysis. In this respect, the relevant sections of national or regional regulations and guidelines governing FPC schemes across Europe were compiled into a single document of approximately 70,000 words and translated into English. Due to their length, the United Kingdom's guidelines (IDs 56-60) were analysed separately rather than included in this document. In addition, an Excel database [34] was created comprising 60 rows – each representing one FPC scheme – with columns indicating, inter alia, the legal source, scheme type, level of

[5] See also https://map.wimby.eu.

[6] In Poland, at least 10% of a wind farm's installed capacity must be allocated for use by residents as virtual prosumers of renewable energy, each entitled to acquire a share of up to 2 kW per household.

[7] In Portugal, developers with an assigned connection power exceeding 1 MVA must provide eligible municipalities with a renewable energy facility for self-consumption, with an installed capacity equivalent to 1% of the plant's connection power. This facility is to be installed in municipal buildings or collective-use equipment, or, with the municipality's consent, made available to residents in the vicinity of the plant. Alternatively, developers may provide electric vehicle charging stations of equivalent capacity, located in public spaces and intended for public use.

enforceability, calculation basis, eligibility criteria for beneficiaries, and other design features.

In a first step, each FPC scheme was examined using a set of analytical metrics. These metrics are employed to systematically and qualitatively assess and compare scheme designs. One example of a metric is the formula used as the basis for calculating compensation payments. Additional metrics were introduced inductively during the review process where relevant. In a second step, identified metrics were assigned to the three dimensions of energy justice – distributive, recognitional, and procedural. For example, we classified the calculation basis metric under the distributive justice dimension, as it concerns the object and amount of distribution. The distinction between the justice dimensions has been explained in Section 2.3. The classification of ambiguous metrics, which could fall under several dimensions, was based on an internal decision among the authors. In a third step, metric configurations were compiled and assessed with regard to their perceived level of justice, drawing on the relevant literature. For instance, the *number of turbines* could be one possible calculation basis for fixed-payment compensation schemes: a predefined and fixed amount is multiplied by the number of wind turbines of a wind farm to calculate the amount of compensation payments a municipality or region can expect. In a fourth and final step, where appropriate, the analysis proposes additional metrics and metric configurations that could enhance perceived fairness but are not currently enshrined in any regulation or guideline, while critically reflecting on their potential advantages and limitations.

4. Results

4.1. Temporal distribution of FPC scheme issuance

This paper provides a snapshot of FPC schemes over a span of nearly twenty years, introduced between January 2006 and October 2025 (see Appendix Table A2). It captures FPC schemes currently in force (n = 60), those that have been repealed (n = 2), and those that are still in the planning or legislative development phase (n = 5). A substantial increase in countries and regions issuing FPC schemes can be observed after 2021 (see Fig. 4). This surge coincides with the adoption of the REPowerEU Plan (2022) [70], introduced to strengthen Europe's energy autonomy following the Russian invasion of Ukraine. The plan proposed the concept of 'go-to areas' – specific sites considered particularly suitable for renewable energy development, to accelerate the energy transition. This concept was subsequently incorporated into RED III, which required Member States, by 21 February 2026, to designate RAAs for one or more renewable energy sources [71]. The updated regime governing renewable energy project siting as well as planning and approval, characterised by a more assertive, top-down approach, may further erode local acceptance of wind farms [3]. Against this backdrop, Member States may increasingly rely on the use of FPC schemes, in line with EU recommendations (see Section 2.2), to ensure conflict-free renewable energy development.

4.2. Geographical distribution and enforceability of FPC schemes

Following the decision-tree approach outlined in Section 3.2, the FPC schemes were clustered into four types[9]: fixed-payment compensation schemes are the dominant type (n = 32), whereas equity-based participation (n = 9), profit-based compensation (n = 5) and debt-based participation (n = 4) play a minor role. This imbalance reflects a preference for administratively simple mechanisms but reveals limited opportunities for citizens to transition from passive beneficiaries to active co-owners. A description of typical FPC schemes identified is offered in Table 1, including information on how many of these schemes are obligatory (level 1 enforceability).

Fixed-payment compensation schemes constitute the largest group of obligatory schemes, followed by profit-based compensation schemes and equity-based participation schemes, while no obligatory debt-based participation schemes were identified in this study. Fig. 5 provides a visual overview of the geographical distribution of FPC schemes across Europe, including their level of enforceability. The following sections examine each of the four FPC scheme types in more detail.

4.2.1. Fixed-payment compensation

Fixed-payment compensation schemes constitute the largest group of obligatory schemes (n = 27), spanning 14 countries and 17 regions. Several schemes are optional, as they are defined in guidelines rather than regulations (IDs 36, 56, 58, 60). Moreover, the wording of §6 EEG (ID13, Germany), although enshrined in a regulation, does not create a legal obligation, as it merely *permits* wind park developers to compensate municipalities with up to EUR 0.002 per kWh fed into the grid. This enabling formulation was deliberately chosen to prevent such payments from being classified as potential offences under German criminal law, such as bribery or corruption [72]. Federal states may, however, introduce obligatory provisions and many have already done so (see Appendix Table A2). Other schemes are conditional, either because they function as penalty mechanisms (IDs 24, 27, 31) or because their application is conditional (IDs 20, 28, 41). Finally, several schemes lack practical leverage (IDs 16, 21, 25, 43).

4.2.2. Profit-based compensation

Three profit-based compensation schemes were identified as obligatory without exception: ID6 (Denmark), which takes the form of an annual *Bonus Scheme*[11] calculated based on the share of electricity production[12] and capped at 1.5% of the plant's capacity; ID7 (Estonia), where payments are determined through a special formula[13]; and ID45 (Slovenia), under which payments amount to 3% of the project's annual revenue, with a distinction made between turbines[14] receiving government support and those[15] that do not. In addition, profit-based compensation is optional under several schemes, including ID17 (Mecklenburg-Western Pomerania, Germany), which introduces an equalisation levy calculated based on the capitalised earnings value corresponding to a 10% project share; ID20 (Lower Saxony, Germany); ID28 (Saxony, Germany); and ID33 (Italy), whereby the latter permits environmental or territorial in-kind compensation measures not exceeding 3% of annual revenues. Finally, it should be noted that, according to Slee (2015) [13], *voluntary* benefit schemes offered by developers typically accounted for less than one per cent of total profits.

4.2.3. Debt-based participation

None of the debt-based participation schemes analysed is obligatory without exception. Of the four schemes identified, all are either defined in guidelines (IDs 36, 56, 58, 60), are conditional in nature (IDs 18, 20,

[9] While MSTs can encompass any scheme type, they were not included in the count for the individual scheme types.

[11] Equals (the share of electricity production x (electricity price in DKK/kWh) x (production per power plant in kWh).

[12] Equals (the Renewable Energy bonus rate in the amount of 9.75 kW) ÷ (the total capacity per renewable energy technology in kW).

[13] Determined in the range of 0.7 to 1% of the product of (the amount of electricity produced in a quarter of the wind power plant in MWh, but not less than 70% of the nominal capacity of the wind power plant x 750) x (the arithmetic average of the day-ahead market electricity price in the Estonian price area for the corresponding quarter).

[14] Here, the compensation base shall be determined as the product of the annual quantity of electricity produced (MWh) and the amount of support (EUR/MWh) in the year in which the liable party received the support.

[15] Here, the compensation base shall be determined as the product of the annual quantity of electricity produced (MWh) and the reference price of electricity (EUR/MWh).

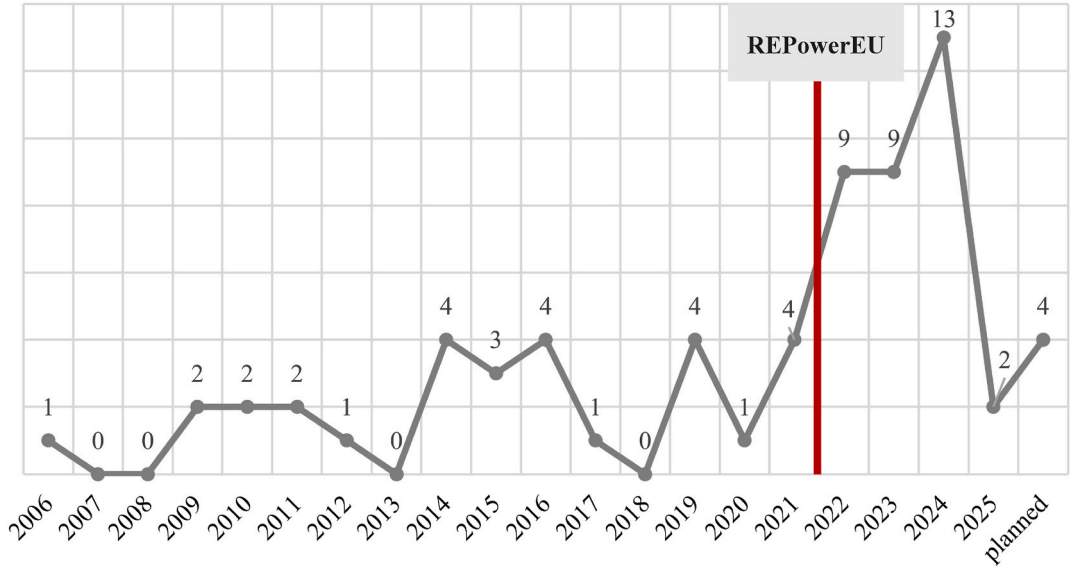

Fig. 4. Publication trends of FPC schemes in Europe (2006–2025; n = 67[8]).

[8] MSTs were treated as a single scheme rather than four separate schemes. Repealed and planned schemes have been included.

23, 28, 53), or lack practical leverage (IDs 11, 16, 21, 25, 43). Among the more elaborate optional schemes are ID18 (Mecklenburg-Western Pomerania), under which participation may be offered through time-limited (3-10 years) saving products with a fixed interest rate, requiring a minimum individual investment of EUR 500 and a total investment volume of at least 10% of the project's equity; ID23 (North Rhine-Westphalia, Germany), where participation may take the form of time-limited (10 years) subordinated loans with a fixed interest rate, a maximum individual investment of EUR 25,000, a minimum investment of EUR 500 and a total participation volume of at least EUR 90,000 per MW; and ID53 (Catalonia, Spain), which allows participation through saving products with a total investment volume of at least 20% of the project's equity.

