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RESEARCH ARTICLE

Communicative power in energy transitions: Media discourse on biorefineries in Spain

[version 1; peer review: 1 approved, 1 not approved]

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Abstract

Background

This study analyses how Spanish digital media frame biorefineries, a key renewable energy technology in the country's energy transition. It draws on theories of social acceptance of renewable energies and the political economy of communication to examine how power asymmetries in media coverage influence public perception and participation.

Methods

A mixed-methods discourse analysis and social listening approach was applied to a corpus of 350 media articles (88 unique cases) published between 2019 and 2024 and collected through Onclusive Social. Articles were coded according to actor presence, argument type, tone, territorial context and socioeconomic indicators. Reliability was ensured through double coding and Cohen's kappa statistics.

Results

The analysis reveals a marked dominance of corporate and institutional actors in shaping narratives, with economic arguments strongly associated with positive coverage, while environmental and health concerns predict negative tone. Rural areas display more critical discourse than urban ones, challenging conventional NIMBY

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explanations. From these findings, the study derives the Communicative Hegemony Model in Energy Transition (CHMET) as a conceptual outcome that integrates observed patterns of media power and proposes axes for future testing and comparative research.

Conclusions

Spanish media discourse on biorefineries reflects structural imbalances that may condition social acceptance of renewable energy projects. Policy recommendations include strengthening independent scientific communication, promoting binding public deliberation and enhancing journalistic standards to balance stakeholder voices. By presenting CHMET as a product of the analysis and a framework for deeper investigation, the study contributes both empirical evidence and a conceptual tool to advance research on communicative power in energy transitions.

Plain Language Summary

This study looks at how Spanish news websites talk about biorefineries, a technology that can produce renewable energy. We wanted to understand who has the most influence in these discussions and how that power shapes what people think about energy projects.

We collected and analysed 350 online news articles published between 2019 and 2024. We examined which actors were quoted, the types of arguments used, the tone of the coverage and differences between rural and urban areas. We found that companies and government institutions dominate the conversation and that economic arguments are linked to more positive coverage, while environmental and health concerns lead to more negative stories. Rural areas showed more critical views than urban areas.

From these results we developed a new way to describe and study these patterns, called the Communicative Hegemony Model in Energy Transition (CHMET). This model offers a framework to explore how media power affects public acceptance of renewable energy projects and can guide future research and policy.

Our findings highlight the need for more independent scientific communication, stronger public participation and higher standards for balanced journalism. Understanding how media influence energy debates can help governments, journalists and citizens design fairer and more democratic strategies for the energy transition.

Keywords

Social acceptance, renewable energy, energy transitions, media discourse, communication power, biorefinery, democratic legitimacy, energy policy



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Introduction

The global energy transition toward renewable technologies is one of the most significant socio-technical transformations of our time, requiring not only technological innovation but also broad social acceptance and democratic legitimacy[1,2]. While substantial research has examined the technical and economic dimensions of renewable energy deployment, the social and communicative processes shaping public acceptance remain less understood[3,4]. This gap is critical because social resistance can delay or derail renewable energy projects, regardless of their technical feasibility or economic viability[5,6].

Biorefineries are a cornerstone of the circular bioeconomy, offering pathways to reduce fossil fuel dependence through biomass valorization for biofuels and bioproducts[7,8]. In Spain, Law 7/2021 on Climate Change and Energy Transition identifies the bioeconomy as a development driver, positioning bioenergy as essential for energy security and environmental sustainability. Yet, despite strong policy support, biorefineries face community concerns about environmental impacts, procedural justice and fair benefit distribution[9,10].

Traditional approaches to social acceptance of renewable energy technologies focus primarily on psychological factors, economic benefits and procedural justice[11,12]. While valuable, these frameworks often overlook the central role of communication and media power in shaping public perceptions and democratic discourse[13]. Recent energy social science research has begun to fill this gap by examining how media representation, partisan identity and communicative strategies influence attitudes toward energy transitions[14,15].

The political economy of communication adds further insight by analysing how media institutions construct rather than merely reflect public opinion through selective attention, framing and differential access to communicative channels[16–18]. In energy transitions, this dynamic becomes especially consequential as governments, corporations, environmental groups and citizen organisations compete to define acceptable and desirable energy futures[19].

Spain provides an ideal context to explore these dynamics because of its ambitious renewable-energy policies, diverse biorefinery projects and well-documented patterns of social resistance to energy infrastructures[20,21]. The country's democratic transition and strong civil-society traditions make communicative asymmetries particularly visible and politically significant.

Despite growing recognition of communication's importance in energy transitions, few studies systematically examine structural inequalities in media access and narrative control. Most research relies on surveys of public attitudes or qualitative case studies, leaving underexplored how apparent "social acceptance" may reflect manufactured consent rather than authentic democratic deliberation[22,23].

This study addresses that gap by analysing Spanish digital media discourse on biorefineries between 2019 and 2024. Using a mixed-methods design that combines content analysis, statistical modelling and critical discourse analysis, we examine which actors gain media visibility, which arguments dominate public narratives and how these patterns vary across geographical and socioeconomic contexts.

Our research makes three contributions to energy social science. First, it provides empirical evidence of systematic media asymmetries in renewable energy discourse, challenging assumptions of neutral information environments. Second, it integrates insights from social acceptance theory and the political economy of communication to explain how power relations shape public debate. Third, it generates a conceptual outcome—the Communicative Hegemony Model in Energy Transition (CHMET)—that synthesizes observed patterns into a framework for future research on media power in energy governance.

The remainder of the article is organized as follows. Section 2 reviews the literature on social acceptance, energy transitions and communication power. Section 3 details the theoretical framework and research questions. Section 4 describes the methodology and data collection. Section 5 presents empirical findings, and Section 6 discusses implications for energy social science and policy. Section 7 concludes with recommendations for democratic energy governance.

Literature review and conceptual framework

Social acceptance of renewable energy technologies: from individual to structural approaches

The study of social acceptance of renewable energy technologies has evolved from early psychological models focused on individual attitudes to more sophisticated frameworks that recognise the interplay of social, economic and political factors[3,5]. Traditional approaches, such as the Technology Acceptance Model (TAM), emphasised perceived usefulness, ease of use and behavioural intentions[24]. While valuable for understanding adoption patterns, these models have been criticised for their individualistic focus and limited attention to structural power relations[4].

Research initially framed local opposition through NIMBY explanations[25], but empirical studies revealed that resistance often reflects legitimate concerns about procedural justice, distributive equity and democratic participation[6,11]. Concepts such as place attachment[26] and justice-oriented approaches[12,27,28] highlighted the importance of fair decision-making and benefit distribution. Comparative studies also show that these dynamics are not limited to specific national contexts. Walker *et al.*[29], for example, analysed news coverage of renewable energy projects involving Indigenous communities in Canada and demonstrated how media narratives intersect with questions of environmental justice and procedural fairness. However, even these justice-based frameworks often treat communication as a neutral process rather than interrogating how power relations shape communicative dynamics.

Recent contributions adopt critical and cultural perspectives to explore how renewable energy deployment can reproduce social inequalities[5,30]. Concepts such as *energy colonialism*

describe how large-scale renewable projects may dispossess local communities of control over their energy futures[31]. Yet, despite these advances, little attention has been paid to the role of media representation and communicative power in shaping acceptance or resistance.

Communication and media power in energy transitions

Energy transitions are not merely technical or economic processes but also communicative arenas where actors compete to define desirable energy futures[2,32]. Media institutions actively construct public opinion through agenda-setting, framing and differential access to communicative channels[33,34]. The political economy of communication highlights structural filters—ownership concentration, advertising dependence and sourcing patterns—that systematically privilege certain perspectives[16–18].

Empirical studies provide growing evidence of these mechanisms. Haas[15] analysed media coverage of energy transitions in Germany and Spain, showing how partisan political contexts shape renewable energy discourse. McNeeley and Franz[14] developed an integrated framework linking media consumption, partisan identity and transition attitudes, demonstrating how communicative strategies can either facilitate or hinder sustainable energy adoption. Cross-national comparisons further reveal shared framing patterns: Rochyadi-Reetz *et al.*[35] found that media outlets across different countries systematically privilege economic narratives over environmental justice concerns, while Boykoff and Yulsman[36] documented how climate and energy coverage often creates false balance between scientific consensus and minority viewpoints, contributing to public confusion about renewable energy benefits. Environmental communication research also shows how broader cultural narratives about progress, nature and risk influence the reception of energy technologies[13,37]. Batel and Castro[19] demonstrate how social representations of renewable energy vary across different communicative spheres, revealing tensions between expert, media and local community discourses.

Despite these contributions, most analyses focus on climate change or general renewable energy rather than specific technologies such as biorefineries. Moreover, few studies systematically examine how structural inequalities in media access affect the democratic quality of energy transitions, a gap that obscures how apparent "social acceptance" may reflect manufactured consent rather than authentic democratic deliberation.

Critical approaches to energy communication: hegemony, counterpublics, and democratic legitimacy

Critical theories provide conceptual tools to examine these inequalities. Gramscian notions of hegemony explain how dominant groups maintain power through cultural leadership and the naturalisation of particular worldviews[18,22]. Habermas's public sphere ideal highlights the need for inclusive, rational debate[38], while Fraser[23] underscores the existence of counterpublics—alternative communicative spaces where marginalised groups contest dominant narratives. In the context of energy transitions, environmental organisations, Indigenous communities and local residents often act as counterpublics that challenge official renewable-energy discourses[39].

Research applying these concepts to energy debates demonstrates how competing energy imaginaries and discourses of energy security can privilege particular technologies and actors[40,41]. Bouzarovski and Bassin[42] reveal how energy geopolitics involves not just material resource flows but also discursive struggles over the meaning and value of different energy systems. Yet most critical work still focuses on fossil fuels or climate denial, overlooking how renewable-energy advocacy can reproduce power imbalances through new forms of accumulation and dispossession[43]. Peck[44] further illuminates the tension between political economy and cultural/discourse analysis, a debate highly relevant for understanding how structural and symbolic forces jointly shape energy.

