

Stakeholder Perspectives on the Revision of the EU Tobacco Products Directive: A Census-Level Thematic Analysis of a Public Consultation using a Large Language Model

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Research Article

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Additional Declarations: Competing interest reported. KF is a research associate at the Smoking Behavior Research Unit of the University of West Attica and a post-doc researcher at the Laboratory for Molecular Biology and Immunology of the University of Patras in Greece. He reports no COI for tobacco cigarettes, e-cigarettes, snus and heated tobacco products. During 2025, he consulted and contributed to the development of research protocols for an independent manufacturer exclusively producing nicotine pouches.

Abstract

Background: The European Commission's 2026 "call for evidence" on revising EU tobacco product and advertising rules drew unprecedented engagement. This study analyzed the attached documents containing the most substantive technical evidence.

Methods: A census-level analysis of 682 policy-relevant technical submissions (684 of 693 retrieved; 2 excluded as irrelevant) was performed using large language model (LLM)-based computational content analysis (NVIDIA Nemotron-3-Ultra-550B). A three-stage inductive-deductive pipeline generated a neutral 9-pillar taxonomy and mapped thematic presence and stance on tobacco harm reduction (THR) and regulation across all submissions.

Results: Evidence-Based Governance & Scientific Rigor (73.2%) and Harm Reduction & Risk-Proportionate Regulation (65.5%) were the most prevalent pillars, followed by Product Innovation, Characterization & Consumer Information (61.4%) and Market Integrity, Illicit Trade & Enforcement Capacity (60.1%). Nearly half (48.7%) of respondents were pro-THR, 37.1% neutral, and 14.2% anti-THR; 80.4% favored regulatory flexibility versus 15.8% favoring stricter rules. Roughly half of Public Authorities and NGOs were anti-THR, whereas most Consumer Organizations (85.7%), EU/non-EU citizens (66.4-69.4%), Academic/Research Institutions (59.1%), and nearly all scientist/healthcare-professional citizens (90.2%) were pro-THR. Manual validation of LLM-determined THR stance (n=68, 10%) showed excellent accuracy (Cohen's kappa = 0.952; F1: 0.95-1.00).

Conclusions: The consultation revealed a predominant call for regulatory flexibility and substantial THR support. This challenges the perceived political consensus for precautionary restriction in the EU, though the sample is not representative of the population or of the full, largely short-form submissions. LLM-driven pipelines can transform policy evaluation, mapping complex stakeholder evidence at scale and ensuring technical expertise is systematically represented in the legislative process.

Introduction

The regulation of tobacco and nicotine products in the European Union (EU) is primarily governed by the Tobacco Products Directive (TPD) 2014/40/EU, which established comprehensive rules for the manufacture, presentation, and sale of tobacco and related products [1]. In alignment with "Europe's Beating Cancer Plan", the European Commission has set an ambitious goal to create a "Tobacco-Free Generation", aiming for less than 5% of the population using tobacco by 2040 [2]. To achieve this, the Commission is currently evaluating the existing legislative framework, including the Tobacco Taxation Directive. Proposed revisions include significantly increased minimum excise duties and the introduction of new tax categories for novel products, such as electronic cigarettes and heated tobacco products, to harmonize the market and discourage youth uptake [3].

Public consultations are a fundamental component of the EU's "Better Regulation" framework, designed to enhance the transparency and legitimacy of the policy-making process. As outlined in the Commission's 2021 Communication on Better Regulation, these consultations are essential for "joining forces to make better laws" by gathering evidence from a broad spectrum of stakeholders, including citizens, health organizations, and economic operators [4]. Beyond mere data collection, these consultations serve as critical instruments for both gathering technical expertise and building political support for EU decisions [5]. Historically, these processes have been pivotal in shaping tobacco control, providing a platform for stakeholders to present technical data and socio-economic arguments that inform the Commission's impact assessments.

Between May 18 and June 15, 2026, the European Commission launched a "Call for Evidence" titled "Tobacco products and tobacco advertising – revision of EU rules" [6]. This consultation sought to gather feedback on the effectiveness of the current legislative framework and the necessity for stricter measures. The scale of public engagement was unprecedented, yielding a total of 82,168 feedback submissions. A significant technical constraint of the EU's portal is the 4,000-character limit for direct text-box submissions. This limitation often prevents respondents from providing detailed scientific evidence, extensive legal reasoning, or comprehensive data sets within the primary submission form. Consequently, stakeholders who wish to provide more rigorous or detailed arguments frequently utilize the option to upload supplementary documents, usually as pdf attachments.