Table 1
Classification of FPC schemes into four types.

Fixed-payment compensation n = 32, of which 27 are obligatory.	Profit-based compensation n = 5, of which 3 are obligatory.	Debt-based participation n = 4, of which 0 are obligatory.	Equity-based participation n = 9, of which 2 are obligatory.
Typically defined as an annual payment calculated using either a fixed rate per MWh of electricity produced or a fixed rate per installed MW capacity. The median value across all jurisdictions is EUR 88,038.	Typically defined as a percentage of the operating company's profits or revenues, paid out annually to the host municipality or local residents. In ID45, benefits amounting to up to 3% of the project's revenues must be offered.	Participation is granted through interest payments over a defined period, typically via bonds or subordinated loans. While no scheme is obligatory, saving products amounting to at least 20% (ID53) or 10% (ID18) of the project's equity may be offered.	Typically, it is granted through the opportunity to acquire shares in the operating company. Financial assistance[a] is possible. In two cases (IDs 15, 55), at least 20% of project shares or co-ownership must be offered.

[a] Such as the provision of loans, securities or deferred payments.

4.2.4. *Equity-based participation*

Equity-based participation was identified as obligatory without exception in two schemes: ID15 (Mecklenburg-Western Pomerania,[16] Germany), where developers must offer municipalities an equity stake of at least 20% of the project's shares; and ID55 (Balearic Islands, Spain), where participation must amount to 20% of the project's equity. Participation is optional or conditional under several other frameworks, including ID15 (Mecklenburg-Western Pomerania), where a minimum 20% share may be offered to residents; ID2 (Wallonia, Belgium), which encourages shares of up to 24.99% to be offered to local authorities and citizens; ID20 (Lower Saxony, Germany); ID28 (Saxony, Germany); ID54 (Catalonia, Spain), which supports a minimum ownership share of 20%; and ID37[17] (the Netherlands), which encourages 50% local ownership. Although the 50% target set out in the Dutch *Klimaatakkoord* is non-binding, some municipalities have incorporated this commitment into their local energy policies [73,74].

5. Discussion

5.1. *Issuance patterns and scheme preferences*

Based on the timing of adoption, countries and regions are grouped into pioneers (2006–2011), early adopters (2014–2021) and a late majority (2022–2025). Once introduced, schemes generally remain in place without a temporal limit. Across the dataset, only two countries – Italy and Denmark – have repealed their FPC schemes, although Denmark replaced its earlier equity-based participation model with a fixed-payment compensation scheme rather than abandoning local benefit-sharing altogether. A visual overview of publication patterns is provided in Fig. 6. To facilitate the identification of countries introducing an FPC scheme for the first time, additional schemes introduced within the same country are represented by circles with a bold edge.

[16] Developers may propose offering ID17 instead; however, municipalities retain the right to insist on the use of ID15.

[17] The goal of 50% local ownership has only been formulated as a policy aim without a legally binding effect.

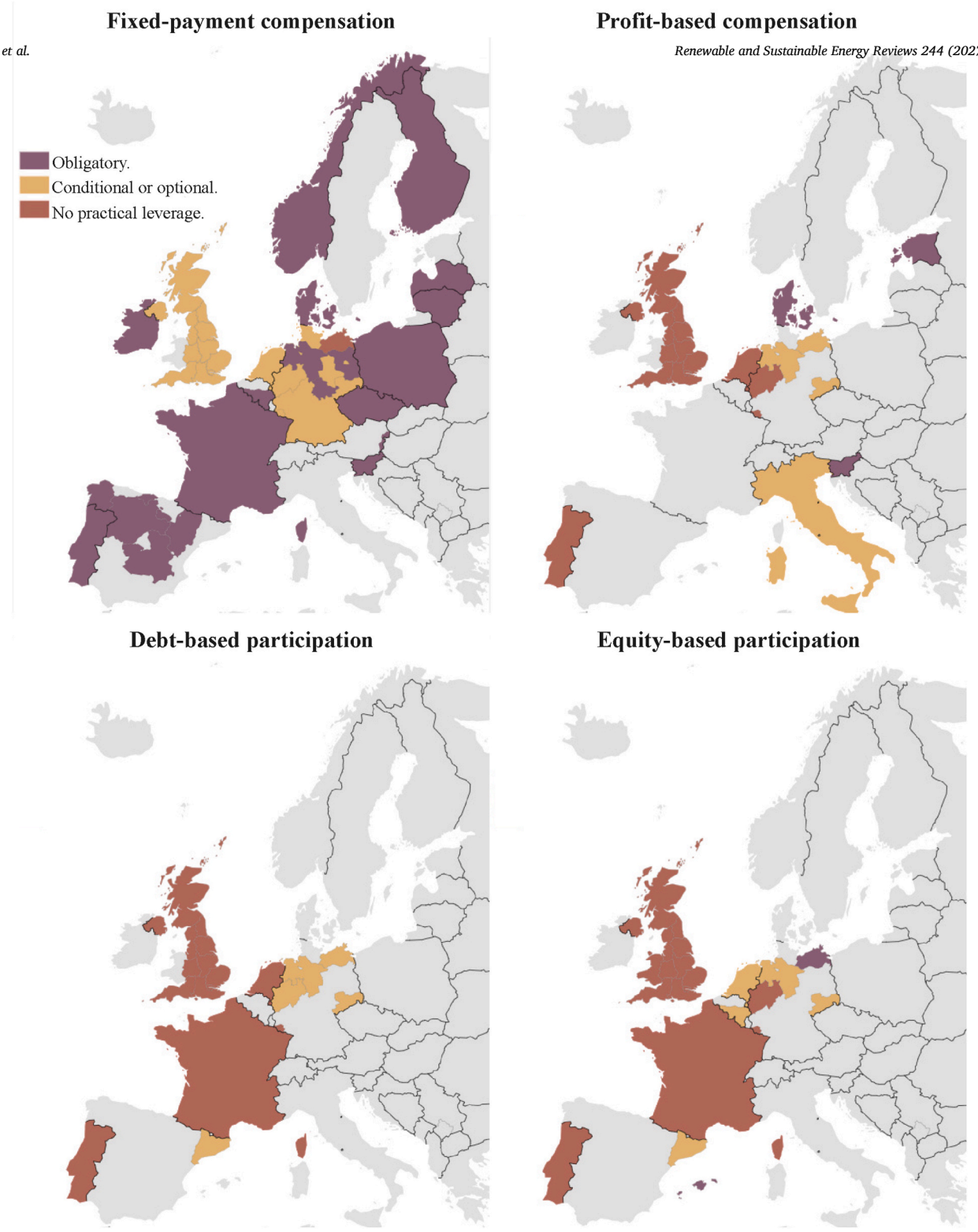

Fig. 5. Mapping of FPC schemes and their level of enforceability in Europe.[10].

[10] Where multiple FPC schemes apply within the same country or region and differ in their degree of enforceability, the highest level of enforceability was recorded (e.g., obligatory schemes take precedence over conditional or optional schemes)

Schemes introduced by pioneers predominantly took the form of obligatory fixed-payment compensation. Early adopters experimented more widely with scheme design, including equity-based participation. Schemes introduced by the late majority largely replicate the models established by pioneers and early adopters, favouring obligatory fixed-payment compensation schemes. Overall, the diffusion pattern suggests policy learning and imitation between countries.

5.1.1. Introduction of FPC schemes in response to wind energy opposition

In several jurisdictions, the timing and stated objectives of FPC reforms suggest that they were introduced partly in response to persistent opposition to wind development. For example, in Norway, rapid wind

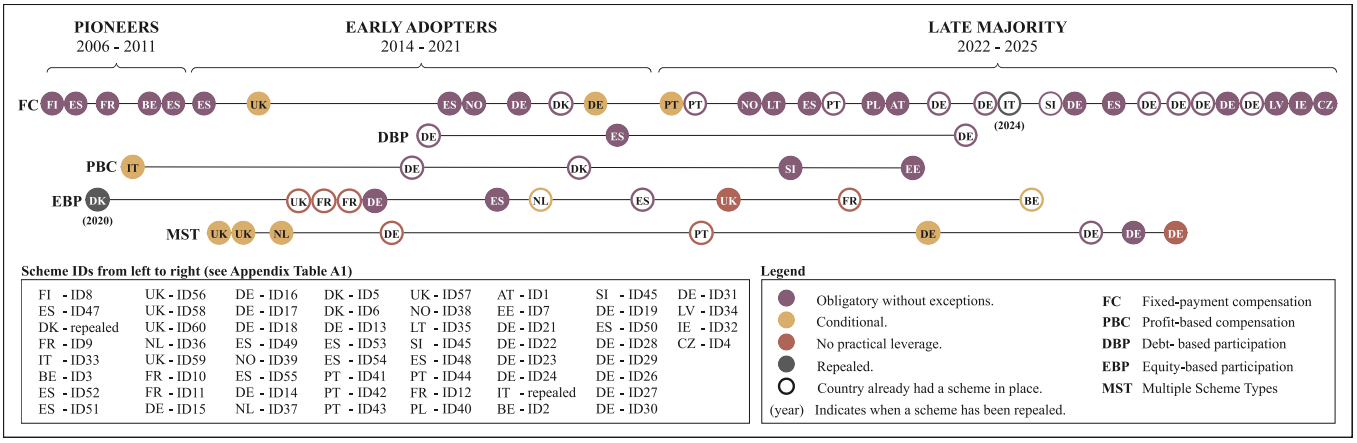

Fig. 6. Publication patterns of FPC schemes in Europe (2006–2025; n = 62[18]).

[18] MSTs were treated as a single rather than four separate schemes. Repealed schemes have been included.

energy expansion between 2017 and 2020 coincided with a marked increase in public opposition [75]. The government suspended the processing of new onshore wind applications in April 2019 and announced its resumption in April 2022 [75]. *Motvind Norge*, established in 2019, became a prominent national opposition organisation, although the suspension remained a government decision [76]. Norway subsequently strengthened municipalities' veto rights and introduced an FPC scheme benefiting host municipalities (ID39) in July 2022 [77].