Integrative perspective

Taken together, these strands of literature reveal a need for frameworks that combine insights from social acceptance research, political economy of communication and critical theories of media power. Such an approach can capture how structural inequalities in media access and narrative control condition the very possibility of "social acceptance." Rather than applying a predefined model, this study responds to that need by integrating these perspectives and, based on the empirical analysis, develops a preliminary conceptual model to guide future research on communicative hegemony in energy transitions.

Objectives

The purpose of this study is to analyse how Spanish digital media construct and circulate narratives about biorefineries, a key renewable energy technology. The analysis focuses on patterns of media access, argument framing and territorial variation to understand how communicative power shapes public perceptions and acceptance of biorefineries and, more broadly, renewable energy transitions.

The specific objectives are:

1. Identify the predominant themes in media narratives about biorefineries-such as sustainability, technological innovation and rural development-and examine how these themes are assembled into dominant interpretive frameworks that present specific positions as "common sense."
2. Assess the distribution of sentiments (positive, neutral, negative) associated with biorefineries across geographical and economic contexts.
3. Analyse the influence of key actors (corporate, governmental, citizen groups) on public narratives, identifying their capacity to shape the media agenda.
4. Characterise arguments for and against biorefineries and relate them to the communicative strategies and actor profiles that promote these narratives.

5. Examine how different actors use communicative resources to consolidate influence or develop resistance narratives.
6. Explore how narrative patterns vary by geographical context, considering population size, regional GDP and the presence of biorefinery installations.
7. Segment recurrent narrative patterns through cluster analysis, differentiating communicative strategies and dominant frames by group.

Insights from these analyses inform the development of a preliminary Communicative Hegemony Model in Energy Transition (CHMET) as a conceptual result of the research, offering a framework for future studies on media power in renewable energy governance.

Hypothesis

The study tests the following hypotheses regarding media discourse on biorefineries in Spain:

H1. Patterns of acceptance and rejection of biorefineries are associated with asymmetric media access, whereby actors with greater visibility are more likely to naturalize their narratives as "common sense," while citizen concerns receive less coverage.

H2. Negative mentions of biorefineries are primarily linked to environmental and health concerns and occur more frequently in rural areas, where institutional discourses have lower penetration.

H3. Communicative strategies that emphasise citizen participation and dialogue generate higher levels of acceptance and perceived legitimacy in rural regions compared with unilateral or top-down strategies.

H4. The use of highly technical or inaccessible language is associated with higher disaffection and negative mentions, whereas clear, context-adapted language facilitates more positive perceptions and deliberative engagement.

H5. Narratives led by governments and corporate actors tend to have a more neutral overall impact on sentiment compared with narratives led by citizen collectives or academic experts.

H6. Regions with higher GDP and a larger number of biorefinery projects display more technical narratives and more positive sentiments, while regions with lower GDP prioritise economic and social arguments.

Table 1 details the operational definition of variables.

Methods

This research employs a mixed qualitative and quantitative methodology structured in four phases (see Figure 1). The qualitative dimension is based on discourse analysis applied to Spanish digital media about biorefineries, using social listening techniques and manual analysis of 350 news articles collected between 2019 and 2024. This approach identifies narrative patterns, social perceptions, and predominant communicative strategies.

Table 1. Operational definition of variables.

ID	Variable name	Operational definition	Indicator
V1	Main themes	Classification of the principal topics addressed in each article regarding biorefineries.	Proportion of mentions by thematic category (sustainability, economy).
V2	Sentiment	Evaluation of the overall emotional tone of each article.	Frequency of positive, negative, or neutral mentions.
V3	Key actors	Identification of entities that lead narratives (governments, companies, NGOs).	Relative frequency of mentions by actor.
V4	Arguments	Identification of benefits or concerns expressed about biorefineries.	Number of mentions by argument (sustainability, health, employment).
V5	Communicative strategies	Methods employed by actors to influence public perception.	Types of predominant strategies (media campaigns, participation).
V6	Language accessibility	Degree of clarity and technical complexity of the text.	Classification of texts according to clarity and technical complexity.
V7	Power relations	Distribution of power among key actors.	Perception of influence in public narratives.
V8	Geographical context	Relationship between narratives and regional variables such as GDP, population, and number of installations.	Comparative analysis between regions.
V9	Narrative cluster	Segmentation of narrative and strategic patterns through cluster analysis.	Grouping of localities and narratives according to common characteristics.

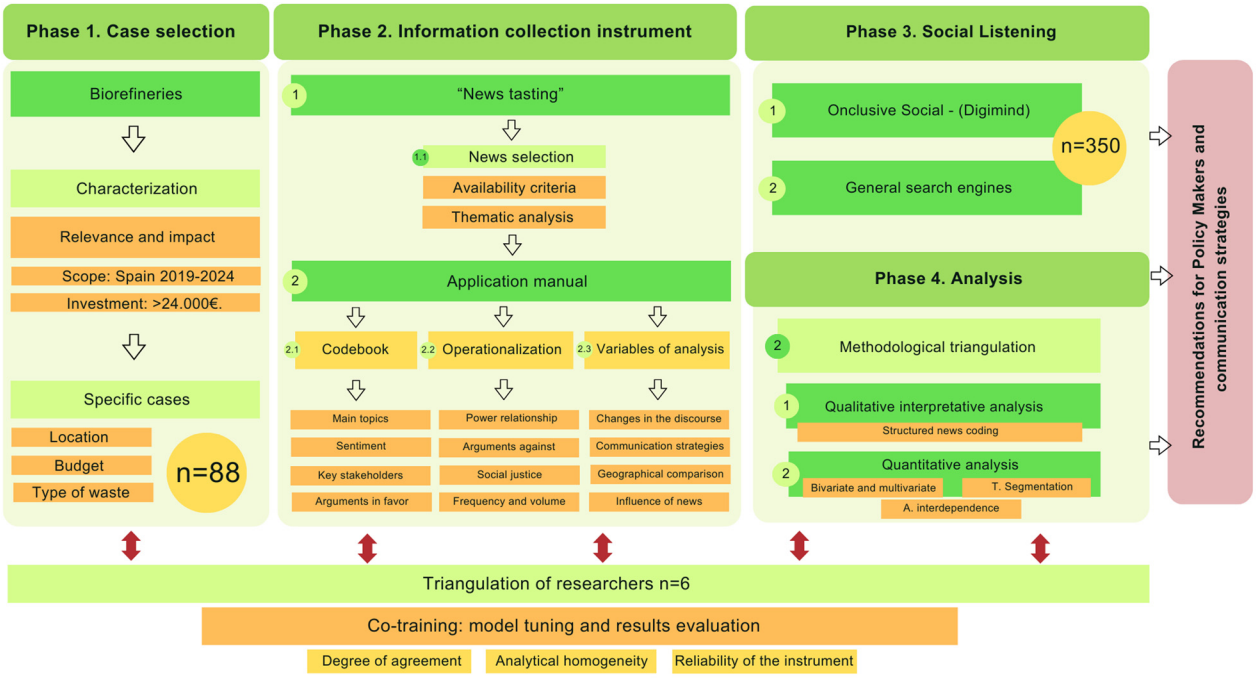

Figure 1. Methodological illustration indicating the phases and techniques used. Source: Own elaboration.

The quantitative approach complements the analysis through statistical tools: frequency analysis, Chi-square tests, and binary logistic regressions, establishing significant relationships between key variables such as predominant sentiments, arguments, and communicative strategies.

To ensure reliability, researcher triangulation was employed throughout the entire process, encompassing sample selection, data collection instrument design, and data analysis. This strategy ensures bias reduction, analytical coherence, and study replicability[45].

Phase 1. Case selection

The study universe encompasses information published in Spanish in digital media, related to the implementation of biorefineries in Spain during the last five years (from November 2019 to November 2024). A total of 88 specific biorefinery cases distributed across Spanish autonomous communities were identified (see Figure 2). These projects include both facilities already operational and making news due to some expansion, as well as those in development phase that were approved during this period.

For biorefinery selection, criteria of geographical diversity, types of processed waste, investment level, and economic and social relevance were used. Due to the absence of a centralized inventory of installations, biorefineries were tracked through various sources such as the Ministry for Ecological Transition and Demographic Challenge[46], the Spanish Association of Biocircularity (BIOCIRC), the Biorefinery and Bioenergy Center (BIO2C), the Spanish Biogas Association (AEBIG), and other relevant sectoral databases. These sources enabled identification of a representative set of installations in terms of scale, economic impact, and technological relevance, ensuring comprehensive and diverse coverage of facilities in Spain.

While communities such as Castilla y León lead in forest and agricultural biomass production, others like Catalonia and Aragon stand out for their industrial capacity and innovative projects. Meanwhile, regions such as Andalusia and Murcia excel in agricultural waste utilization, while urban communities like Madrid prioritize municipal solid waste (MSW) valorization.

Phase 2. Development of data collection instrument and researcher training

To ensure a structured and consistent framework, an application manual was developed that includes a codebook, operational terms, analysis variables, coding instructions, and practical examples[47]. To ensure coding consistency, an iterative approach was used where the team of six researchers followed a co-training model[48,49] and conducted weekly calibration sessions for four months (September–December 2024). An online form was developed for analyzing selected news articles, whose access can be found in the underlying data section at the end of the article.