Because these attachments are not bound by the character limit, they are expected to contain the most substantive evidence and nuanced positions of the respondents, offering a depth of detail that short text submissions cannot accommodate. This study provides a systematic analysis of the themes addressed in the pdf attachments submitted during the 2026 consultation and evaluates stakeholder positions regarding tobacco harm reduction (THR) and their preferred direction for future regulatory policy.

Methods

Data Acquisition and Computational Processing

Primary data were retrieved from the European Commission's "Have Your Say" portal, specifically the public consultation regarding the revision of the legislative framework for tobacco control (Initiative ID: 17612) [6]. An automated computational pipeline was developed in Python (version 3.11) to interface with the Commission's official Application Programming Interface (API). Data acquisition was finalized on June 22, 2026.

The study systematically indexed 80,159 unique submissions. For each entry, the pipeline captured a comprehensive metadata profile comprising unique Feedback IDs, respondent types (stakeholder categorization), country of origin and submission language.

This algorithmic collection method adheres to established "text-as-data" frameworks, providing a robust empirical basis for analyzing digital political participation and regulatory lobbying in the public health sphere [7, 8].

Processing of Supplemental Technical Evidence

The retrieval module identified 693 supplemental documents (attachments). Of those, 684 files were retrieved (98.7%); nine files were inaccessible due to server-side 404 errors at the source. Two submissions were excluded due to irrelevant content. Therefore, the final analytical census was refined to N = 682 policy-relevant submissions.

The text of all attachments was extracted either automatically (using PyMuPDF library) or manually (**See Supplementary File**). Subsequently, all extracted text underwent a process of lexical linearization [9]. This involved the removal of non-printable control characters and the replacement of newline sequences and carriage returns with single whitespace characters. This preserved the full semantic integrity of submissions while ensuring a uniform data structure for text analysis [10, 11]. Finally, since some submitted attachments included mainly a reference list, I merged the submission text with the attachment text; therefore, both texts were analyzed as one (combined) submission.

Stakeholder Classification

Respondents were stratified according to the taxonomy downloaded by the European Commission portal: Academic research institution, Business association, Company, Consumer Organisation, Environmental Organisation, EU Citizen, Non-Governmental Organization (NGO), Non EU Citizen, Other, Public Authority and Trade union. This classification was utilized to compare the discursive strategies and policy stances across different interest groups, as they were self-reported by each person submitting the comment.

Identification of Scientific and Healthcare Credentials

To provide granular stakeholder stratification, a secondary semantic extraction was performed on all citizen submissions (N = 176). The LLM was utilized to detect explicit self-identification of professional credentials (e.g., MD, PhD, pharmacist, researcher, or scientist). This allowed the study to distinguish between independent professional evidence and personal consumer testimony within the "EU Citizen" and "Non-EU Citizen" categories.

Computational Semantic Analysis

To evaluate the evidence presented across the 684 supplemental attachments, I deployed a computational pipeline programmatically executed in Python and utilizing a Large Language Model (LLM), to move beyond simple keyword frequencies and to systematically extract the underlying discursive framing of the regulatory revision [12]. While traditional unsupervised techniques, such as BERTopic, are effective for identifying lexical clusters, they often lack the cognitive capacity to distinguish between passing keyword mentions and substantive policy argumentation. LLMs have shown to be effective, though not perfect, in topical modeling [13, 14].

For this study, I utilized the NVIDIA Nemotron-3-Ultra-550B-A55B, a transformer-based multilingual model with 550 billion parameters, optimized for complex reasoning tasks [15, 16]. Further details on the model characteristics and the methodology are provided in the **Supplementary File**.

Thematic Pipeline: Discovery, Synthesis, and Mapping

A three-stage analytic framework combining inductive and deductive thematic analysis was employed to ensure that the thematic taxonomy was grounded in the raw data while remaining aligned with established policy frameworks (see **Supplementary File**) [17].

Stage 1 involved stratified inductive thematic discovery, adapting the pattern detection phase of Computational Grounded Theory [18]. The 684 submissions were partitioned into nine batches stratified by stakeholder taxonomy. The LLM was tasked with identifying 10 recurring themes within each batch. Stage 2 involved hierarchical semantic synthesis. The 90 themes from stage 1 were deduplicated and merged into 19 intermediate themes, to ensure thematic parsimony while preserving technical detail [19]. Then, a "human-in-the-loop" refinement was utilized to merge these into 9 definitive master pillars [20]. Stage 3 involved thematic mapping. All submissions were re-analyzed against the finalized taxonomy looking for substantively relevant content, using a specific prompt (**Supplementary File**) [21, 22]. Submissions that addressed the pillar were assigned the binary value of "1", while the rest were assigned with "0".