Denmark experienced a comparable policy development. Research links increasing opposition partly to the commercialisation and upscaling of wind development, declining local ownership, and concerns about the unequal distribution of project benefits and burdens [16]. A 2009 equity-based participation scheme [78] was initially introduced partly in response to these concerns [6]. Also, the *Green Pool* (ID5) FPC scheme, which entered into force in June 2020, was explicitly designed to promote local and municipal support for renewable-energy development [6,16,79].

Similar developments can also be observed in Germany. Brandenburg's Energy Strategy 2040 [80] records around one hundred citizen initiatives opposing further wind development and identifies limited opportunities for local economic participation. It also describes the state's FPC scheme (ID14) as an instrument for increasing public acceptance. Mecklenburg-Western Pomerania likewise experienced substantial opposition to wind energy development [81]. The explanatory memorandum to the state's FPC legislation (IDs15-18) emphasises that implementation of the energy transition increasingly depends on public acceptance and identifies financial participation and regional value creation as central objectives of the law [82].

5.1.2. *Equity-based participation schemes in areas with strong citizen energy traditions*

The study results indicate that equity-based participation schemes are concentrated in regions with strong citizen-energy traditions. Denmark [83] and the Netherlands [84] have long histories of citizen ownership and wind cooperatives while citizen-owned projects have also emerged in Wallonia [85] and Mecklenburg-Western Pomerania [86]. Such traditions may create expectations that local communities should have access not only to compensation, but also to equity participation, cooperative ownership and other negotiated participation models. However, no comparable long-standing citizen-wind tradition was identified in Catalonia or the Balearic Islands, suggesting that equity-based schemes may also be introduced proactively to create local ownership structures rather than merely reflecting established traditions.

It is important to note that the Danish equity-based participation scheme was repealed in 2020. Until then, developers were required to offer at least 20% of project ownership to citizens within the affected area [59,79]. Evaluations by the Danish Energy Agency in 2011 and 2019 found limited citizen uptake [87,88]. Research identifies several barriers, including insufficient capital [59,89,90], limited public awareness and trust, and a lack of technical knowledge [20,79]. The Danish Energy Agency also criticised the concentration of shares among specialised investors, sometimes described as 'wind energy nomads' [87]. Despite measures such as limiting the number of shares per buyer, the scheme was replaced by the *Green Pool* (ID5), which introduced fixed-payment compensation.

5.2. *Fixed-payment compensation levels*

This section compares the compensation levels of fixed-payment schemes across Europe. Payments received by residents, municipalities and regions vary considerably between countries and even between regions within the same country.

5.2.1. *Variation in compensation levels and ranking robustness*

The ranking remains broadly stable across the sensitivity scenarios (see Table 2). Twelve of the 29 countries and regions retain the same rank throughout, including Denmark, Slovenia, France, Norway, Ireland, the Czech Republic and all six Spanish jurisdictions. The largest changes occur in the middle of the ranking: Wallonia, Finland and Burgenland each move by five positions, Germany and several German regions rise by up to three positions, and Lower Saxony rises from eighth to fifth place as the assumed capacity factor increases.

5.2.2. *Explanations for comparatively high compensation levels*

Jurisdictions with comparatively high compensation levels include Denmark, Slovenia, France, the United Kingdom, Ireland, Wallonia, Norway, the Czech Republic as well as selected German regions (see Table 2). These levels may partly reflect favourable wind resources and bargaining dynamics between developers and host communities, particularly in Ireland [23,91] and the United Kingdom [31], where voluntary community benefit arrangements developed alongside favourable wind conditions [92].

Historically established participation practices may also shape local

Table 2
Compensation rankings under alternative wind energy capacity factor scenarios.

Country, region	Base value in EUR	Rank (−15%)	Rank (−10%)	Rank (−5%)	Rank (0%)	Rank (+5%)	Rank (+10%)	Rank (+15%)	Rank range
Denmark	366,894	1	1	1	1	1	1	1	0
Slovenia	250,000	2	2	2	2	2	2	2	0
France	212,750	3	3	3	3	3	3	3	0
Norway[a]	183,533	4	4	4	4	4	4	4	0
Great Britain, England	144,726	5	5	5	5	5	6	6	1
Great Britain, Scotland	144,726	5	5	5	5	5	6	6	1
Great Britain, Northern Ireland	144,726	5	5	5	5	5	6	6	1
Germany, Lower Saxony[b]	132,057	8	8	8	8	8	5	5	3
Ireland	123,516	9	9	9	9	9	9	9	0
Czech Republic	107,222	10	10	10	10	10	10	10	0
Germany	88,038	14	12	12	11	11	11	11	3
Germany, North Rhine-Westphalia	88,038	14	12	12	11	11	11	11	3
Germany, Saarland	88,038	14	12	12	11	11	11	11	3
Germany, Saxony	88,038	14	12	12	11	11	11	11	3
Germany, Thuringia	88,038	14	12	12	11	11	11	11	3
Belgium, Wallonia (Walhain)	85,000	11	11	11	16	16	16	16	5
Finland	77,610	12	17	17	17	17	17	17	5
Austria, Burgenland	75,000	13	18	18	18	18	18	18	5
Spain, Castile and León	60,000	19	19	19	19	19	19	19	0
Lithuania	52,560	24	24	24	24	24	24	22	2
Spain, Galicia	52,500	20	20	20	20	20	20	20	0
Spain, Aragon	52,360	21	21	21	21	21	21	21	0
Germany, Brandenburg	50,000	22	22	22	22	22	22	23	1
Latvia	50,000	22	22	22	22	22	22	23	1
Spain, Cantabria	31,100	25	25	25	25	25	25	25	0
Netherlands	28,689	27	26	26	26	26	26	26	1
Portugal[c]	18,750	26	27	27	27	27	27	27	1
Spain, La Rioja	16,000	28	28	28	28	28	28	28	0
Spain, Castile-La Mancha	9780	29	29	29	29	29	29	29	0

[a] IDs 38-39 were aggregated; sensitivity analysis was conducted only for ID39, the production-based FPC scheme.
[b] IDs 19-20 were aggregated; sensitivity analysis was conducted for both schemes, as both are production-based FPC schemes.
[c] IDs 42 and 44 were aggregated, no sensitivity analysis was conducted for either scheme, as both are capacity-based FPC schemes.

expectations regarding compensation levels. For example, Denmark [83,85] – the country with the highest annual compensation level according to our calculations (see Section 5.2.1) – combines a long history of wind energy development with traditions of citizen ownership, cooperative projects and municipal involvement. Citizen wind initiatives also exist in Germany [85], the United Kingdom [85], Ireland [93], Belgium [85] and France [94], all of which have relatively high compensation levels. As commercial projects increasingly supplement or replace locally owned wind farms, higher compensation payments may be needed to partly substitute for the financial benefits and local control previously associated with citizen ownership and prevent local protests.

However, a long wind energy tradition is not sufficient to explain high compensation levels. Slovenia and the Czech Republic represent important counterexamples. In Slovenia, despite comparatively limited wind energy deployment [95] its two schemes (IDs 45-46) provide some of the highest payments in the European comparison. Moreover, one scheme is funded by the government rather than wind energy developers. This may reflect the government's awareness that Slovenia has lagged behind other EU countries in wind energy development and its explicitly stated intention to 'encourage the introduction of wind power' [96]. The Czech Republic should likewise be considered separately. Its comparatively high payment level may reflect an effort to create strong municipal incentives for new wind development in a country where deployment remains limited. A government report, for example, states that wind energy 'faces resistance from municipalities' but that acceptance could increase if 'financial compensation' were offered [97].

5.3. FPC scheme design and regulatory density

The following Sections 5.3.1 to 5.3.3. provide an overview of FPC scheme designs aspects, focusing on three metrics per justice dimension. In our analysis, we have clustered the calculation basis, first payment and payment duration metrics below distributive aspects; the beneficiary type, distance-based eligibility and inclusivity below recognitional aspects and the governance of payments, earmarking of payments and monitoring of payments and penalties in case of non-compliance below procedural aspects.

The most frequently used metric configurations include identifying municipalities as beneficiaries (n = 25), earmarking payments (n = 17), calculating compensation on a production-based basis (n = 13), monitoring payments (n = 12), initiating the first payment at project completion or up to one year thereafter (n = 11), applying radius-based eligibility criteria for municipalities (n = 11), including neighbouring or otherwise affected municipalities as potential beneficiaries (n = 11), and earmarking compensation payments for local infrastructure, the local economy (n = 11), or cultural and social initiatives (n = 11). In contrast, comparatively few schemes specify that payments should begin at the start of construction (n = 1), continue until decommissioning (n = 1), or extend until dismantling and site restoration (n = 4). Furthermore, only a few schemes define a maximum investment threshold (n = 2), establish a maximum share price (n = 1), or require a clear link between compensation spending and the project (n = 3).

In this study, Tables 3–5 show the scheme IDs associated with each metric configuration. Schemes with the highest regulatory density, here defined as schemes covering a comparatively large number of metric configurations, include ID15 (10 metric configurations), IDs 26, 29, and 31 (each containing 9 metric configurations), and ID34 (8 metric configurations). In contrast, schemes appearing only once across the analysed metrics include IDs 3, 8, 9-11, 17, 39-41, 44, 45, 52, 55, 56, 58 and 60. ID15 belongs to the fixed-payment compensation type and governs fixed-payment compensation in Mecklenburg-Western Pomerania. Published in 2016, it represents the earliest among the schemes with high regulatory density. IDs 26, 29, and 31 also fall under the fixed-payment compensation type and regulate fixed-payment compensation

Table 3
FPC scheme design and distributive aspects.