Phase 3. News collection in digital media

Once the 88 biorefineries were selected, relevant information published in digital media was collected through a combined method of semi-automatic search using the social listening tool Onclusive Social (formerly Digimind) and manual searches

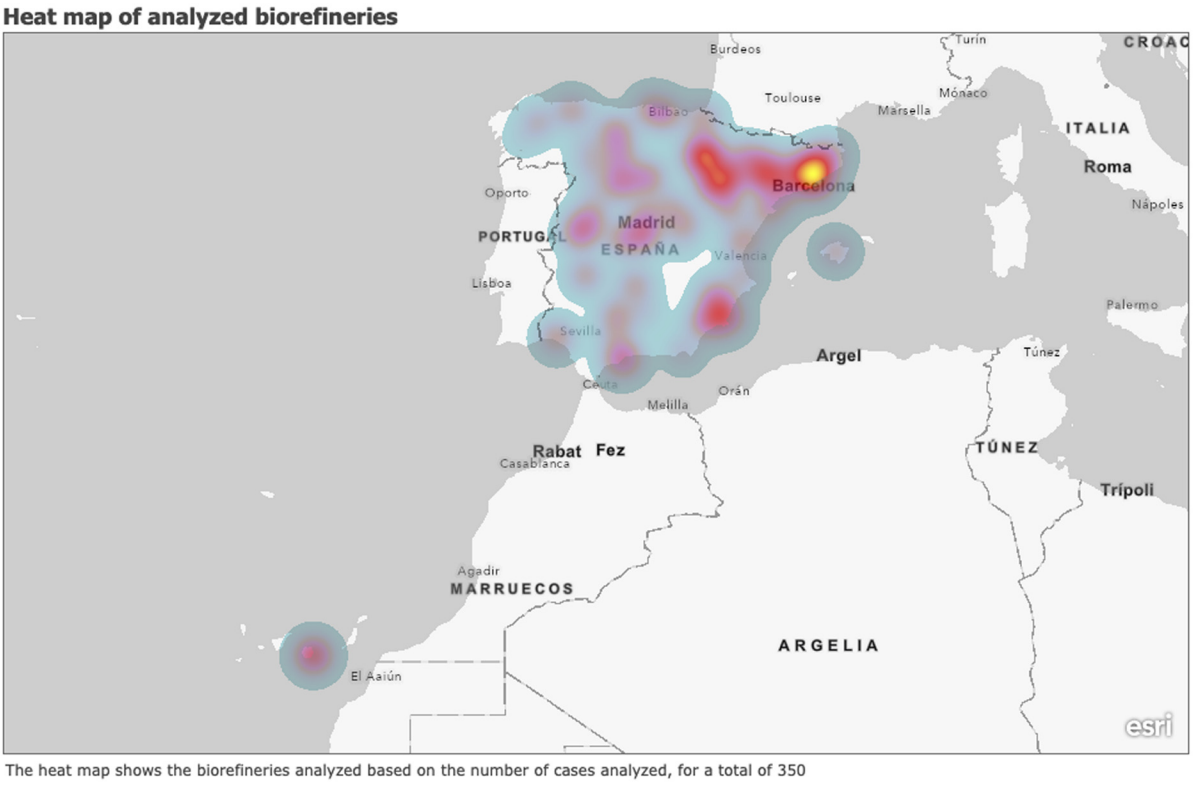

Figure 2. Heat map of analysed biorefineries. Source: Own elaboration.

in general search engines. This strategy ensured comprehensive coverage and coherent collection, addressing limitations of automated tools in qualitative analysis.

The initial configuration included detailed definition of key terms, exclusion criteria, and specific labeling schemes for each installation. To overcome limitations of automated tools, such as low reliability in interpreting complex contexts[50], semi-automatic searches were complemented with manual searches. This mixed approach integrating social listening with manual analysis has been successfully used in previous studies[51].

Onclusive Social provides metadata that classify each source by outlet type (e.g., national press, regional/provincial press, digital-native platforms, specialised outlets, municipal or corporate sites, and NGO/citizen platforms). These categories were cross-checked by the research team to verify accuracy and to distinguish mainstream journalistic content from institutional or advocacy material. This classification allowed subsequent analyses to differentiate narrative patterns according to media type and to ensure that the final sample of 350 articles reflected the diversity of Spanish digital media ecosystems.

Phase 4. Analysis, statistical validation, and methodological triangulation

The final analysis included a sample of 350 news articles collected between September and December 2024, with an approximate average of 4 news articles per installation (see Table 2). The data, classified by their origin (press articles, specialized blogs...), were systematically analyzed applying the model based on the codebook variables.

The analysis sought to identify predominant narratives and arguments employed, both for and against biorefineries, evaluating their perceived benefits and risks. Likewise, it examined how these narratives reflect and reinforce power dynamics, as well as social and economic inequalities, to better understand the factors that influence acceptance or rejection of these projects.

The analysis methodology included structured coding of news articles through the predefined coding system that encompassed the defined variables, and adopted a qualitative interpretive approach, focused on extracting narrative patterns and relevant social perceptions.

In order to guarantee the quality of results, a cross-validation strategy was followed through methodological triangulation. The identified patterns were confirmed using various complementary statistical techniques, including bivariate analyses (contingency tables and chi-square tests), multivariate analyses (binary and multinomial logistic regression), segmentation techniques (K-means cluster analysis), and interdependence analyses (multiple correspondence analysis).

This enabled validation of result consistency regardless of the analytical technique employed, confirming that the determining

Table 2. Distribution of cases and news by Spanish Region.

Region	Number of cases	Number of News
Andalucía	10	31
Aragón	13	46
Canarias	3	15
Cantabria	1	5
Castilla y León	17	40
Castilla-La Mancha	7	25
Cataluña	20	69
Comunidad de Madrid	3	11
Comunidad Foral de Navarra	4	16
Comunidad Valenciana	3	11
Extremadura	5	16
Galicia	3	9
Islas Baleares	2	5
La Rioja	2	7
País Vasco	3	12
Principado de Asturias	2	6
Región de Murcia	8	26

factors of media discourse (presence of specific actors, type of argumentation, and socioeconomic context) remain significant ($p < 0.001$) across all applied statistical approaches.

The collected data and all analytical materials are available in the underlying data section at the end of the article.

Findings

The analysis explores social perceptions and communicative factors that influence acceptance or rejection of biorefineries in Spain. The findings include patterns in predominant sentiments and arguments, relationships between communicative strategies and narratives, language impact, key actor dynamics, and how these variables interact in different geographical and population contexts. These results provide the empirical basis from which a broader conceptual framework on communicative hegemony is later derived.

Social perception: sentiment and argument analysis

Sentiment analysis reveals that 64.8% of mentions toward biorefineries are positive, while 24.6% are negative and 10.6% neutral (n = 349). These results contrast with initial expectations, indicating a predominantly favourable portrayal of biorefineries in Spanish digital media, which suggests that these technologies are framed as broadly acceptable within the media discourse on energy transition (see Figure 3).

The analysis of specific arguments shows that positive sentiment is strongly associated with the type of argumentation employed. Arguments related to the economic development of areas where installations are implemented register 87.0% positive

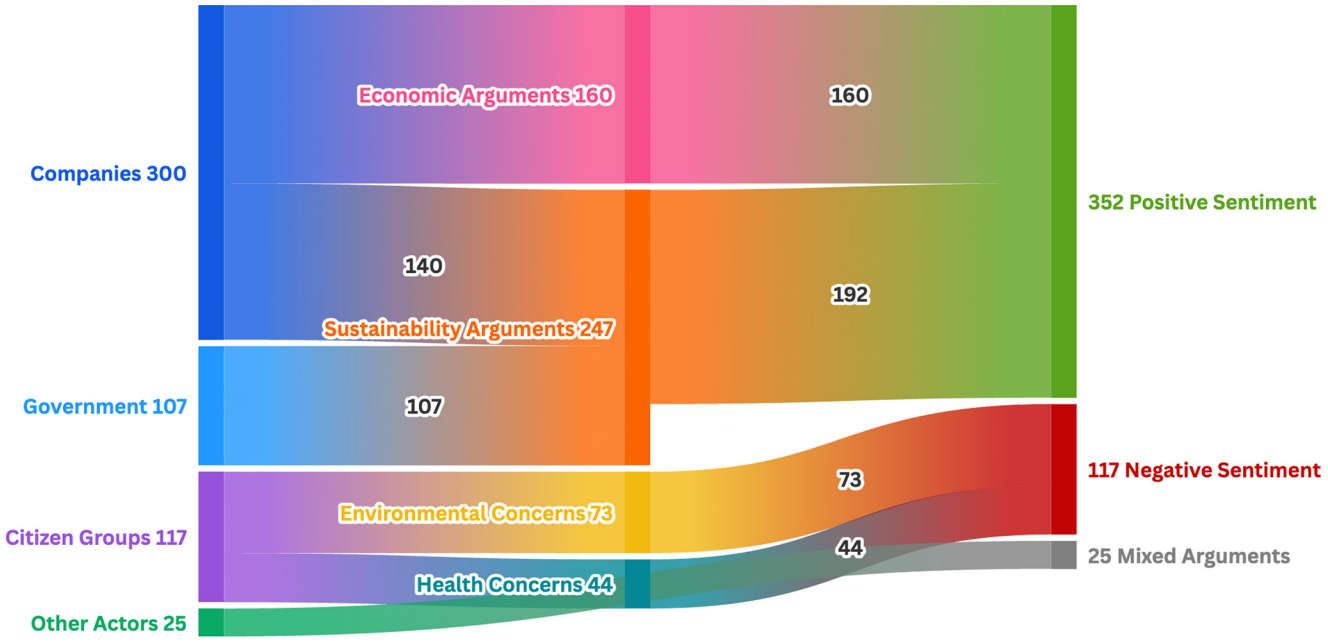

Figure 3. Communication flow in biorefinery media discourse. Source: Own elaboration.

mentions (Cramer's V = 0.511, $p < 0.001$). Media narratives emphasise benefits such as "the three million euro loan granted by the ICF, intended for the construction of a biogas plant" or highlight their "model of transformative, innovative activity." Sustainability arguments occupy the second position, with 77.7% positive mentions (Cramer's V = 0.466, $p < 0.001$), frequently framed as a "total example of the circular economy."