Zero-Shot Policy Classification

To provide a granular evaluation of the policy positions, I utilized the same LLM as a senior policy analyst to perform zero-shot classification on the linearized corpus. The classification was guided by a structured prompt designed to evaluate two primary dimensions:

1. **Tobacco Harm Reduction (THR) Stance:** Categorized as "anti" (e.g., emphasizing addiction and precautionary risks), "pro" (e.g., supporting cessation through non-combustible alternatives), or "neutral".
2. **Regulatory Stance:** Categorized as "pro-strict (e.g., supporting increased restrictions), "pro-flexible (e.g., supporting risk-proportionate and more "relaxed" frameworks) and neutral.

Validation

A stratified random sample of n=68 submissions (10% of the total number) were manually coded by the author for THR stance, blinded for the classification performed by the LLM. For the thematic validation, the same LLM was used to re-run the 68 submissions using the identical prompt employed in the original census-level thematic mapping. Precision, recall, F1-scores and Cohen's Kappa were employed as measures of the LLM reliability [23]. Further details are provided in the **Supplementary File**.

Furthermore, all submissions IDs which were classified by the model as being citizen-scientists were manually examined to verify that they truly reported their scientific identity into the submitted content.

Statistical analysis

Categorical variables were expressed as number (N) and proportions (%). Comparisons in thematic distribution, THR stance and regulatory stance between stakeholder groups was performed using chi-square tests, with separate analysis using the classification of citizens as scientists vs. non-scientists. A thematic co-occurrence matrix was prepared, to identify the proportion of all submissions that contain a specific pair of themes (global co-occurrence prevalence). All tests were two-tailed, with statistical significance set at $p < 0.05$, and were performed using SPSS v.25 (IBM Corp., Armonk, NY, USA).

Results

Baseline characteristics of the submissions

The baseline characteristics of the submissions are presented in **Table 1**. The mean submission length was 32,849 characters, far exceeding the 4,000-character limit of the standard portal text box. Companies and Business Associations represented 37.3% of the total submission volume. Institutional civil society and research bodies (NGOs and Academic / Research Institutions) contributed 26.5% of the submissions. While individual citizens (EU and Non-EU) accounted for 25.8% of the total sample ($n=176$), with 17.1% of EU citizens and nearly half of all non-EU citizens (47.2%) being self-identified as healthcare professionals or scientists. Geographically, the consultation drew significant engagement from Spain (11.3%), Poland (10.1%), and Italy (8.9%), with participation from a total of 61 countries. English was the primary language of submission (51.2%).

Thematic Prevalence

The prevalence of the nine master pillars is shown in **Table 2**. The structural mapping, showing how the 19 themes were merged into the final 9 master themes, is presented in **Supplementary Figure 1**. Four pillars appeared in more than 60% of all submissions. The most prevalent theme was “Evidence-Based Governance & Scientific Rigor”, identified in 73.2% of the submissions. Closely related was the pillar of “Harm Reduction & Risk-Proportionate Regulation”, present in 65.5% of submissions. This pillar consolidated 43 of the 90 candidate themes that were created during the first stage of the thematic analysis, related to risk-proportionate frameworks with the specific trade-offs regarding flavor regulation and the balance between youth protection and adult access, appeal and cessation. Market-centric concerns were equally prominent, with “Product Innovation, Characterization & Consumer Information” and “Market Integrity, Illicit Trade & Enforcement Capacity” being addressed in approximately 60% of the submissions. “Fiscal Architecture & Economic Impact” was addressed by 31.5% of respondents, merging the themes of taxation policy with broader impacts on competitiveness and rural livelihoods. “Regulatory Harmonization & EU Legal Competence” was a significant theme for 29.3% of the stakeholders, addressing the legal foundations of the revision, including principles of subsidiarity and proportionality, and the prevention of national regulatory fragmentation. “Global Value Chains, Development & Agricultural Livelihoods” (14.2%) captured arguments regarding international trade and the tobacco value chain in outermost regions. “Environmental Sustainability & Product Lifecycle Management” (9.7%) focused on the persistency of waste and environmental obligations. Finally, “Health Equity & Distributional Justice” (7.9%) represented the most specialized pillar, focusing on the socioeconomic disparities in health outcomes.