Source	Metrics	Metric configurations	Scheme ID(s)	n
Fixed-payment n = 32	Calculation basis	Production-based (per MWh/kWh).	4, 13, 19, 22, 24, 26, 27, 29-32, 35, 39.	13
		Capacity-based (per MW/kW/MVA).	1, 5, 9, 34, 40-42, 44, 46, 50.	10
		Number of wind turbines.	3, 14, 48, 49, 51-52.	6
		Wind turbine height (in meters).	47, 48, 50.	3
		Wind turbine value (in per cent).	8, 38.	2
All schemes n = 51[a]	First payment and retroactivity	At completion or up to one year thereafter.	1, 4, 15, 19, 21, 28, 30, 34, 46, 47, 50.	11
		Retroactivity of payments.	1, 13, 49, 51.	4
		Upon or shortly after energy is produced.	5, 6.	2
		One year after the DSO permit.	45.	1
		At the start of construction.	7.	1
All schemes n = 51	Payment duration	Repowering mentioned.	19, 21, 25, 30, 34, 49.	6
		Until dismantling and site restoration.	34, 38, 50-51.	4
		Lump-sum payment.	42, 44, 46.	3
		At least 20 years or operation lifetime.	4, 14, 30.	3
		Until decommissioning.	1.	1

[a] We did not include schemes that did not define binding standards (n = 9) leaving us with 51 rather than 60 schemes.

Table 4
FPC scheme design and recognitional aspects.

Source	Metrics	Metric configurations	Scheme ID(s)	n
All schemes n = 51	Beneficiary type	Municipalities.	3, 4, 8, 13, 14, 17, 19, 22-24, 26, 27, 29-31, 33, 38, 39, 42, 44-46, 56, 58, 60.	25
		Residents and municipalities.	2, 7, 15, 20, 34, 35, 41, 47, 55.	9
		Residents.	5, 6, 18, 32, 37, 40, 53, 54.	8
		Regions.	49-52.	4
		Municipalities and regions.	1, 9, 48.	3
All schemes n = 51	Distance-based eligibility	Neighbouring or affected municipality.	2, 10, 11, 13, 30, 31, 47, 48, 53-55.	11
		Municipalities within a certain radius.	13-14, 17, 19-20, 22-24, 26, 27, 29.	11
		Residents within a certain radius.	5-7, 15, 18, 32, 34, 35, 37.	9
		Near the wind turbines.	41, 47.	2
Debt- and equity-based n = 9	Inclusivity	The max. investment threshold is defined.	18, 23.	2
		The max. share price is defined.	15.	1

in Saarland, Saxony, and Thuringia, respectively. Since all three schemes were issued in 2024 and share a high degree of regulatory similarity, it is plausible that they were influenced by one another. ID34 governs fixed-payment compensation in Latvia and was also introduced in 2024.

Table 5
FPC scheme design and procedural aspects.

Source	Metrics	Metric configurations	Scheme ID(s)	n
Fixed-payment and profit-based n = 43	Governance of payments	Payments are earmarked.	1, 6, 15, 16, 26, 29, 31, 34-36, 42, 46, 48-51, 53.	17
		Citizens can apply for funding.	5, 32, 36, 56, 58, 60.	6
		Used to enhance local acceptance.	15, 16, 26, 29, 31.	5
		Clear link to the project.	15, 16, 26.	3
		Used to meet the community's needs.	46.	1
Fixed-payment and profit-based n = 43	Earmarking of payments	Local infrastructure and economy	15-16, 26, 29, 31, 35-36, 48, 49, 51, 53.	11
		Culture and society.	15-16, 26, 29, 31, 35-36, 48, 50, 51, 53.	11
		Climate and nature.	1, 6, 26, 29, 31, 34-36, 48, 50.	10
		Renewable energy.	15-16, 26, 29, 31, 34, 35, 42, 52, 53.	10
		The promotion of the UN SDGs.	46.	1
All schemes n = 51	Monitoring and penalties	Monitoring mentioned.	5-6, 14-15, 19, 21, 25, 28, 32, 34, 35, 47.	12
		Penalty payments mentioned.	14-15, 19, 24, 27, 28, 31.	7

5.3.1. *Distributive aspects*

In our analysis, we highlight three justice metrics that affect the perceived distributive justice of FPC schemes: the basis on which compensation amounts are calculated, the timing of the first payments, and the duration of payments (see Table 3). The first metric is pertinent to fixed-payment compensation schemes (n = 32), whereas the second and third metrics apply to all FPC schemes (n = 51).

5.3.1.1. Calculation basis. A central question regarding distributional aspects concerns how compensation amounts are calculated. In many countries and regions, schemes predetermine a fixed compensation value and link it to a specific calculation basis. The most common calculation bases are production-based (n = 13) and capacity-based (n = 10). Less frequently, schemes rely on the number of wind turbines (n = 6), turbine height (n = 3), or turbine value (n = 2).

Some schemes (IDs 3, 48-52) apply different compensation values depending on wind farm size. For instance, in La Rioja, Spain (ID49), wind turbines with an installed capacity exceeding 5 MW incur compensation payments of EUR 950 per turbine for wind parks with up to five turbines, EUR 1150 for wind parks with six to ten turbines, and EUR 1350 for wind parks with more than eleven turbines. These schemes thus consider annoyance caused by wind turbine in two ways: First, in the increasing amount of compensation payments that is linked to the number of turbines. Second in the fixed compensation levy that increases with increasing wind farm size.

Calculating compensation based on the number of turbines constitutes the simplest mechanism, as each turbine generates the same amount of compensation. However, uniform compensation overlooks substantial variation in local burdens: five turbines of 100 m and five turbines of 250 m would generate identical transfers despite markedly different visual and environmental impacts. By contrast, formulas indexed to turbine height or installed capacity may better reflect the

burden imposed on local communities and therefore be more consistent with perceived fairness. This assumption is supported by Brennan and Van Rensburg (2016), who found that larger turbines require higher compensation payments to secure local acceptance [14].

Production-based schemes may also capture burdens more accurately than turbine-count approaches because they reflect project scale and output. However, they may simultaneously undermine perceived fairness by linking compensation to wind conditions, thereby rewarding municipalities in windier locations more generously than those in less windy areas. Compensation thus becomes partially disconnected from the actual distribution of burdens and may create perceptions of injustice.

Other potential methods for calculating compensation amounts, which are not reflected in any of the analysed schemes, could link payments to the landscape and its level of 'scenicness' or ecological value of a region; tools for assessing such parameters already exist [98,99]. Likewise, population- or density-based metrics could distribute benefits more equitably across society: the greater the number of people negatively affected by wind turbines, the higher the compensation required to ensure perceived fairness. Finally, property-value metrics could take into account market prices and depreciation in order to reflect actual value loss [100].

5.3.1.2. First payment and retroactivity. Regarding the timing of the first payment, the majority of schemes require payment upon project completion or within one year thereafter (n = 11). Other schemes require the first transfer to occur upon or shortly after energy production begins (n = 2), one year after the issuance of the distribution system operator's permit (n = 1), or already at the start of construction (n = 1). In a case study by Aitken [31], developers recognised that 'the majority of disruption to the local community would occur during the construction phase', which encouraged them to initiate payments at that stage. Linking the initiation of compensation payments to the beginning of project implementation may therefore be better suited to reflecting the actual burdens experienced by local communities than commencing payments one year after project completion.

Further, the question arises whether payment obligations should apply only to newly constructed turbines or also extend to existing installations. Citizens who have lived near wind turbines for years may perceive it as unfair if residents in neighbouring areas receive compensation for newly built projects under updated legislation while they themselves remain excluded. Legislators, however, are often constrained by the principle of legal certainty [101], which generally precludes retroactive taxation or payment obligations. A few schemes (n = 4) have nevertheless adopted retroactive provisions, using gradually increasing payments to avoid an immediate financial burden and to allow developers to adapt progressively to the newly introduced levy. In Burgenland (Austria, ID1), for instance, payment obligations apply to all wind parks over a transition period of five years, beginning with EUR 800 in the first year and gradually increasing to the full charge of EUR 3000.

5.3.1.3. Payment duration. Only a few schemes explicitly address payment duration. Several schemes (n = 4) link payment duration to dismantling and site restoration, ensuring that compensation continues until the environmental impacts of wind turbines have ceased and, where possible, have been remedied. Such an approach may strengthen perceived justice, particularly from a restorative justice perspective [102], while also supporting local acceptance. Two schemes (n = 2) tie compensation to the operational lifetime of the turbines, while one scheme (n = 1) extends payments until decommissioning. Linking compensation to operational lifetime may, however, create inconsistencies, as payments could cease even though turbines remain physically present. Operational lifetime generally refers to a planned technical lifespan of approximately 20 to 25 years [67], whereas turbines remain installed beyond this period. Against this background, linking compensation payments to dismantling and site restoration may provide higher levels of perceived justice as it establishes a clearer relationship between the duration of the burden imposed and the compensation received. Finally, a small number of schemes (n = 3) rely on lump-sum payments, thereby severing the link between compensation and ongoing burdens altogether.

Some schemes (n = 6) explicitly refer to repowering measures – that is, the modernisation or replacement of existing turbine components – specifying that such activities must also trigger compensation payments. The repowering potential of existing wind turbines across Europe is considerable [103], offering several advantages, including lower investment costs compared to new wind parks [103], increased renewable electricity generation after installing more modern and efficient turbines [104], and reduced noise emissions [105]. Furthermore, Philpott and Windemer [106] emphasise that repowering presents a unique opportunity to facilitate community co-ownership when municipalities are granted the option of local buy-in, particularly if these investments can be financed through compensation payments accumulated over time. Against this background, explicitly addressing repowering measures in compensation schemes may enhance transparency, facilitate long-term planning, and create additional opportunities for community co-ownership.

5.3.2. Recognitional aspects

In our analysis, we highlight three justice metrics that affect the perceived recognitional justice of FPC schemes: beneficiary type, distance-based eligibility, inclusivity, and the retroactive effect of FPC schemes (see Table 4). The first and second metrics are pertinent to all FPC scheme types (n = 51), whereas the third metric, focusing on inclusivity, is only pertinent to debt- and equity-based schemes (n = 9).