In contrast, narratives that include concerns about environmental impacts show 78.5% negative mentions (Cramer's V = 0.805, $p < 0.001$), making this the strongest predictor of negative sentiment. Local communities express concerns such as "residents of Albarreal de Tajo complain about bad odors attributed to a nearby biogas plant" or that "residents consider the odors as 'bothersome and unhealthy'." Mentions of potential health effects generate even higher negativity, with 84.6% negative mentions (Cramer's V = 0.611, $p < 0.001$), highlighting "risks to public health."

To assess the predictive capacity of these factors, a binary logistic regression was used with positive sentiment (versus negative/neutral) as the dependent variable and main themes, key actors, and geographical context as independent variables. The model shows good fit (Nagelkerke $R^2 = 0.607$, correct classification = 85.6%) and indicates that arguments related to economic development increase the probability of generating positive sentiment by 12.8 times (OR = 12.82, 95% CI: 4.52–36.40, $p < 0.001$), whereas communications linked with citizen collectives reduce the probability of positive sentiment to approximately 1.8% (OR = 0.018, 95% CI: 0.006–0.052, $p < 0.001$).

This polarization is reflected in contrasting narratives: while companies emphasise that "the plant has all the permits and official controls," citizen collectives argue that "residents perceive that they bear the inconveniences of the plant without receiving clear benefits," questioning the fairness of environmental impacts. These patterns of asymmetric visibility and argument strength underpin the conceptual development of the Communicative Hegemony framework presented in the discussion, where media power emerges as a key structural factor.

Geographical differences in narratives: a rural-urban and regional approach

Narratives about biorefineries display significant differences according to geographical context, revealing more complex patterns than initially expected. The analysis confirms a significant association between type of geographical area and predominant sentiment ($\chi^2 = 8.555$, $p = 0.014$). Contrary to the common expectation that rural communities would show greater acceptance of renewable projects, coverage of installations in urban areas presents a higher proportion of positive sentiment (80.9%) compared with rural areas (62.1%), while rural areas register a higher proportion of negative mentions (28.6% vs. 8.5%). Urban narratives frequently frame biorefineries as "development opportunities in urban and industrial contexts," whereas rural coverage highlights concerns such as "residents complain about bad odors" or that local people "bear the inconveniences of the plant without receiving clear benefits."

The geographical distribution of the sample reflects the predominantly rural siting of Spanish biorefineries, with 85.7% of cases located in rural areas (n = 281) and 14.3% in urban areas (n = 47). This imbalance has important implications for communicative strategies, as most installations are situated in contexts where the probability of public contestation is structurally higher.

Analysis by regional socioeconomic level also reveals an unexpected pattern that challenges the assumption that economically poorer regions would be more resistant to biorefineries (see Figure 4). Medium-GDP regions show the highest proportion of negative sentiment (43.5%), exceeding even low-GDP regions (16.1%) ($\chi^2 = 40.467$, $p < 0.001$). This suggests that while medium-income regions may have greater expectations of benefiting from new projects, they also demonstrate a stronger critical capacity to question perceived inequities in benefit distribution.

Coverage of installations in low-GDP regions shows unexpectedly high positive sentiment (79.3% positive mentions), whereas high-GDP regions maintain moderately positive levels (76.7% positive). Multiple correspondence analysis confirms the centrality of medium-GDP regions in explaining patterns of contestation, with the highest factor loading (0.705) in the primary dimension of variability, identifying regional economic context as the most influential geographical factor associated with negative sentiment in Spanish digital media discourse.

At the regional level, extreme differences emerge that mirror the political, economic and social specificities of each autonomous community. Madrid exhibits the highest proportion of negative mentions (81.8%), followed by Castilla y León (55.0%) and La Rioja (85.7%). In contrast, Andalusia (96.8% positive), the Canary Islands (100% positive) and the Balearic Islands (100% positive) display very high levels of positive sentiment. Narrative contrasts are clear: regions with high positive coverage emphasise topics such as the "conversion of 70,000 tons of livestock manure" or "loans to finance construction," whereas more critical regions highlight local concerns such as "community unrest" and the perception that "residents bear the inconveniences without receiving clear benefits."

These regional differences are significantly associated with the arguments employed. Coverage in regions with higher positive sentiment predominantly uses economic development arguments ($\chi^2 = 59.359$, $p < 0.001$), while critical regions more frequently highlight environmental and health concerns ($\chi^2 = 80.805$, $p < 0.001$).

Distinct narrative patterns are also evident within specific communities. For example, Cantabria shows high local polarisation, with economic arguments present in 100% of positive

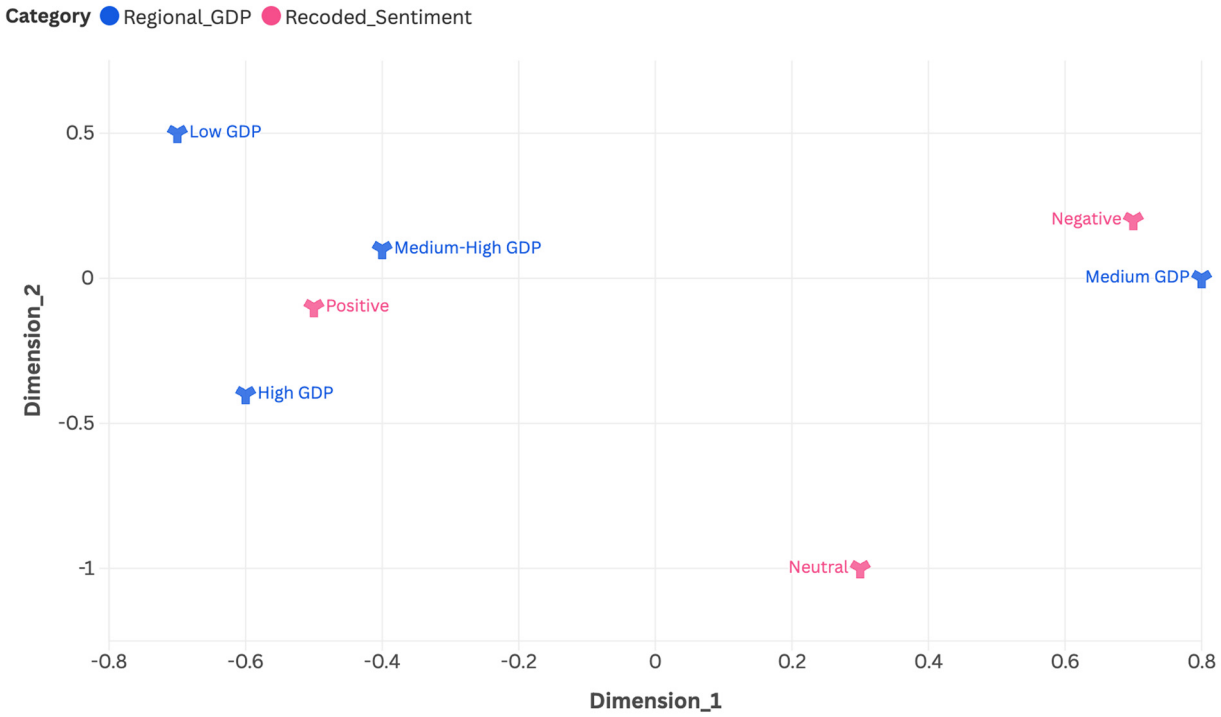

Figure 4. Correspondence analysis of regional GDP levels and sentiment categories toward biorefineries in Spain. Source: Own elaboration.

articles and environmental concerns in 80% of negative ones. In contrast, the Basque Country combines extensive use of economic arguments (83.3%) with minimal reference to environmental concerns (8.3%), resulting in a high proportion of positive sentiment (91.7%).

Key actors, arguments, and predominant sentiments: Discourse polarization

The analysis reveals pronounced polarization in media discourse on biorefineries depending on which actors lead the published narratives. Companies appear most frequently, featuring in 68.3% of analysed mentions, followed by governments (63.1%), while citizen collectives are present in 22.0% of cases and other interest groups in only 5.4% (see Figure 5).

However, the influence of these actors on sentiment is inversely related to their quantitative presence. Logistic regression shows that when companies are identified as key actors, the probability of a positive tone increases more than fivefold (OR = 5.10, 95% CI: 2.54–10.24, $p < 0.001$). In contrast, when citizen collectives are prominent, the probability of positive sentiment falls to about 1.8% (OR = 0.018, 95% CI: 0.006–0.052, $p < 0.001$). This difference represents the strongest effect detected in the analysis, with a very high association magnitude (Cramer's V = 0.602, $p < 0.001$).

Polarization is also evident in the discursive patterns linked to each actor. When citizen collectives lead the narrative, only 11.7% of mentions are positive and 67.5% are negative. Typical justifications highlight local concerns such as "residents consider the odors as 'bothersome and unhealthy,' generating unrest in the community." In contrast, when companies dominate coverage, 73.6% of mentions are positive and only 15.9% are negative. Corporate narratives frequently stress transformative aspects, for example describing projects as a "model of transformative, innovative activity […] without generating waste and standing as a total example of the circular economy." Governments occupy an intermediate position, with predominantly positive narratives (70.9%) but a higher proportion of negative mentions (17.3%) than companies.

The relationship between actors and arguments reveals differentiated communicative strategies. Government narratives tend to emphasise sustainability and procedural legitimacy, highlighting global environmental benefits and institutional oversight. Private companies focus on technological innovation and economic development. Conversely, NGOs and citizen collectives foreground critical narratives that draw attention to local impacts and the need for social justice, identifying actors such as "affected residents, the biogas plant owner, and the City Council."