From the thematic co-occurrence analysis (**Supplementary Table 1**), the most frequent intersection was observed between Evidence-Based Governance & Scientific Rigor and Harm Reduction & Risk-Proportionate Regulation, with 389 submissions addressing both pillars. This reflects a global co-occurrence prevalence of 57.0%. A high degree of connectivity was also identified between Product Innovation, Characterization & Consumer Information and Evidence-Based Governance & Scientific Rigor, occurring in 365 submissions. The coupling between Harm Reduction & Risk-Proportionate Regulation and Product Innovation, Characterization & Consumer Information was found in 50.4% of submissions while the former was also substantially coupled with Market Integrity, Illicit Trade & Enforcement Capacity (40.3%). In general, the vast majority of participants (88.9%) addressed more than one thematic in their submissions, with 46.0% addressing more than three thematic.

Thematic stratification according to stakeholder

The distribution of thematic pillars varied significantly across stakeholder categories (**Table 3** and **Supplementary Figure 2**). Evidence-Based Governance & Scientific Rigor was most prevalent among Academic / Research Institutions (90.9%), Business Associations (81.2%), and NGOs (79.6%). Trade Unions showed the lowest engagement with this technical dimension (22.2%). A similar trend was observed in the Harm Reduction & Risk-Proportionate Regulation pillar. Engagement was highest among Consumer Organizations (92.9%) and EU Citizens (85.0%) and much lower among Trade Unions (11.1%) and Public Authorities (25.0%). Product Innovation, Characterization & Consumer Information reached 100% prevalence among Consumer Organizations. High frequencies were also recorded for NGOs (72.0%) and EU Citizens (70.0%). The lowest prevalence for this theme was found among Public Authorities (41.7%) and Trade Unions (11.1%). Market Integrity, Illicit Trade & Enforcement Capacity was most frequently addressed by Business Associations (87.5%), Companies (72.2%), and Consumer Organizations (71.4%). The lowest hit counts for this pillar were recorded for NGOs (45.2%) and Non-EU Citizens (41.7%). Regarding Fiscal Architecture & Economic Impact, prevalence was higher among Trade Unions (55.6%) and Business Associations (44.8%). Public Authorities (8.3%) and Academic/Research Institutions (22.7%) addressed this pillar at the lowest rates. Regulatory Harmonization & EU Legal Competence was present in 50.0% of submissions from Business Associations and 39.8% of those from NGOs. In contrast, Academic/Research Institutions (10.2%) and Non-EU Citizens (11.1%) recorded the lowest prevalence. For Global Value Chains, Development & Agricultural Livelihoods, the highest prevalence was identified among Trade Unions (44.4%), Other stakeholders (36.1%), and Public Authorities (33.3%).

Consumer Organizations (0.0%) and Academic/Research Institutions (2.3%) exhibited the lowest engagement with this theme. Environmental Sustainability & Product Lifecycle Management was most frequently addressed by NGOs (23.7%) and Consumer Organizations (21.4%). Frequencies were lowest among Non-EU Citizens (2.8%), Academic/Research Institutions (3.4%), and Companies (4.4%). Finally, Health Equity & Distributional Justice was most prevalent in submissions from Consumer Organizations (28.6%), Non-EU Citizens (16.7%), and NGOs (12.9%). This pillar was absent in submissions from Public Authorities and Trade Unions, and recorded at 3.8% among Companies.

Position for THR and regulatory policy

The classification according to the position towards THR and future regulation is presented in **Table 4**. Nearly half of the submissions (48.7%) were favorable to THR, while a minority (14.2%) were classified as anti-THR. Regarding the preferred regulatory framework, a substantial majority (80.4%) had a pro-flexible approach, while 15.8% expressed a pro-strict stance.

There were statistically significant differences in THR stance between stakeholders. The anti-THR stance was primarily concentrated among NGOs (50.5%) and Public Authorities (50.0%). Conversely, this stance was virtually absent among Companies (1.3%) and Business Associations (1.0%). The pro-THR stance was most prevalent among Consumer Organizations (85.7%), followed by Non-EU Citizens (69.4%), EU Citizens (66.4%), and Academic/Research Institutions (59.1%). Notably, while individual Companies were rarely anti-THR, the majority of their submissions were classified as neutral (60.1%), a pattern also observed among Business Associations (53.1%) and particularly Trade Unions (88.9%). Citizens reporting being scientists were predominantly classified as pro-THR (90.2%), with only 4.9% being anti-THR.