5.3.2.1. Beneficiary type. Across the analysed FPC schemes, three primary beneficiary groups can be identified: residents, municipalities and regions. The majority of the analysed schemes (n = 25) benefit municipalities exclusively, followed by a smaller number of schemes benefiting both residents and municipalities (n = 9), residents exclusively (n = 8), regions exclusively (n = 4), and both municipalities and regions (n = 3). Appendix Table A5 offers an overview of beneficiary groups across schemes and the respective compensation share allocated to each group.

Regions are identified as beneficiaries in several schemes. In Burgenland (Austria, ID1), 50% of the payments are transferred into the federal state social and climate fund, while the remaining share is allocated to host municipalities. In France, 30% of payments are transferred to the regional level, while, in general,[19] 50% are allocated to the EPCI (public establishment of intercommunal cooperation) and 20% to the municipalities. In Cantabria (Spain, ID48), 4% of the payments are transferred to the regional level for fund administration. In La Rioja, Aragon, Castile and León and Castile-La Mancha (Spain, IDs 49-52), 100% of compensation payments are transferred to the respective autonomous regions.

5.3.2.2. Distance-based eligibility. One question that arises with respect to distance-based eligibility criteria is whether only the host municipality or also neighbouring communities should benefit from a wind farm project. Research indicates that tensions may arise in neighbouring municipalities that, despite bearing negative impacts, remain excluded from compensation [40,107]. Nonetheless, among the schemes in which municipalities exclusively receive compensation payments (n = 25),

[19] Different distribution constellations may apply, as indicated in the Official Bulletin of Public Finance of the French Republic, available online at: https://bofip.impots.gouv.fr/bofip/8322-PGP.html/identifiant=BOI-ANNX-000448-20230628 (last accessed on May 16, 2026).

only a few (n = 11) explicitly extend eligibility to neighbouring or otherwise affected municipalities.

Several schemes define eligibility based on a specific radius, typically ranging from 2 km to 5 km (see Appendix Table A5). More specifically, a number of schemes identify municipalities within a defined radius as eligible beneficiaries (n = 11), while a somewhat smaller number apply similar criteria to residents (n = 9). A report by the Danish Energy Agency argues that using distance-based rather than municipal boundaries is preferable, as visibility and impact are not confined to administrative borders [87]. Similarly, a small number of schemes (n = 2) define beneficiaries as those living 'near' a project. However, without providing a clear definition of proximity, the question of who should ultimately be included is effectively shifted from the legislators to local authorities.

Finally, Brennan and Van Rensburg (2016) [14] found that residents often favour a staggered compensation model granting higher benefits to those living closest to turbines. Such an approach aligns with the principle of equity outlined in Section 2.3, as compensation becomes more closely linked to the unequal distribution of burdens. However, none of the schemes analysed in this study currently reflects such an approach.

5.3.2.3. Inclusivity. Certain stakeholders, such as low-income households or municipalities with limited financial resources, face particular challenges in investing and, consequently, participating in the energy transition [108]. Both debt- and equity-based participation schemes typically presuppose the financial capacity to invest, thereby excluding those unable to purchase project shares or subordinated loans. Across the identified schemes, specific provisions for low-income households are largely absent. Among the analysed debt- and equity-based participation schemes, two seek to broaden participation by setting a maximum entry threshold of EUR 500, and one introduces a maximum share price of EUR 500 to enhance accessibility. Yet, even this amount can remain prohibitive. Financing mechanisms such as the Consumer Stock Ownership Plan (CSOP) could address these barriers by allowing citizens to repay their investment through future earnings of the shares themselves [109,110], thereby democratising ownership and enhancing distributive justice.

Another barrier for individuals may arise from their interaction with means-tested transfers. An OECD report identifies 26 EU countries with formal rules that restrict the accumulation of moveable and immovable assets for recipients of minimum income benefits [111]. While the value of certain moveable and immovable assets, such as vehicles or the main residence, is often exempt from the means test, others, such as wind energy project shares, are fully counted. This effectively removes incentives for households to invest in a wind farm, as it would consume a substantial share of their allowed assets [112]. In an analogous example, Schmidt-De Caluwe and Schneller [113] highlight the difficulties faced by low-income households wishing to purchase more energy-efficient household appliances, as such appliances typically have a higher asset value, thereby reducing the remaining share of permitted assets. Exempting project shares from the means test could substantially enhance inclusivity [113], but would require amendments to social benefit regulations.

Certain schemes require residents to submit written forms to become eligible for compensation payments. In Denmark, residents must sign an acceptance form specifying, among other things, how benefits of the *Bonus Scheme* (ID6) should be distributed among household members, making one person responsible for the internal allocation. Similarly, in Estonia (ID7), residents must submit a written application to receive compensation. However, research on administrative burden and (energy) poverty shows that marginalised people often lack the time, resources, mental bandwidth or cognitive resources to complete complex administrative procedures [114,115], an interdependency of obstacles dubbed the 'engagement chain' [112]. Lacking financial literacy and access to information are other structural barriers that inhibit low-income households from investing in renewable energy [116–118]. Without targeted assistance, such procedural requirements may risk disproportionately excluding vulnerable households from financial participation. Against this background, reduced energy bills that are granted automatically, without requiring an application process, represent one of the most tangible and easily implementable benefits for low-income households [119].

5.3.3. Procedural aspects

In our analysis, we highlight three justice metrics that affect the perceived procedural justice of FPC schemes: the governance of payments; the earmarking of payments; and monitoring of payments and penalties in case of non-compliance (see Table 5). The first metric is pertinent to fixed-payment compensation schemes, the second to fixed- and profit-based schemes (n = 43), and the third to all schemes (n = 51).

5.3.3.1. Governance of payments. The question of how compensation payments should be spent can either be determined within the legal framework of the scheme itself or left to the beneficiaries, namely regions, municipalities or residents. In our analysis, several schemes (n = 17) explicitly earmark compensation payments for predefined purposes, thereby limiting the beneficiaries' flexibility in the use of these funds. A more detailed discussion of earmarking approaches is provided in the following subsection.

Several schemes (n = 6) channel compensation payments into local funds, thereby allowing residents to participate in decisions on how resources are allocated. Such participatory governance approaches are similar to those analysed in a study by Le Maitre et al. (2023) [120], which suggests that citizens tend to prefer wind energy funds to be governed by representative community committees rather than by local authorities alone. Similarly, MacDonald et al. (2017) argue that the absence of mandatory community consultation in the design of community benefit schemes may undermine their potential to promote equity and justice [51]. Furthermore, while auction-based development models often limit residents' influence over project characteristics [5], granting communities a role in fund allocation may help restore a sense of agency and control over this aspect of the development process and thereby reduce scepticism [31].

More specifically, in Denmark (ID5), wind park developers are required to transfer payments into a municipal fund, with the Danish government providing detailed guidelines to support municipalities in establishing and managing such funds [121]. These guidelines emphasise the involvement of local councils, citizen groups, and other relevant actors in setting funding priorities. For example, the Danish municipality of Skive has established a climate committee composed of five citizens and four council members that regularly advises on funding priorities. Similarly, in Ireland (ID32), the Renewable Electricity Support Scheme (RESS) requires developers to establish a community fund governed by a committee of three to twelve volunteer representatives to ensure broad local participation.

Although the Netherlands (ID36) and the United Kingdom (IDs 56, 58, 60) have not introduced legally binding FPC regulations, they provide noteworthy examples and guidance in this area. In the Netherlands, the Climate Agreement [122] promotes meaningful participation in renewable energy projects through both procedural and financial involvement, alongside a policy target of 50% local ownership in renewable energy projects by 2030. The Financial Participation Monitor (2023) [123] documents innovative examples in which residents contributed to the design and management of wind energy funds. Likewise, England [124–126], Scotland [127], and Wales [128] have each published guidance supporting developers and municipalities in establishing community organisations, administering benefit funds, and promoting transparent and inclusive engagement practices.

In addition, some schemes (n = 5) explicitly require municipalities to use compensation payments in ways that enhance local acceptance of

wind energy projects or address residents' needs. Rather than using compensation to fill general budgetary gaps, funds are intended to support projects that generate visible community benefits. Building on this principle, several schemes (n = 3) further require municipalities to maintain a clear connection between expenditure and the respective wind project. In other words, residents should be able to identify how compensation payments derived from wind energy development are used to benefit the communities.

5.3.3.2. Earmarked payments. Of the 17 schemes identified as providing earmarked payments, the majority allocate funds to supporting local infrastructure and the local economy (n = 11), culture and social initiatives (n = 11), followed by climate and nature protection (n = 10) and renewable energy projects (n = 10). In addition, one scheme (n = 1) earmarks payments explicitly for the promotion of the UN SDGs. While earmarking payments can help prevent misuse of funds, finding the right balance is essential: defining the use of funds too broadly does not necessarily ensure that resources are used in the community's interest, whereas overly narrow specifications may constrain the flexibility municipalities require to respond effectively to local needs.

5.3.3.3. Monitoring and penalty payments. The monitoring of FPC schemes is almost as important as the institutionalisation of the schemes themselves. Without monitoring and legal enforcement measures, the risk remains that compensation payments will not be made and participation opportunities will not be provided. Initial findings from the federal state of Brandenburg suggest that, despite a legal basis, wind energy compensation payments have not been transferred to a number of municipalities [129].

In our analysis, several schemes (n = 12) require regular reporting on the allocation and use of funds. Some countries and regions try to increase transparency through interactive online platforms that inform stakeholders about specific benefit-sharing schemes and, in some cases, provide information on potential compensation amounts. National examples include the *Energieportal Brandenburg* (Brandenburg, Germany) [130]; the *Transparenzplattform NRW* (North Rhine-Westphalia, Germany) [131]; *VeroSkatt* (Finland) [132]; and *Local Energy Scotland* (Scotland, UK) [133]. On an EU-wide level, the *WIMBY Map* [99] offers a comprehensive overview of benefit-sharing schemes. In addition, several schemes (n = 7) establish rules addressing non-compliance, with penalties ranging from EUR 0.005 to EUR 0.008 per kWh fed into the grid or lump-sum fines between EUR 100,000 and EUR 1 million [134].