Communicative strategies and their impact on media discourse

Analysis of the communicative strategies present in media narratives shows that positive sentiment is strongly associated with the type of argumentation used (see Figure 6). Results reveal a clear hierarchy in which economic development

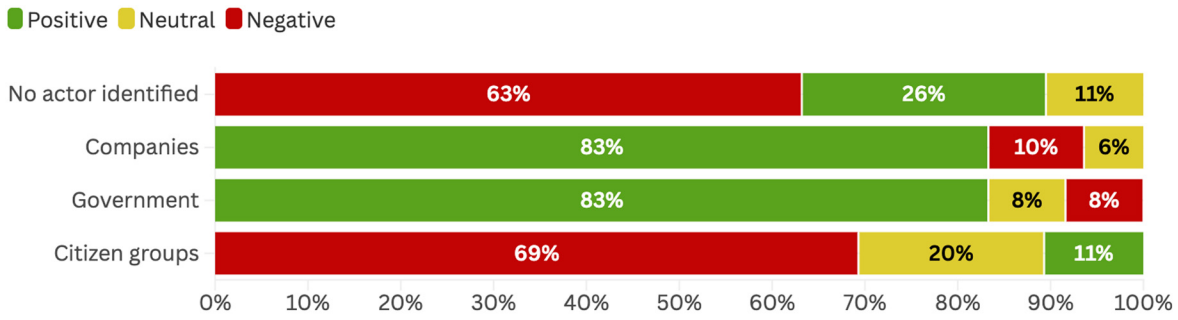

Figure 5. Media discourse polarisation by key actors. Source: Own elaboration.

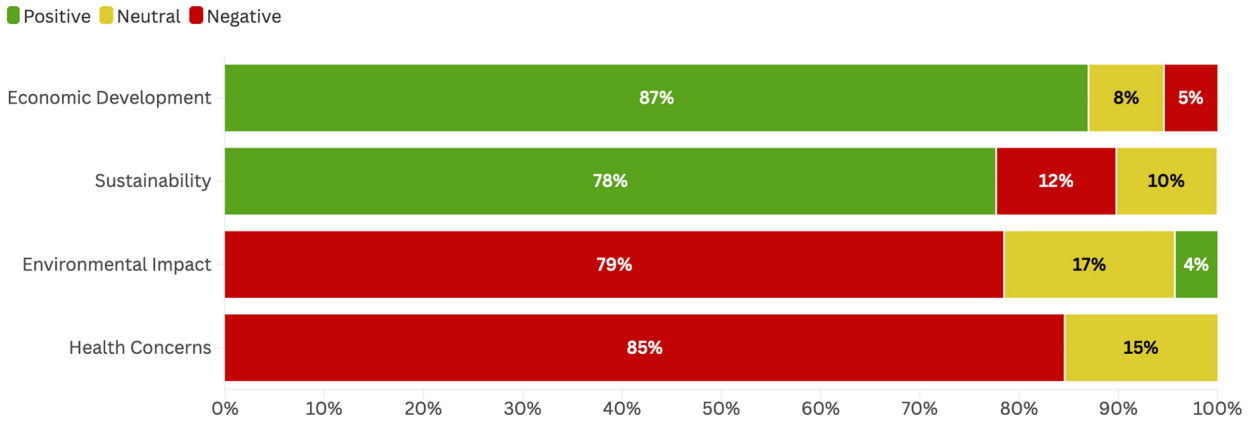

Figure 6. Communication Strategy Effectiveness on Biorefinery Discourse. Source: Own elaboration.

arguments appear as the most influential frame, with 87.0% of mentions coded as positive (Cramer's V = 0.511, $p < 0.001$). These narratives highlight tangible benefits such as "the three million euro loan granted by the ICF, intended for the construction of a biogas plant" or stress that "farmers expect the plant to reduce costs for their farms." Sustainability arguments occupy the second position, reaching 77.7% positive mentions (Cramer's V = 0.466, $p < 0.001$).

Conversely, narratives that introduce environmental concerns show the strongest association with negative sentiment, with 78.5% of mentions coded as negative (Cramer's V = 0.805, $p < 0.001$). Typical examples include "residents fear that odors are indicative of environmental problems." This effect intensifies when narratives reference public health risks, where negative sentiment rises to 84.6% and positive mentions are absent (0%) (Cramer's V = 0.611, $p < 0.001$), illustrated by statements expressing "risks to public health."

Analysis of communication type distinguishes between institutional or unsigned news and items signed by individual authors, revealing differentiated patterns in media framing. Institutional news, which represents 65% of the analysed corpus, is mainly associated with neutral (70%) or positive (20%) tones, generally aligning with the communicative objectives of companies or institutions responsible for the projects. In contrast, news signed by individual authors (35% of cases) tend to adopt more critical approaches, with 40% negative mentions, suggesting that signed journalism reflects more independent analysis and a greater diversity of perspectives ($\chi^2 = 16.7$, $p < 0.05$).

Analysis of language accessibility produced results contrary to initial expectations. Contrary to hypothesis H4, no statistically significant association was found between language complexity and narrative tone ($\chi^2 = 7.187$, $p = 0.304$). Articles coded as "very comprehensible" display a similar distribution of positive tones (66.4%) to those with "somewhat comprehensible" language (78.9%), indicating that linguistic accessibility does not determine the sentiment of media framing around biorefineries.

Regional differences in communicative strategies reflect adaptation to specific contexts. Autonomous communities with greater positive coverage, such as the Canary Islands (93.3% positive) and the Basque Country (83.3% positive), predominantly employ economic development arguments, while regions with a stronger presence of critical narratives, such as Madrid (72.7% negative) and Cantabria (80.0% negative), centre discourse on environmental and health concerns.

The relationship between dominant narratives and communicative strategies is statistically significant ($\chi^2 = 14{,}877.49$,

$p < 0.001$). Narratives focused on sustainability are linked to institutional strategies and traditional media, whereas those centred on economic development are associated with media campaigns and direct communication. Narratives highlighting social and environmental impacts frequently rely on digital mobilisation and lobbying strategies, which show a strong correlation with the presence of citizen collectives ($r = 0.73$, $p < 0.001$), suggesting coordination between actors and alternative communication channels.

Overall, the findings indicate that the success of communicative strategies in shaping positive sentiment does not depend on language sophistication but rather on the ability to articulate tangible economic benefits while minimising environmental concerns, establishing a media environment where the most favourable narratives shift attention from local risks toward regional economic opportunities.

Cluster segmentation: narrative patterns and communicative strategies

Cluster analysis was implemented to identify underlying patterns in media narratives, discourse tone, and communication strategies associated with biorefineries in Spain, allowing a more precise segmentation of media framings and the strategies employed in public discourse (see Figure 7).

Six main variables were selected for the analysis: predominant discourse tone, presence of economic development and sustainability arguments, participation of companies and citizen collectives as key actors, and type of geographical area. Using K-means clustering with four groups, the model maximised explained variability between clusters ($F = 958.989$, $p < 0.001$ for discourse tone). The solution identified four distinct narrative profiles that together explain 82.6% of the total variability in the sample (see Figure 7).

Cluster 1 – OCR: Organised Citizen Resistance (n = 54, 16.5%)
This profile exhibits a predominantly critical media discourse, with 81.5% negative mentions and no positive mentions. Narratives are largely led by citizen collectives (88.9% presence) and focus on sustainability arguments (92.6%), while references to local economic benefits are minimal (9.3%). Coverage refers mainly to installations in rural areas (96.3%). This cluster reflects structured citizen mobilisation that uses

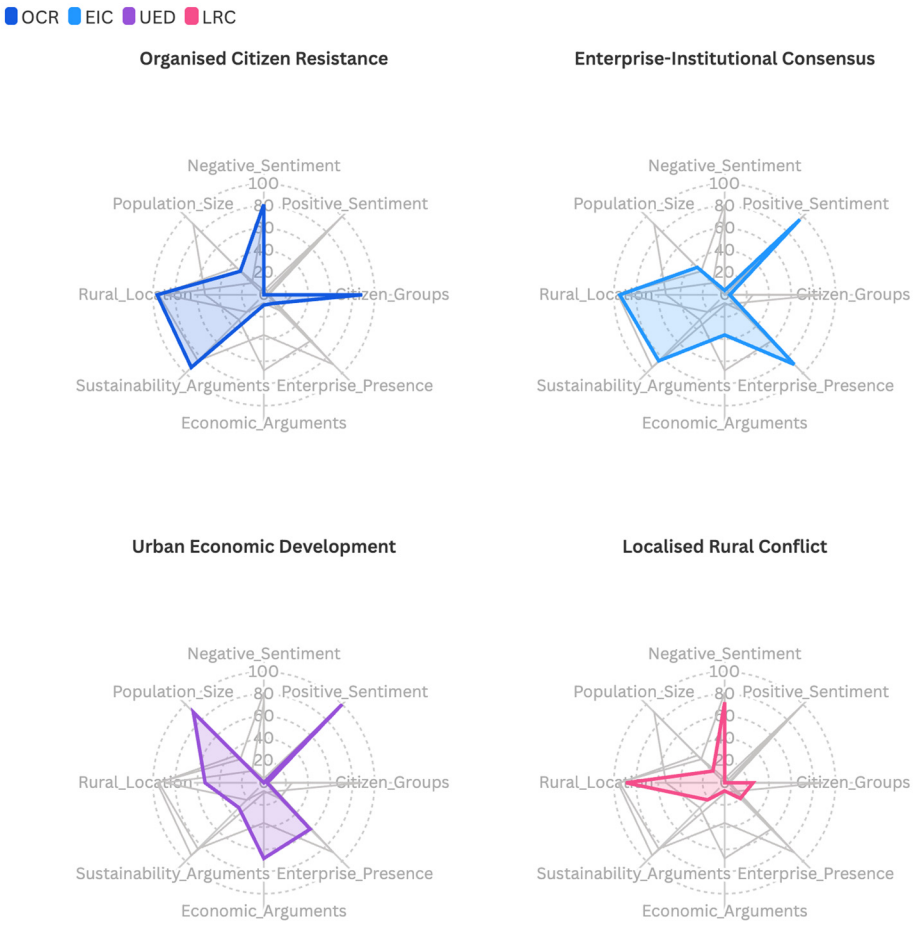

Figure 7. Biorefinery Discourse Profiles: Cluster Analysis. Source: Own elaboration.

environmental arguments to contest projects perceived as externally imposed.