Statistically significant differences were also observed regarding regulatory preferences. Support for a pro-strict regulatory framework was most prevalent among Public Authorities (58.3%) and NGOs (54.8%). A pro-flexible regulatory preference reached near-unanimity among Business Associations (95.8%) and Companies (96.2%). High levels of support for flexible frameworks were also identified among Non-EU Citizens (86.1%), Consumer Organizations (85.7%), EU Citizens (81.4%), and Academic/Research Institutions (77.3%). Neutrality regarding regulatory frameworks was highest among Trade Unions (22.2%) and Non-EU Citizens (11.1%). Citizens reporting being scientists were predominantly classified as pro-flexible (92.7%), with only 4.9% being pro-strict.

Validation of the LLM output for THR stance and thematic pillars

The results of the tests performed to validate the model for THR stance and for the thematic pillars are displayed in **Supplementary Tables 2, 3 and 4**. The model achieved near-perfect agreement with manual coding for THR stance (Cohen's kappa = 0.952). Precision and recall were both 1.00 for the anti-THR category. For the pro-THR category, precision was 1.00 and recall was 0.94 (two submissions manually coded as pro-THR were classified as neutral by the LLM; in both cases the position was expressed in only one or two sentences). F1-scores across all three THR categories ranged from 0.95 to 1.00.

Validation of the nine master pillars showed strong overall performance. Cohen's Kappa ranged from 0.49 (Evidence-Based Governance & Scientific Rigor) to 1.00 (Health Equity & Distributional Justice). Four pillars achieved Kappa $\geq$ 0.87, indicating almost perfect agreement. The lowest Kappa (0.49) was observed for Evidence-Based Governance & Scientific Rigor, which had the highest prevalence (76.5% positive in the validation sample). This reflects the well-known prevalence paradox: when the base rate of the positive class is high, chance agreement is inflated and kappa is deflated despite high observed agreement (77.9%) and excellent precision (0.93) [24-26].

All submissions that were flagged by the LLM as being citizens-scientists were manually verified as accurate (100% agreement).

Discussion

The thematic analysis of the 2026 EU Tobacco Products consultation reveals a deeply polarized discursive landscape, characterized by a fundamental clash between technocratic arguments and precautionary regulatory paradigms. The primary conclusion of this study is that the stakeholder debate is not confined to moral or health-based preferences but expands toward a sophisticated and diverse thematology, from scientific rigor, to market dynamics, economic context, legal and environmental aspects. Scientific evidence, harm reduction, product innovation and market dynamics were the themes addressed by the majority of the submissions. Almost half of the submissions expressed a positive stance for THR, while the vast majority supported more flexible (rather than stricter) regulation. Interestingly, both stakeholders who overwhelmingly support THR and those who oppose it addressed similar themes, suggesting a polarized conflict between two competing regulatory approaches. Finally, this research demonstrates the transformative value of utilizing LLMs with massive context windows for policy analysis. Previous studies have used various AI models to analyze social media messages or policy documents [27-29]. To the best of my knowledge, no prior study has applied an LLM with advanced reasoning at census scale to long-form, technical regulatory submissions of the kind analyzed here, nor combined inductive thematic discovery with stance classification and human validation across an entire stakeholder population responding to a policy consultation. By employing a 1-million-token model with advanced reasoning, it was feasible to perform a comprehensive analysis of unstructured, high-volume data—including technical reports of hundreds of pages—that would traditionally remain opaque to researchers due to the prohibitive human labor required for manual coding [14]. This methodology ensures that stakeholder evidence can be systematically integrated into the policy evaluation process rather than being sampled or ignored, a process that has been associated with more success during the decision-making stage for policy formation [30].