However, evidence from Brandenburg illustrates that informing citizens and municipalities about their rights through an online platform may be insufficient. An online investigation started in 2025 based on responses from municipalities found that reported revenues were collectively lower than the amounts apparently due, with some municipalities missing up to 90% of their expected payments [135]. The responsible state ministry reportedly had neither conducted systematic inspections nor imposed any fines since the scheme's introduction, instead relying on municipalities to report irregularities [136]. The investigation attributed implementation problems to accidental or disputed non-payment by operators, limited transparency and overstretched local administrative structures. These findings underline that statutory payment obligations alone may be insufficient without proactive monitoring, accessible payment information and clearly assigned enforcement responsibilities.

6. Conclusions

6.1. Synthesis of research question findings

This paper examined the regulatory and policy frameworks governing FPC schemes in the wind energy sector across the EU27, Switzerland, Norway, and the United Kingdom at the NUTS2 level. A systematic web-based search identified 60 such schemes across 19 countries and 21 regions at the NUTS2 level, introduced between January 2006 and October 2025. A marked increase in FPC schemes was observed from 2021 onwards, coinciding with the publication of the REPowerEU Plan. The following sections aim to synthesise research results and highlight research limitations.

6.1.1. Classification of FPC schemes within a coherent typology

This paper developed a coherent typology for classifying FPC schemes across European jurisdictions. Building on existing distinctions between collective and individual compensation, as well as between direct active, direct passive and indirect participation, the analysis introduced a refined framework distinguishing between financial compensation and financial participation. Financial compensation was further divided into fixed-payment and profit-based compensation, while financial participation was divided into debt-based and equity-based participation. This typology allows existing schemes to be compared across otherwise highly heterogeneous legal and policy contexts. Fixed-payment compensation captures one-off or recurring monetary or in-kind benefits that are not linked to project profits and do not require capital investment. Profit-based compensation covers schemes linked to project revenue or profits. Debt-based participation includes loans, bonds or savings products that provide interest payments without ownership rights, whereas equity-based participation refers to project shares or co-ownership, potentially including decision-making rights at the level of the operating company.

6.1.2. Most commonly adopted FPC scheme types

The analysis shows that fixed-payment compensation is the most commonly adopted FPC scheme type in Europe. Of the 60 classified FPC schemes, fixed-payment compensation schemes represent the largest group (n = 32), followed by equity-based participation (n = 9), profit-based compensation (n = 5), and debt-based participation (n = 4). This pattern suggests a clear preference for administratively simple and predictable compensation mechanisms. The dominance of fixed-payment compensation is even more pronounced when considering enforceability. Among obligatory schemes, fixed-payment compensation constitutes the largest category (n = 27), whereas only three profit-based compensation schemes and two equity-based participation schemes are obligatory. No obligatory debt-based participation scheme was identified. This indicates that European jurisdictions increasingly institutionalise financial compensation, while financial participation in the narrower sense remains less commonly required.

6.1.3. Highest levels of fixed-payment compensation

The highest fixed-payment compensation levels were identified in Denmark, Slovenia, France, Norway, the United Kingdom, Ireland, the Czech Republic and selected German regions, with the ranking remaining broadly robust across alternative capacity-factor assumptions. High payment levels may reflect favourable wind resources, stronger bargaining positions of host communities and historically established expectations of local participation, although Slovenia and the Czech Republic indicate that generous payments may also be used proactively to stimulate wind deployment and overcome municipal resistance.

6.1.4. Commonly addressed scheme design aspects

The analysis also revealed substantial variation in the degree of regulatory density, understood here as the extent of textual specificity embedded within individual schemes. Certain schemes exhibited considerably greater regulatory detail than others. Specifically, four schemes simultaneously addressed at least nine design aspects, whereas many schemes addressed only a single aspect. Design aspects frequently addressed include the identification of municipalities as beneficiaries, the earmarking of payments, the use of production-based compensation formulas, the requirement to initiate first payments at project

completion or within one year thereafter, the definition of radius-based eligibility criteria for municipalities, and the inclusion of neighbouring or otherwise affected municipalities. In contrast, the following design aspects were only rarely specified in existing schemes: the timing of initial payments at the construction stage, the duration of compensation arrangements, and provisions governing compensation in case of repowering. Only a limited number of schemes established maximum entry thresholds or maximum share prices that would facilitate broader stakeholder participation. Further, only a few schemes specified enforcement mechanisms in cases of non-compliance.

6.1.5. Scheme design aspects associated with local acceptance

The existing literature suggests that FPC schemes are more likely to promote local acceptance when they address distributive, recognitional and procedural justice concerns. From a distributive perspective, compensation formulas linked to turbine height, installed capacity, landscape impacts or property-value effects may better reflect the burdens experienced by local communities than formulas based only on the number of turbines. In addition, starting payments during the construction phase and extending them until decommissioning or site restoration may strengthen perceived fairness by recognising the full duration of local impacts. From a recognitional perspective, eligibility rules should reflect different degrees of affectedness. Schemes that consider neighbouring municipalities and apply staggered compensation according to proximity to turbines may better correspond to the principle of equity than schemes limited strictly to host municipalities. From a procedural perspective, participatory wind fund governance, citizen councils, earmarked spending, public reporting and monitoring mechanisms may increase transparency and trust.

6.2. Potential negative side effects of inadequate scheme design

It is worth highlighting the potential negative side effects of inadequately designed FPC schemes. First, large regional or national differences in compensation levels may create distributional inequities, particularly where neighbouring municipalities or regions across borders face similar burdens but receive substantially different payments. Against this background, greater convergence in compensation levels across Europe could reduce possible market distortions and regulatory competition between jurisdictions. Second, FPC schemes may foster regional competition and generate perceptions of unfairness among residents or municipalities affected by nearby wind energy projects but excluded from compensation. Extending eligibility beyond host municipalities and linking benefits more closely to the distribution of local impacts could mitigate these effects. Third, long-term reliance on compensation payments may emerge, with municipalities increasingly expecting or depending on continued wind energy development or repowering as a source of revenue. This dependency could, to some extent, be reduced by investing compensation payments into ownership shares of wind farms or other forms of local renewable energy infrastructure.

6.3. Policy recommendations

This paper contributes to policy development by enabling policymakers to make more informed decisions through comparisons between existing scheme designs and insights from the literature. However, given the diversity of institutional, legal, socio-economic and normative contexts across Europe, the recommendations presented in this section should not be interpreted as a universal governance model. Rather, they should be understood as context-sensitive design considerations that policymakers may adapt according to local circumstances.

6.3.1. Recommendations for compensation schemes

When it comes to financial compensation schemes, several scheme design preferences could be identified. For example, staggered compensation models based on proximity to turbines have been associated in the literature with increased local acceptance [14]. Furthermore, a number of studies suggest that community-oriented benefits, such as the establishment of municipal funds, are perceived more positively than narrowly individualised compensation mechanisms [20,24,51,52,57]. Further, when establishing a wind fund, the creation of citizen councils to select community projects can foster a sense of ownership and trust in the project [6,51,120]. Also, the earmarking of compensation payments, or legal requirements mandating that such payments be used in the community's interest, can help ensure legitimate use. Finally, when it comes to compensation schemes, formulas that are tied to turbine height or installed capacity better reflect the burden imposed on local communities than formulas based on the number of turbines as they consider both turbine number and height. Similarly, approaches incorporating landscape 'scenicness', ecological value [98,99], or economic property value [100] aim to estimate required compensation amounts more accurately, each analysing burdens from a different perspective.

6.3.2. Recommendations for financial participation

With respect to financial participation schemes, inclusivity and addressing a broad and heterogeneous group of citizens remain an issue. For example, in Denmark, low levels of citizen participation in the equity-based participation scheme led to its repeal [65]. Measures to alleviate structural exclusion of certain stakeholder groups exist and may include introducing maximum share prices and participation thresholds, exempting small investments from the means-testing requirements, and providing targeted assistance or simplified administrative procedures. Furthermore, financing models such as the Consumer Stock Ownership Plan (CSOP) [109,110] may facilitate participation of both individuals and municipalities with limited financial resources. However, these measures may not be sufficient to guarantee inclusivity. Additional safeguards should ensure that purchase rights are reserved for genuinely affected residents and municipalities, thereby avoiding speculative misuse. However, they also do little to address participation barriers such as limited financial literacy and access to information [116–118]. Consequently, automatically granted reductions in energy bills, which do not require an application, may represent one of the most tangible and accessible benefits for low-income households, with the drawback that they do not allow them to acquire co-ownership of the project.

6.3.3. Cross-scheme recommendations

6.3.3.1. Distributional justice aspects. When designing FPC schemes, policymakers should ensure that benefits are distributed from the outset of project-related disruption. In the case of wind parks, residents already experience disturbance during the construction phase; indeed, disruption may be greatest during this period [31]. Likewise, payments should ideally continue beyond the end of project operations until decommissioning and site restoration have been completed. Furthermore, several schemes apply only to wind parks constructed after the relevant FPC legislation has entered into force. However, residents who have lived near wind turbines for many years may perceive this as unfair. Introducing progressive retroactivity—whereby FPC obligations are gradually extended to existing wind farms rather than imposed simultaneously—may alleviate such tensions without undermining the principle of legal certainty [101]. Finally, from a forward-looking perspective, repowering presents a particular opportunity to facilitate community co-ownership, especially where municipalities are granted local investment rights and can finance these investments through compensation payments accumulated over time [106]. Explicitly addressing repowering in FPC schemes may therefore enhance transparency, facilitate long-term planning, and create additional opportunities for community co-ownership.

6.3.3.2. Recognitional justice aspects. While distributional aspects and the definition of an acceptable compensation level do play prominent roles in the design of FPC schemes, recognitional aspects and the definition of eligibility criteria are at least equally important. Across all analysed schemes, three main beneficiaries emerge: residents, municipalities, and, in some cases, regions. However, eligibility criteria vary considerably. Linking eligibility strictly to administrative boundaries and recognising only the host municipality as a beneficiary may generate tensions [40,107]. Conversely, considering neighbouring municipalities and offering staggered compensation models [87] – where payment levels decrease with increasing distance from the project – more accurately reflects degrees of affectedness and better aligns with the principle of equity.