Cluster 2 – EIC: Enterprise–Institutional Consensus (n = 152, 46.5%)
The largest profile, it displays an overwhelmingly positive discourse (96.1% positive, negligible negative mentions). Publications are predominantly led by companies (88.8% presence) with minimal involvement of citizen collectives (4.6%), combining sustainability arguments (84.2%) with economic benefits (36.2%). Coverage focuses mainly on rural installations (94.7%). This cluster illustrates a hegemonic narrative in which business and institutional actors align to produce highly optimistic media portrayals.

Cluster 3 – UED: Urban Economic Development (n = 66, 20.2%)
This profile shows complete positive discourse (100%) and is distinguished by a strong emphasis on economic arguments (68.2%), framing biorefineries as development opportunities in urban and industrial contexts. Sustainability arguments are less frequent (31.8%). Business participation is significant (59.1%) while citizen collectives are almost absent (3.0%). It is the only cluster with extensive reference to urban installations (47.0%), associated with the largest populations in the study (mean 101,201 inhabitants).

Cluster 4 – LRC: Localised Rural Conflict (n = 55, 16.8%)
Although the least numerous, this cluster exhibits the highest polarization, reflecting local conflicts in small communities where perceived lack of benefits fuels resistance despite limited argument elaboration. Negative mentions account for 72.7% and positive mentions are absent. Business participation is low (20.0%), citizen collectives are present in 25.5%, and both economic (7.3%) and sustainability arguments (21.8%) are scarce. Coverage refers mainly to rural installations (89.1%) and is associated with the smallest populations in the sample (mean 15,146 inhabitants).

The overall analysis reveals statistically significant associations across all examined dimensions ($\chi^2 = 309.108$, $p < 0.001$ for the relationship between cluster and discourse tone; $\chi^2 = 72.761$, $p < 0.001$ for the relationship between cluster and geographical area). This segmentation indicates that media discourse on biorefineries in Spain is not randomly distributed, but is organised around specific configurations of actors, arguments, and geographical contexts.

Conceptual proposal: Communicative Hegemony Model in Energy Transition (CHMET)

The empirical findings provide the basis for proposing the Communicative Hegemony Model in Energy Transition (CHMET) as a conceptual synthesis of the patterns identified in Spanish media discourse on biorefineries. Rather than testing a predefined theory, the analysis highlights recurrent dynamics that inform the model and illustrate key dimensions of communicative power in energy transitions (see Figure 8).

- **Axis 1. Media power structure:** Structural filters condition differential access to communicative channels. Companies dominate coverage (68.3% of mentions), while citizen collectives remain marginal (22.0%). This asymmetry translates into contrasting tones: when companies lead narratives, 73.6% of mentions are positive versus 15.9% negative, whereas when citizen collectives dominate, only 11.7% are positive and 67.5% are negative.

- **Axis 2. Construction of dominant narratives.** Economic arguments achieve clear primacy, reflecting a process of *naturalisation of common sense*. Economic frames are associated with 87.0% positive mentions (Cramer's $V = 0.511$, $p < 0.001$), while environmental concerns generate 78.5% negative mentions (Cramer's $V = 0.805$, $p < 0.001$), illustrating how economic criteria are presented as "objective" and politically neutral.

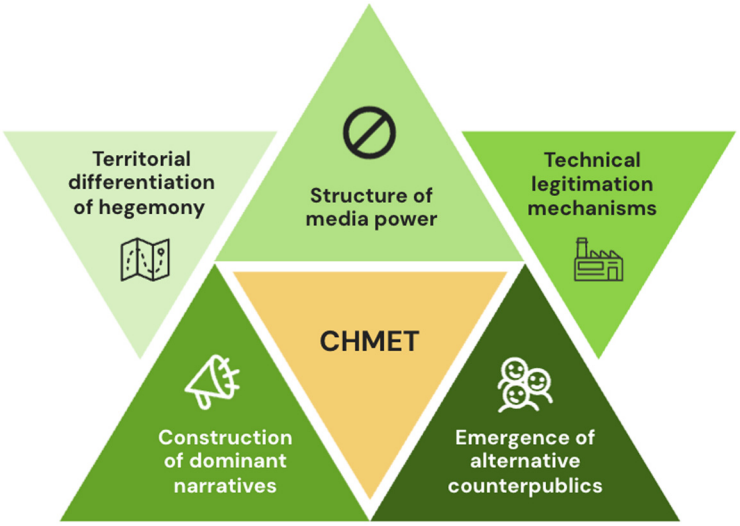

Figure 8. Model of Communicative Hegemony in Energy Transition (CHMET). Source: Own elaboration.

- **Axis 3. Emergence of alternative counterpublics.** Citizen collectives act as counterpublics of communicative resistance. Their narratives are predominantly critical (67.5% negative, 11.7% positive), challenging hegemonic frames and foregrounding environmental and social justice concerns.

- **Axis 4. Territorial differentiation.** Resistance varies across spatial and economic contexts. Rural areas show lower positive sentiment (62.1%) than urban areas (80.9%), and medium-GDP regions display the highest proportion of negative sentiment (43.5%) compared to low-GDP regions (16.1%), indicating that socio-territorial conditions shape the balance of hegemonic and counter-hegemonic narratives.

- **Axis 5. Actor-based legitimation mechanisms.** Language complexity shows no significant association with sentiment ($\chi^2 = 7.187$, $p = 0.304$). This suggests that communicative effectiveness depends less on linguistic sophistication than on who speaks and with what resources, reinforcing the importance of actor power rather than textual accessibility.

Together, these five axes constitute an emergent conceptual model that synthesises the structural, narrative, and territorial dynamics identified in the data. The CHMET is therefore presented not as a validated theory but as a research-based proposal to guide future comparative and longitudinal studies on communicative power in energy transitions.

Discussion and conclusions

Discussion and interpretation of findings

The results demonstrate that media discourse on biorefineries in Spain is shaped by the presence of specific actors and regional socioeconomic characteristics, reflecting the complexity of public perceptions highlighted in the Integrated Acceptance Model of Hübner *et al.*[52]. Rather than validating a predefined theory, the findings inform the construction of the Communicative Hegemony Model in Energy Transition (CHMET) as a conceptual synthesis of the patterns observed.

The evidence supporting the main hypothesis (H1) shows the existence of communicative hegemony dynamics, in which certain arguments become naturalised as priorities while others are marginalised. Economic development arguments increase the likelihood of positive narratives by 12.8 times (OR = 12.82, $p < 0.001$), illustrating how media power privileges interpretive frameworks that favour economically dominant actors. This extends beyond traditional distributive justice models[11,12] by revealing not only the importance of communicating local benefits but also how communicative hegemony frames economic arguments as "common sense," rendering environmental or social concerns less visible. This supremacy of economic framings, consistent with Komendantova[53], reflects processes of consensus manufacturing that privilege narratives serving dominant interests and present complex political decisions as technical-economic issues, thereby challenging the democratic legitimacy of energy communication.

Findings on geographical differences partially contradict hypothesis H2, revealing patterns that surpass traditional NIMBY and BANANA explanations[25]. Contrary to expectations, urban areas show a higher proportion of positive mentions (80.9%) than rural areas (62.1%), suggesting that rural resistance reflects a greater capacity to develop critical counterpublics. This aligns with Marciano *et al.*[54], who found that small rural communities are more sensitive to perceived negative impacts than urban populations.

Results on citizen participation refine the understanding of procedural justice approaches. When citizen collectives gain visibility in media spaces, their narratives are predominantly critical (67.5% negative), which might seem at odds with classical procedural justice theories[6,12]. However, this critical participation illustrates how counterpublics articulate resistance to dominant hegemonic frames, consistent with the legitimate concerns about risk–benefit balance identified by Wang *et al.*[55]. Citizen participation thus operates less as a mechanism for consensus building and more as a channel for alternative discourses that contest the processes of consensus manufacturing, in line with the critical perspectives of Batel & Devine-Wright[30].

The analysis refutes hypothesis H4 on language adequacy ($\chi^2 = 7.187$, $p = 0.304$). From a communicative hegemony perspective, narrative power resides not in the technical accessibility of messages but in the structural capacity of certain actors to legitimise their interpretive frameworks. Articles coded as "somewhat comprehensible" present a higher proportion of positive mentions (78.9%) than those rated "very comprehensible" (66.4%), indicating that message accessibility is not a determining factor in media framing when compared with argumentative content and actor credibility.

Findings on key actors support hypothesis H5 and underscore the polarisation inherent to communicative hegemony. When companies lead media narratives, 73.6% of mentions are positive, whereas when citizen collectives dominate, only 11.7% are positive (Cramer's $V = 0.602$, $p < 0.001$). This asymmetry reflects patterns of energy colonialism[30], where economic elites secure the benefits while local communities bear the impacts. These dynamics resonate with Herman and Chomsky's concept of structural filters[16], which privilege voices with greater economic and political capital.

The evidence supporting hypothesis H6 on regional differences aligns with theories of contextual heterogeneity in social acceptance[56] but adds a critical dimension by showing how regional economic power conditions access to media channels, creating differentiated geographies of communicative hegemony in the energy transition.

Taken together, these findings reveal a hierarchical construction of interpretive frameworks that reflects structural power relations in the definition of legitimate priorities. Democratising communication in energy transition therefore requires strategies that go beyond manufacturing consent based solely on economic benefits. Policies and communication practices should

recognise the legitimacy of alternative frameworks that foreground environmental and health concerns, helping to overcome the false dichotomy between economic rationality and local community interests.

Conclusions

The analysis of media discourse about biorefineries in Spain reveals a structural imbalance in access to communicative channels, raising questions about the democratic quality of energy-transition processes. The findings show that public perception is shaped not by an open and balanced debate but by asymmetric power dynamics in which certain actors dominate the public narrative.

- **Imbalance in narrative control.** The communicative effectiveness of business and institutional actors demonstrates a concentration of discursive power operating through structural filters of media access. This dominance, while generating positive coverage of biorefineries, risks a *manufacturing of consent* that downplays the legitimate concerns of local communities. The marginalisation of citizen voices reflects deficits in procedural and distributive justice and informs the first axis of the CHMET, which highlights asymmetric structures of media power where actors with greater economic and political capital enjoy privileged access.

- **Citizen participation as resistance.** Citizen collectives act as counterpublics, developing alternative narratives that reveal how formal participation mechanisms often fail to integrate local concerns into project design. Their predominantly critical discourse suggests that participation functions less as cooperation and more as the creation of communicative spaces of resistance to dominant frames. This dynamic supports the third axis of the CHMET, centred on the emergence of counterpublics that dispute, albeit with structural limitations, hegemonic narrative control.

- **Hegemony of economic arguments.** Frames focused on local economic development have been naturalised as "common sense," gaining greater salience than environmental arguments. Economic criteria are presented as technically objective and politically neutral, creating disproportionate expectations of local benefits while subordinating environmental and health concerns. This process underpins the second axis of the CHMET, which explains how dominant narratives gain legitimacy by presenting market criteria as neutral facts.

- **Unequal geographies of communicative power.** Urban areas display higher positive coverage than rural areas, contradicting assumptions of stronger urban resistance and suggesting that rural communities develop greater capacity for critical discourse due to direct experience of local impacts. Medium-GDP regions show greater resistance than low-GDP ones. These patterns inform the fourth axis of the CHMET, which emphasises the territorial differentiation of communicative hegemony and the adaptation of narrative control to specific spatial and socioeconomic contexts.

- **Actor-based legitimation over message complexity.** The credibility of the sender, grounded in institutional legitimacy, proves more influential than linguistic clarity. The absence of a significant relationship between language complexity and sentiment supports the fifth axis of the CHMET, highlighting that communicative effectiveness depends more on actor power than on textual accessibility.

- **Hegemony and communicative deficit.** Overall, the results depict a model of communicative hegemony in which apparent social acceptance reflects control of media discourse more than genuine democratic consensus. Decisions are legitimised post-hoc through business–institutional dominance, illustrating what Gramsci[22] described as the construction of consent through naturalised "common sense." This dynamic signals a democratic deficit in energy-transition processes, where communication alone does not ensure political legitimacy or long-term social sustainability.

Recommendations for policy makers and communication strategies

The conclusions reveal a communicative hegemony that raises concerns about the democratic quality of debate on biorefineries in Spain. Current strategies generate media acceptance but perpetuate asymmetric dynamics in which business and institutional actors dominate public narratives through structural filters of access to information systems[16], marginalising citizen voices and weakening procedural and distributive justice.

The following recommendations aim to democratise communicative processes so that energy transition is grounded in genuine consensus and not in the reproduction of hegemonic narrative control::

1. **Democratise media access and ensure transparency of economic links.** Establish citizen representation quotas in media coverage of biorefinery projects and require explicit disclosure of financial relationships between media outlets, sector companies, and public institutions. This would help identify systematic biases and guarantee that affected communities have a voice in the public debate.

2. **Institutionalise binding public deliberation.** Create mandatory citizen consultation processes before final project design, granting real capacity to modify or cancel installations according to the consultation results. Participation must move beyond post-hoc legitimation to exert effective influence on planning.

3. **Balance economic narratives with critical risk assessment.** Develop communication protocols that present

economic benefits realistically, including distribution of costs and benefits, verifiable implementation timelines, and scenarios of potential non-compliance. Incorporate monitoring systems directly accessible to citizens to track fulfilment of commitments.

4. **Strengthen independent scientific communication.** Ensure that independent technical evaluations have access to public communication channels so citizens receive rigorous information not mediated by actors with direct economic interests.

5. **Integrate information-balance requirements into project evaluation.** Make the analysis of information balance a mandatory component of social impact assessments. Establish verifiable criteria for equitable access to information, diversity of consulted sources, and mechanisms for responding to citizen concerns as prerequisites for project approval.

These strategies are informed by the five axes of the proposed Communicative Hegemony Model in Energy Transition (CHMET), derived from the empirical findings of this study. They target:

- Axis 1: Democratise media power structures.
- Axis 2: De-naturalise hegemonic economic narratives through critical risk assessment.
- Axis 3: Strengthen citizen counterpublics via binding participation.
- Axis 4: Recognise territorial specificities in communicative strategies.
- Axis 5: Overcome legitimation based solely on institutional or technical authority.

Applied together, these measures would help move beyond the current manufacturing of consent and contribute to an energy transition that combines environmental sustainability with social legitimacy and procedural justice.

Ethics and consent

Ethical approval and consent were not required for this study. The research analysed publicly available media content and did not involve human participants, interviews, surveys, or personal data collection.

Data availability

Underlying data

Zenodo: Media discourse on biorefineries in Spain: database and methodological resources for the Communicative Hegemony Model in Energy Transition (CHMET). https://doi.org/10.5281/zenodo.17282338[57]

Data citation:
Zenodo: *Media discourse on biorefineries in Spain: database and methodological resources for the Communicative Hegemony Model in Energy Transition (CHMET)* [dataset]. Zenodo. https://doi.org/10.5281/zenodo.17282338[57]

The project contains the following underlying data:

- **01_Database_BiorefineryNews.xlsx**: Complete database of 350 coded news articles with all operational variables (themes, sentiment, actors, arguments, strategies, geographical context).
- **02_SPSS_Syntax_Files**: Set of SPSS 29 syntax files(spv & spss(organised by type of analysis (basic exploratory, logistic regression, cluster analysis, multiple correspondence analysis).
- **03_SPSS_Outputs.zip**: Complete statistical output files in *.spv* format to facilitate replication and interpretation of the analyses.
- **04_Biorefinery_Cases.xlsx**: Database of the 88 biorefineries studied, including technical characteristics, processing type, investment data, and geographical location.
- **05_Onclusive_Configuration.pdf**: Full configuration of the Onclusive Social monitoring setup, detailing query parameters, exclusion criteria, and hierarchical search levels used for digital media monitoring.
- **06_Specific_Queries.xlsx**: Complete set of facility-level queries designed for each monitored installation, including the detailed combinations of keywords by location, technology, and time period.

All files comply with FAIR principles and are openly accessible for verification, reuse, and further research. Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Extended data

Supplementary methodological materials—including the codebook, operational definitions of variables, and examples of coding procedures—are available as extended data in the same Zenodo repository (https://doi.org/10.5281/zenodo.14599770[57]). These resources provide detailed guidance for replicating the analyses and applying the CHMET framework.

Data are available under the terms of the Creative Commons Attribution 4.0 International

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✘

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The authors present an analysis of 350 media articles (press, blogs) over 5 years (2019-24) on biorefineries in Spain. The paper analyses a broad range of issues and variables, and makes arguments about which actors dominate the discourse or how article sentiment relate to (regional) variation in GDP. The authors present many different objectives, hypotheses, tables and figures, and My impression is that this article will become more compelling if the authors apply more focus.
The authors deal with too many different dimensions, ideas, and analyses, and it may be that clear guidance and focus setting was lacking in the team. There are major weaknesses in paper structure, which make it hard to digest.
Below, I detail my comments and I wish the authors good luck with the revisions.
Major comments:
Theory. The theory section is well written, but I have some questions. First, I had the impression that there is some bias in the sense that pro-renewable voices are depicted as dominant or hegemonic whereas other actor groups (e.g., enviro NGOs) are marginalized. Two things: I would develop the theory independent of who is dominant /marginalized in a specific setting. Also, if you widened the boundaries of your analysis, you might find e.g., oil & gas industry players dominating the pro-renewable players. So, who dominates or not depends on the empirical setting and scoping.
Second, I would like to see more compelling arguments why these three strands of literature need to be combined. What has each what the other two lack? Combining two strands can already be challenging, but three needs extra careful handling because it increases the complexity of the article (same goes for lots of variables, see below). Also, I find the third strand was introduced in a somewhat cursory way, compared to the other two. Also, I would introduce all literatures in a neutral way (what do they investigate, what are key approaches/concepts, how do they work), before turning to marginalization, or colonialisation, in each of them. Alternatively, you could introduce them in a neutral way and add a separate sub-section on the latter issues.
Objectives: I very much like the systematic way of introducing objectives and hypotheses,

including Tab 1. However, there seem to be some inconsistencies (not all numbers correspond, pls explain why / why not. I was also wondering if you could also do with less items to reduce complexity. 1. Themes: I would split themes (first step, more objective) from 'dominant frameworks' (additional step, more interpretive). Perhaps the latter in the discussion? "actors with greater visibility" unclear – what do you mean, how do you operationalize? 2. what do you mean by "institutional discourses"? I also feel H2 cannot be known without having done the analysis. 3. "influence" of key actors, "capacity" – these concepts cannot be covered with the indicators mentioned. Rather reframe/ drop!? why no hypothesis? 4. What do you mean by actor profiles? Corresponding indicator in table? Two hypotheses? 5. You talk about 'resources' but also about 'strategies' (table) – revise. V7 – how to measure? On whose perception do you rely and why? V8/9. at this point it remains unclear to the reader how the cluster analysis works and why it is needed. Also, territorial variation appears somewhat out of the blue. Either motivate better in theory or drop it. Again, I'd reduce complexity.
Method: Fig 1 make sure it fully corresponds to Tab 1. Here or elsewhere: I would like to get some information as to what biorefineries do and what impacts they typically have (pos/neg) and why. 2-3 paragraphs!? Can you also provide some figures on how typical articles looked like, how much text (words?) you analyzed, how many themes you identified, how many statements you coded etc. etc. Do you distinguish statements (within each article) from the article as a whole, e.g., when it comes to sentiments. How do you deal with pos and negative statements ("mentions") within one article – neutral sentiment? Fig. 3 – I understand that you count pos/neg sentiment at the article level, how can you relate that then to specific actors. That would only work at a statement level, no? For example, if one article cites an investor highlighting economic benefits and an NGO highlighting problems!? What do you mean by "analysis of specific arguments" (p9) – is that what I mean with statements?
"Case selection" – It is not convincing to depict individual biorefineries as cases because the news analysis takes place at a much higher level of analysis, mostly. I would say your case is bioref in Spain (and within this case there are different plants/locations).
Article selection: pls present a detailed search string / method description so that somebody else could replicate your search.
Overall, I suggest further clarifying the method, adding more detail for what matters most and perhaps leaving out aspects (see theory) that matter less for your main arguments.
Results: In the results section, I had difficulties, following the general line of argumentation, to see the big picture between all details and to understand the structure. I suggest applying the same order as before and to better guide the reader as to how the different sub-sections relate to each other and why they are important.
The CHMET model did not convince me yet. I found the link to the empirical analysis could be strengthened. You introduce 7 objectives, 6 hypothesis, 5 results sections, and 5 axis, which again follow a new way of categorizing. This left me confused. Also, the way the model is presented now, it primarily repeats some selected figures from the results, structure along five "axes" (why axes btw?). Also, if at all, I'd move the model to the discussion.
Discussion: The discussion presents the answers to the hypothesis, instead of critically discussing the results.