6.3.3.3. Procedural justice aspects. Investigations indicate that monitoring of FPC schemes is almost as important as institutionalisation of the schemes themselves [135,136]. Without monitoring and legal enforcement measures, there is a risk that compensation payments will not be made and participation opportunities will not be provided. Mandatory public reporting on fund use helps maintain trust and ensure compliance. Furthermore, interactive online platforms that provide information on financial participation opportunities and potential compensation amounts can increase transparency and trust. Finally, penalty payments in cases of non-compliance – for both, developers who fail to approach municipalities to offer compensation payments and municipalities that fail to use funding in the community's interest where this constitutes a legal obligation – provide FPC schemes with the legal enforceability required to function effectively.

6.4. Research limitations

Several limitations should be considered when interpreting the findings. First, despite systematic multilingual web-based searches and expert validation focused primarily on ten countries, the identification of all relevant regulations and guidelines cannot be guaranteed, particularly where instruments are adopted at the municipal level, embedded in broader tax or planning legislation, or unavailable in consolidated form. Accordingly, the absence of a scheme should be understood as meaning that no qualifying instrument was identified under the applied search strategy. Second, the energy-justice assessment identifies justice-relevant design features in legal texts rather than measuring their implementation or perceived fairness in practice. The analysis therefore does not rank national or regional schemes as inherently more or less just. Third, the comparison of FPC schemes necessarily relied on simplifying heterogeneous legal texts. Consequently, FPC schemes were clustered under rather broad and generic justice-metric definitions, and readers should consult the WIMBY database and the underlying legal texts for scheme-specific details. Similarly, the comparison of compensation levels relied on converting production-based payments using average national wind capacity factors. While the calculations were supported by a sensitivity analysis to account for variations in capacity factors, the compensation amounts and rankings should be interpreted cautiously. The original aim of this section was to offer a broad picture of compensation levels across Europe. Finally, our research has shown that further FPC schemes and amendments can be expected. Nevertheless, the paper provides the first systematic mapping of FPC schemes over nearly twenty years and an overview of their principal types and design features.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDICES

Appendix Table A1
Basic profile information of experts interviewed.

Generic description of organization	Countries covered	Interview date
Environmental planning consultancy	AT	September 2024
National wind energy association	AT	July 2024
Independent renewable energy expert	BE, IT	December 2024
Engineering firm & technical consultancy	DK	November 2024
European wind energy association	Europe	September 2024
European environment agency	Europe	October 2024
European environment agency	Europe	October 2024
Federal environmental agency	DE	October 2024
Public research institute	IT	October 2024
Engineering firm & energy consultancy	NL	October 2024
Renewable energy project developer & consultancy	NO	November 2024
Engineering firm & energy consultancy	NO	October 2024
National renewable energy association	PT	November 2024
National renewable energy association	PT	November 2024
Federal energy authority	CH	December 2024
Federal energy authority	CH	December 2024
Engineering firm & sustainability consultancy	UK	November 2024
Acoustic consultancy firm	UK; IE	October 2024

Appendix Table A2
Overview of fixed-payment compensation (FC), profit-based compensation (PBC), debt-based participation (DBP), equity-based participation (EBP) schemes and multiple scheme types (MST) in Europe.

ID	Reference	Country, region (municipality)	FPC type	Document type	Publication
1	[137]	Austria, Burgenland	FC	regulation	30.06.2023
2	[138]	Belgium, Wallonia	EBP	guideline	25.01.2024
3	[139]	Belgium, Wallonia (Walhain)	FC	regulation	01.01.2011
4	[140]	Czech Republic	FC	regulation	01.08.2025
5	[141]	Denmark	FC	regulation	01.06.2020
6	[142]	Denmark	PBC	regulation	01.01.2021
7	[143]	Estonia	PBC	regulation	01.07.2023
8	[144]	Finland	FC	regulation	01.01.2006
9	[145]	France	FC	regulation	01.01.2010
10	[146]	France	EBP	regulation	17.08.2015
11	[146]	France	DBP	regulation	17.08.2015
12	[146]	France	EBP	regulation	12.03.2023
13	[147]	Germany	FC	regulation	16.07.2021
14	[148]	Germany, Brandenburg	FC	regulation	20.06.2019
15	[149]	Germany, Mecklenburg-Western Pomerania	EBP	regulation	28.05.2016
16	[149]	Germany, Mecklenburg-Western Pomerania	MST	regulation	28.05.2016
17	[149]	Germany, Mecklenburg-Western Pomerania	PBC	regulation	28.05.2016
18	[149]	Germany, Mecklenburg-Western Pomerania	DBP	regulation	28.05.2016
19	[150]	Germany, Lower Saxony	FC	regulation	17.04.2024
20	[150]	Germany, Lower Saxony	MST	regulation	17.04.2024
21	[151]	Germany, North Rhine-Westphalia	MST	regulation	28.12.2023
22	[151]	Germany, North Rhine-Westphalia	FC	regulation	28.12.2023
23	[151]	Germany, North Rhine-Westphalia	DBP	regulation	28.12.2023
24	[151]	Germany, North Rhine-Westphalia	FC	regulation	28.12.2023
25	[152]	Germany, Saarland	MST	regulation	19.07.2024
26	[152]	Germany, Saarland	FC	regulation	19.07.2024
27	[152]	Germany, Saarland	FC	regulation	19.07.2024
28	[153]	Germany, Saxony	MST	regulation	12.06.2024
29	[153]	Germany, Saxony	FC	regulation	12.06.2024
30	[154]	Germany, Thuringia	FC	regulation	19.07.2024
31	[154]	Germany, Thuringia	FC	regulation	19.07.2024
32	[155]	Ireland	FC	regulation	26.05.2025
33	[156]	Italy	PBC	regulation	25.10.2010
34	[157]	Latvia	FC	regulation	30.08.2024
35	[158]	Lithuania	FC	regulation	08.07.2022
36	[122]	Netherlands	MST	guideline	01.06.2014
37	[159]	Netherlands	EBP	guideline	28.06.2019
38	[160]	Norway	FC	regulation	01.07.2022
39	[161]	Norway	FC	regulation	01.01.2019
40	[162]	Poland	FC	regulation	23.04.2023
41	[163]	Portugal	FC	regulation	14.01.2022
42	[163]	Portugal	FC	regulation	14.01.2022
43	[164]	Portugal	MST	regulation	19.04.2022
44	[164]	Portugal	FC	regulation	20.10.2022
45	[165]	Slovenia	PBC	regulation	07.08.2022
46	[166]	Slovenia	FC	regulation	06.04.2024
47	[167]	Spain, Galicia	FC	regulation	30.12.2009
48	[168]	Spain, Cantabria	FC	regulation	09.09.2022
49	[169]	Spain, La Rioja	FC	regulation	31.10.2017
50	[170]	Spain, Aragon	FC	regulation	30.05.2024
51	[171]	Spain, Castile and León	FC	regulation	30.03.2012
52	[172]	Spain, Castile-La Mancha	FC	regulation	01.04.2011
53	[173]	Spain, Catalonia	DBP	regulation	27.10.2021
54	[173]	Spain, Catalonia	EBP	regulation	27.10.2021
55	[174]	Spain, Balearic Islands	EBP	regulation	02.05.2019
56	[126]	Great Britain, England	MST	guideline	01.01.2014
57	[128]	Great Britain, Wales	EBP	guideline	01.06.2022
58	[127]	Great Britain, Scotland	MST	guideline	01.01.2014
59	[127]	Great Britain, Scotland	EBP	guideline	01.01.2015
60	[175]	Great Britain, Northern Ireland	MST	guideline	28.04.2014

Appendix Table A3
Calculation of fixed-payment compensation of an exemplary 25 MW wind farm.

ID	Payment duration	Formula for the annualised equivalent over a 20-year reference period
1	until decommissioning	5 WT x 5 MW x EUR 3000 x 20 ÷ 20
3	operation lifetime (assumed)	5 WT x EUR 17,000 x 20 ÷ 20
4	operation lifetime	5 WT x 5 MW x FLH (2,102.4) x EUR 2.04[a] x 20 ÷ 20
5	maximum of 7 years	5 WT x 5 MW x EUR 41,930.69 x 7 ÷ 20
8	operation lifetime (assumed)	5 WT x EUR 3.6 million x 0.3 x 0.75 (WT value) x 0.975^(20-1) x 0.031[b] x 20 ÷ 20

(*continued on next page*)

Appendix Table A3 (*continued*)

ID	Payment duration	Formula for the annualised equivalent over a 20-year reference period
9	operation lifetime (assumed)	5 WT x 5 MW x EUR 8510 x 20 ÷ 20
13	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
14	operation lifetime	5 WT x EUR 10,000 x 20 ÷ 20
19	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
20	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 1 x 20 ÷ 20
22	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
26	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
29	operation lifetime (assumed)	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
30	at least 20 years OR until decommissioning	5 WT x 5 MW x FLH (1760.76) x EUR 2 x 20 ÷ 20
32	operation lifetime (assumed)	5 WT x 5 MW x FLH (2470.32) x EUR 2[c] x 20 ÷ 20
34	until dismantling and site restoration	5 WT x 5 MW x EUR 2000 x 20 ÷ 20
35	operation lifetime (assumed)	5 WT x 5 MW x FLH (2,102.4) x EUR 1 x 20 ÷ 20
36	operation lifetime (assumed)	5 WT x 5 MW x FLH (2295.12) x EUR 0.5 x 20 ÷ 20
38	operation lifetime (assumed)	5 WT x 3.6 million (WT value) x 0.975^(20-1) x 0.007[d] x 20 ÷ 20
39	operation lifetime (assumed)	5 WT x 5 MW x FLH (2,102.4) x EUR 2.01 x 20 ÷ 20
42	one-off payment	5 WT x 5 MW x EUR 1500 ÷ 20
44	one-off payment	5 WT x 5 MW x EUR 13,500 ÷ 20
46	one-off payment	5 WT x 5 MW x EUR 200,000 ÷ 20
47	until dismantling and site restoration	5 WT x 140 m x EUR 75 x 20 ÷ 20
48	operation lifetime (assumed)	5 WT x 140 m x EUR 9 + 5 WT x EUR 5000 x 20 ÷ 20
49	until dismantling and site restoration	5 WT x EUR 800 x 4 (annual quarters)
50	until dismantling and site restoration	5 WT x 124 m x EUR 38 + 5 WT x 16 m x EUR 35 + EUR 1040 × 25 MW x 20 ÷ 20
51	operation lifetime (assumed)	5 WT x EUR 12,000 x 20 ÷ 20
52	operation lifetime (assumed)	5 WT x EUR 489 x 4 (annual quarters) x 20 ÷ 20
56	operation lifetime (assumed)	5 WT x 5 MW x EUR 5789.05 x 20 ÷ 20
58	operation lifetime (assumed)	5 WT x 5 MW x EUR 5789.05 x 20 ÷ 20
60	operation lifetime (assumed)	5 WT x 5 MW x EUR 5789.05 x 20 ÷ 20

[a] In ID4, the fee base is the amount of electricity produced by the plant, reduced by its technological self-consumption; however, for reasons of simplicity, this reduction has not been considered in the present calculation.