Minor comments:
p5 "*most analyses focus on climate change or general renewable energy rather than specific technologies such as biorefineries.*" I disagree, there are numerous studies on wind and biofuels, for example.
"official renewable energy discourse" – reconsider wording, I doubt there is an 'official' discourse,

what would official mean anyway?
"*Taken together, these strands of literature reveal a need for frameworks that combine insights*" – I don't see that need yet
Why is territorial variation now relevant? That was not properly introduced and discussed before.
p7 as of today it is not the "last five years"
"*To assess the predictive capacity of these factors, a binary logistic regression …*" why is prediction necessary – I would rather not go there, offers your article to critical questions you do not necessarily need to address.

Is the work clearly and accurately presented and does it engage with the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

Are all the source data and materials underlying the results available?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Innovation and Transition Studies, Discourse analysis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 28 January 2026

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The article provides a timely, theoretically grounded and methodologically sound analysis of media discourse on biorefineries in Spain. It addresses a spot that is often underexplored in social acceptance literature: while acceptance research has mostly focused on community acceptance and moved from NIMBY considerations toward place-based, justice-oriented and governance-focused understanding of socio-political acceptance, the mediated construction of acceptability and the role of communicative power and media asymmetries is still too often treated as a background rather than a fully constitutive mechanism shaping what is represented as legitimate and therefore acceptance dynamics. The paper ambition connects acceptance literature with political economy of communication and critical theory while proposing an integrative heuristic framework that seems timely and promising. along with an empirical richness in data and transparency of the analytical process.
Mixed-method design is solid, empirical data very rich and analytical process transparent. Results are clearly communicated, showing particularly the imbalance between economic and institutional actors and citizen collectives and how economic framings are normalized as common sense while other frames (environmental, health, justice) are marginalized or conflictual.
At the same time, the paper would benefit from a minor revision to achieve greater conceptual and methodological precision, especially regarding the use of social acceptance concept, the positioning of biorefineries within the broader energy transition and the relationship between discourse and content analysis.

Introduction
The introduction motivates the relevance of the study, linking energy transition to democratic legitimacy and social contestation. It articulates clearly the relevance of biorefineries withing national climate and bioeconomy strategies.
However, the claim that the “social and communicative processes shaping public acceptance remain less understood” would benefit from some recalibration. Over the last two decades a substantial body of research has examined social acceptance and how energy technologies are represented in the media and influence public or socio-political acceptance and debates. While I agree that much research has been done on public acceptance focusing on local level interactions between developers, decision-makers and hosting communities, the paper added value lies in examining how media are being ‘used’ to convey discourses legitimizing or delegitimizing certain sources and technologies and shaping public and political discourses. It provides a solid methodological approach that combine quantitative analysis of texts with more fine-grained discourse analysis and actor positioning to reveal the structural role of media and communicative power in shaping how acceptance and legitimacy are socially constructed and by adopting a polycentric perspective on the process of social acceptance and energy system change (similarly to our research on the phase-out of coal and uptake of renewables in coal regions, Biddau et al., 2024, https://doi.org/10.1007/s11625-023-01420-2 and as suggested by e.g., Devine-Wright et al., 2017 https://doi.org/10.1016/j.enpol.2017.04.020) to analyse multiple societal groups and particularly the influence of incumbent groups. The real strength of the manuscript lies in showing how acceptance may be manufactured or contested and it would be useful to state clearly that the paper does not measure acceptance but rather examines the discourse conditions under

which certain positionings are legitimized or delegitimized. Clarifying these points would sharpen the paper's contribution and avoid the impression of overlooking key strands in acceptance literature and overclaims.

Literature review and conceptual framework

The review of acceptance literature is well referenced, tracing the evolution from individualistic and NIMBY-based explanations toward governance-focused, justice and place-based approaches. The discussion aligns with the original conceptualization of social acceptance by Wüstenhagen et al. (2007) and later refinements that emphasize the socio-political acceptance layer as foundational for public and market acceptance with Wolsink's (2020, https://doi.org/10.1016/j.rser.2020.109841).

Given the ambitions of the paper, this section could more explicitly engaged with recognitional justice, meaning whose concerns, knowledge, and frames are treated as legitimate within dominant media narratives.

The sections on political economy, media power and critical theory are among the strongest part in the paper. The engagement with Gramsci's theory on cultural hegemony, Fraser, and Habermas' work is coherent and well suited with the notion of counterpublics.

Objective, hypotheses, and methods

The objective of the study are clearly stated and logically structured covering themes, sentiment, actors, arguments and communicative strategies along with geographical differentiation. The methodological section is detailed, transparent and carefully designed.

However, while the paper refers frequently to discourse and critical discourse analysis, it remains somewhat unclear how (critical) discourse analysis is understood and operationalized in analytical terms. Discourse and critical discourse analysis are umbrella terms that encompass a wide range of analytical devices and traditions (e.g., discourse repertoires, storylines and actor coalitions, actor positionings, rhetorical devices, etc.). If discourse analysis is intended as an interpretative plot informing the coding and synthesis of results this should be stated explicitly. Given the article overall approach, I suggest engaging more with the discourse analysis literature and clarifying if and how your approach resonates with Hajer's argumentative discourse analysis – a key approach focusing emphasizing storylines and discourse coalitions and the role of power, subject positions and the production of meaning (see also, Buschmann, P., & Oels, A. (2019); Biddau et al., 2024). Alternatively, specify the discoursive elements and dynamics (legitimation strategies, framing of risks and benefits, etc.) that are key to the analysis of "arguments dominating public narratives". I see the value of Table 1 but it resonates more with a qualitative content or thematic discourse analysis using variables and indicators as sensitizing concepts for bottom-up coding than critical discourse analysis itself.

Findings

Findings are clearly presented and supported by solid analyses. Sentiment and perception analysis are greatly presented as the visualization helps clearly convey how diverse actors mobilize specific arguments and whether these are associated with positive or negative sentiments. The distinction between actor groups and their dominant framings is convincing, although it raises important interpretative questions: is there such a clear distinction that citizen groups perceive negatively the facilities and mainly report environmental and health concerns? While this pattern sounds plausible in media discourse, it would be appropriate clarify what this could reflect (e.g., selective visibility of conflict-driven narratives in media coverage).

The geographical patterns are also interesting, though not entirely surprising. The finding that urban contexts display more positive sentiments than rural ones aligns with place-based literature

showing suggesting industrial facilities like energy technologies may be perceived as unfitting or out of place in rural landscapes that are often essentialized as natural and uncontaminated (see e.g., Batel, 2015 https://doi.org/10.1016/j.jenvp.2015.10.004).
On the other hand, the findings on regional differences in communication strategies are particularly interesting and would merit brief contextualization, e.g., in terms of economic structure, energy dependence or environmental problems as this could further strengthen the explanatory power of results: "*Autonomous communities with greater positive coverage, such as the Canary Islands (93.3% positive) and the Basque Country (83.3% positive), predominantly employ economic development arguments, while regions with a stronger presence of critical narratives, such as Madrid (72.7% negative) and Cantabria (80.0% negative)*" and that " *Coverage in regions with higher positive sentiment predominantly uses economic development arguments ($\chi2 = 59.359$, $p < 0.001$), while critical regions more frequently highlight environmental and health concerns ($\chi2 = 80.805$, $p < 0.001$).*"
Could you contextualize these findings in terms of economic development and environmental problems of these areas? I would assume that, for example, Canary islands need to diversity their energy supply and economy and that pollution/air quality are a minor issue compared to areas like Madrid.
The analysis of actors and polarization convincingly reveals the dominance of business and institutions as an hegemonic coalition, in line with political economy perspectives on socio-technical regime dynamics. This aligns with Geels (2014 https://doi.org/10.1177/0263276414531627) argument that firms, industries and governments often tend to form alliances because of a mutual dependence (e.g., economic groups depend on regulation and governance structures prepared by governments, while the latter depend on industrial investments, to ensure the security of energy supplies, jobs, economic development and so on).
The cluster analysis is an effective synthesis tool and the identified profiles seem coherent and meaningful. These closely resemble storylines and discourse coalitions from argumentative discourse analysis approach, and making this conceptual link explicit would further strengthen the connection with critical discourse analysis.
Finally, the proposed conceptual framework represents an original and valuable contribution. To further strengthen its value, it would be helpful to clarify its scope and epistemic value as a heuristic framework for analysing communicative conditions under which legitimacy and acceptability preconditions are socially constructed and mediated..
Final remarks
Overall, this is definitely a high quality manuscript providing rich empirical evidence and a solid conceptual and methodological contribution to critical energy social research on social acceptance and public discourse.

Is the work clearly and accurately presented and does it engage with the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

Are all the source data and materials underlying the results available?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Social acceptance, energy transitions, environmental conflicts, public discourse, discourse analysis, quantitative analysis of texts

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.