[b] The Finnish Supreme Court [176] classifies the foundation and tower with the engine as taxable property, while other equipment (such as the rotor, blades, gearbox and generator) is movable fixed assets excluded from property tax. Consistent with this, Renewables Finland assumes that roughly 30% of the investment cost is taxable [177]. The first-year taxable value equals 75% of the investment value [178], and a 2.5% annual depreciation applies [179]. Calculations are based on an illustrative investment value of EUR 3.6 million per wind turbine [177]

[c] In ID32, the monetary contribution is set at a minimum of EUR 2 per MWh of loss-adjusted metered quantity; however, for reasons of simplicity, this adjustment has not been considered in the present calculation.

[d] In Norway, fixed-payments are also based on property value. Here, taxable property value may be determined by either technical value (replacement cost less wear, age and obsolescence) or yield value (discounted future cash flows), plant [161,180]. Drawing on numbers presented by Renewables Finland, technical value was again set at EUR 3.6 million per wind turbine with a 2.5% annual depreciation.

Appendix Table A4
FPC schemes, their level of enforceability and original formulas.

ID	Enforceability		Original formulas
1	Level 1		EUR 3000 per MW.
2	Level 2		Up to 49.98% co-ownership.
3	Level 1	If the municipality opts for tax.	EUR 17,000 per wind turbine.
4	Level 1		CZK 50 per MWh.
5	Level 1		DKK 313,000 per MW.
6	Level 1		Special formula (see Section 4.2.2).
7	Level 1		Special formula (see Section 4.2.2).
8	Level 1	If the municipality opts for tax.	Up to 3.1% of the property value.
9	Level 1		EUR 8.51 per kW fed into the grid.
13	Level 2		Up to EUR 0.002 per kWh fed into the grid.
14	Level 1		EUR 10,000 per wind turbine.
15	Level 1	Unless opted for ID17 or ID18.	At least 20% of project shares.
17	Level 1	If used as an alternative to ID15, provided mun accepts.	Capitalised earnings corresponding to a 10% project share.
18	Level 1	If used as an alternative to ID15.	Saving products with at least 10% of the project's equity.
19	Level 1	Unless the developer already pays according to ID13.	EUR 0.002 per kWh fed into the grid.
20	Level 1	Must be appropriate[a]; additional to ID19.	EUR 0.001 per kWh fed into grid OR 20% co-ownership.
22	Level 1	If no agreement pursuant to ID21 is reached.	EUR 0.002 per kWh fed into the grid.
23	Level 1	If no agreement pursuant to ID21 is reached.	Participation volume of at least EUR 90,000 per MW.
24	Level 1	If the municipality asks for a penalty payment.	EUR 0.008 per kWh fed into the grid.
26	Level 1	If no agreement pursuant to ID24 is reached.	EUR 0.002 per kWh fed into the grid.
27	Level 1	If the municipality asks for a penalty payment.	EUR 0.008 per kWh fed into the grid.
28	Level 1	Must be appropriate[b]; alternative to ID29.	EUR 0.001 - EUR 0.004 per kWh fed into the grid.
29	Level 1	Unless opted for ID28.	EUR 0.002 per kWh fed into the grid.
30	Level 1		EUR 0.002 per kWh fed into the grid.
31	Level 1	If the municipality asks for a penalty payment.	EUR 0.005 per kWh fed into the grid.
32	Level 1		At least EUR 2 per MWh fed into the grid.
33	Level 2		In-kind benefits are worth up to 3% of project revenues.
34	Level 1		EUR 2000 per MW installed capacity.
35	Level 1		EUR 0.001 per kWh fed into the grid.
36	Level 2		EUR 0.4 – EUR 0.5 per MWh fed into the grid.

(*continued on next page*)

Appendix Table A4 (*continued*)

ID	Enforceability		Original formulas
37	Level 2		At least 50% co-ownership.
38	Level 1	If the municipality opts for tax.	Up to 0.7% of the value of the wind turbine.
39	Level 1		NOK 0.0237 per kWh fed into the grid.
40	Level 1		See Section 3.2.
41	Level 2	If the municipality opts for it instead of ID42.	See Section 3.2.
42	Level 1	Unless the municipality opts for ID41.	EUR 1500 per MVA of connection power assigned.
44	Level 1		EUR 13,500 per MVA of connection power assigned.
45	Level 1		Special formula (see Section 4.2.2).
46	Level 1		EUR 200,000 per MW installed capacity.
47	Level 1		EUR 75 per m wind turbine height.
48	Level 1		EUR 5,000[c] per WT + EUR 9 per m WT height.
49	Level 1		EUR 800[d] per wind turbine.
50	Level 1		EUR 38[e] per m WT height + EUR 1040 per MW.
51	Level 1		EUR 12,000[f] per wind turbine.
52	Level 1		EUR 489[g] per wind turbine.
53	Level 1	Unless opted for ID54.	Saving products with at least 20% of the project's equity.
54	Level 1	Unless opted for ID53.	At least 20% co-ownership.
55	Level 1		At least 20% co-ownership.
56	Level 2		GBP 5000 per MW.
58	Level 2		GBP 5000 per MW.
60	Level 2		GBP 5000 per MW.

[a] An appropriate offer within one year after commissioning must be made which is deemed 'appropriate' if the annual surplus accrued by the beneficiaries corresponds to EUR 0.001 per kWh of the average annual amount of energy supplied for remuneration over the plant's operating period.

[b] Participation is considered appropriate if its economic value ranges between EUR 0.001 and EUR 0.004 per kWh fed into the grid, based on the notional amount of electricity as defined in Section 7.2 of Annex 2 to the German Renewable Energy Sources Act.

[c] Applies to wind farms with 4–8 turbines; EUR 7300 for those with 9–15 turbines and EUR 8300 for those with more than 15 turbines.

[d] Applies to wind farms with 6–10 turbines and an installed capacity between 1 MW and 5 MW; other criteria apply to different farm configurations.

[e] EUR 40 per m for the first 125 m of WT height, EUR 35 for the next 75 m, EUR 30 for the following 50 m, and EUR 25 for every m above 249 m of WT height.

[f] Applies to turbines with an installed capacity of more than 2 MW; other fees apply to wind turbines with lower capacity levels.

[g] Applies to farms with between 3 and 7 turbines; other criteria apply to wind farms with different numbers of wind turbines.

Appendix Table A5
FPC schemes, beneficiaries and eligibility criteria.

ID	Beneficiary		Share (%)	Distance-based eligibility
1	host	municipality, region	50/50	
2	host, neighbour	residents, municipality	50/50	
3	host	municipality	100	
4	host	municipality	100	
5		residents	100	residents 6 × WT height
6		residents	100	residents 8 × WT height
7	host	residents, municipality	50/50	residents 2 km
8	host	municipality	100	
9	host	municipality, region	20/80	
10	host, neighbour	residents, municipality	50/50	residents near turbines
11	host, neighbour	residents, municipality	50/50	residents near turbines
13	neighbour	municipality	100	municipality 2.5 km
14		municipality	100	municipality 3 km
15	host	residents, municipality	50/50	residents 5 km
17	host	municipality	100	municipality 5 km
18	host	residents	100	residents 5 km
19		municipality	100	municipality 2.5 km
20		residents, municipality	50/50	municipality 2.5 km
22	host	municipality	100	municipality 2.5 km
23	host	municipality	100	municipality 2.5 km
24	host	municipality	100	municipality 2.5 km
26		municipality	100	municipality 2.5 km
27		municipality	100	municipality 2.5 km
29		municipality	100	municipality 2.5 km
30	host, neighbour	municipality	100	
31	host, neighbour	municipality	100	
32		residents	100	residents 2 km
33	host	municipality	100	
34	host	residents, municipality	50/50	residents 2 km
35	host	residents, municipality	50/50	residents 5 km
37		residents	100	residents 2 km
38	host	municipality	100	
39	host	municipality	100	
40	host	residents	100	
41	host	residents, municipality	50/50	residents near turbines
42	host	municipality	100	
44	host	municipality	100	
45	host	municipality	100	

(*continued on next page*)

Appendix Table A5 (*continued*)

ID	Beneficiary		Share (%)	Distance-based eligibility
46	host	municipality	100	
47	affected	residents, municipality	50/50	residents near turbines
48	affected	municipality, region	96/4	
49		region	100	
50		region	100	
51		region	100	
52		region	100	
53	host, neighbour	residents	100	
54	host, neighbour	residents	100	
55	host, neighbour	residents, municipality	50/50	
56		municipality	100	
57		municipality	100	
58		municipality	100	
59		municipality	100	
60		municipality	100	

Data availability

The data have been published on YODA (University of Utrecht) and can be visualised interactively in the Kelso Institute Europe's Virtual Centre for Wind Energy Regulation (https://kelso-institute-europe.de/tools/compare-countries-copy/) and the WIMBY Map (www.map.wimby.eu).

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