A predominant finding was the centrality of scientific evidence as an important argument for all stakeholder groups. Evidence-Based Governance & Scientific Rigor serves as the primary source of authority for both sides of the debate, but it was obviously utilized through a different perspective. For some stakeholders (predominantly academic institutions, citizens, consumer organizations and business associations who were positive for THR), the evidence base was probably used to justify product differentiation based on the "risk continuum" [31]. Conversely, for precautionary-oriented stakeholders

(primarily NGOs and public authorities), the same pillar may have been used to highlight scientific uncertainty and the absence of long-term longitudinal data, as well as concerns about youth use, nicotine risks and perpetuating dependence [32]. Similarly, Harm Reduction & Risk-Proportionate Regulation and Product Innovation, Characterization & Consumer Information could reflect a central tension regarding the "intended use" of nicotine products. Participants supporting THR may frame product variability and innovation (such as flavors and device design) as essential technical components of cessation efficacy for adult smokers. In sharp contrast, anti-THR respondents may frame the same characteristics as "attractiveness strategies" designed to trigger youth initiation and nicotine dependence. This high degree of co-occurrence between innovation and harm reduction themes suggests that policymakers may need to address a fundamental trade-off between adult smoking cessation utility and the prevention of adolescent uptake.

While Market Integrity, Illicit Trade & Enforcement Capacity was the predominant thematic among companies and business associations, a substantial proportion (> 40%) of NGOs and Public authorities also addressed this thematic. Again, this might reflect diverging interpretations. On one side, market-oriented stakeholders may frame illicit trade as a direct causal consequence of regulatory overreach, such as product restrictions or heavy taxes. It may also highlight a widespread skepticism regarding the enforcement feasibility of the planned regulatory measures. This may be justified considering that illicit tobacco trade has historically been a major concern [33], while serious enforcement problems and a growing illicit market for THR products have been observed in Australia [34]. In contrast, NGO and public authority submissions may frame the illicit trade argument itself as a rhetorical industry tactic intended to undermine public health objectives.

The stratification of stakeholders reveals a distinct paradigm gap between NGOs and the broader scientific and consumer community. While NGOs and public authorities remain the primary proponents of a pro-strict regulation and an anti-THR approach, they represent a minority in the overall volume of technical submissions. In contrast, the high level of support for risk-proportionate frameworks among academic institutions, citizens, and industry associations indicates a growing trend for a non-prohibitive approach to nicotine regulation. This suggests that the tobacco-free goal set by the European Commission is being reinterpreted by many stakeholders not as the total elimination of nicotine, but as the elimination of combustion-related harm [35].

The identification of specialized credentials within the citizen category provides a critical new dimension to the interpretation of public consultations. The findings suggest that the "Citizen" stakeholder label is often used as a direct channel for expert scientific and medical feedback, both from within and outside the EU, that bypasses traditional institutional lobbying. The fact that a significant proportion of these respondents are healthcare professionals and researchers—who appear to overwhelmingly support harm reduction and a more flexible regulatory approach—indicates that the "expert-citizen" voice is a vital, yet frequently overlooked, component of digital political participation. The support for THR by academic institution and scientists is noteworthy, considering that major scientific organizations as well as the World Health Organization are strongly objecting the value of THR and raise substantial concerns about potential risks. At the same time, it is expected that citizens and consumer organizations predominantly support THR as users are probably more motivated to prepare submissions. In any case, policymakers should consider this high density of expertise when weighting "citizen" feedback, as it may often contain the same clinical, toxicological and public health rigor as submissions from major research bodies.

Limitations

This study is not without limitations. First, while the analysis focused on the high-effort PDF attachments which contain the most substantive evidence, it did not include the over 80,000 short-form submissions from the general portal. While the latter likely represent a lower level of technical detail, they may contain different thematic trends or different distribution of the themes analyzed herein. Both the attachments and the shorter text submissions come from a self-selected sample of participants, who probably are highly motivated due to their personal or organizational involvement within the subject of tobacco and nicotine regulation. Thus, the views presented in this call for evidence do not represent public consensus. While the model achieved almost perfect agreement with human coding for THR stance and a strong agreement with the LLM re-run for the thematic pillars, no manual validation for other LLM outputs was performed. LLMs remain sensitive to prompt engineering and may still exhibit subtle biases inherent in their training data [36, 37]. Experience with other, smaller models in analyzing the same submissions was disappointing, with large inconsistencies, poor understanding of the submission content and erroneous classification even when viewpoints were clearly presented within the pdfs. Therefore, the choice of the model is crucial for reliable results. Third, the classification of professional credentials relied on explicit self-identification; thus, the true expert density within the citizen sample may be under- or over-estimated. Furthermore, manual verification was performed only in those submissions identified as scientists by the LLM. No manual assessment was performed for potential false negatives. Finally, to better understand the argumentative content, additional correlation analysis should be performed linking the thematic content with the THR and regulatory stance for each stakeholder group. This should be the focus of a dedicated manuscript.

Conclusions

This census-level analysis of 682 technical submissions to the European Commission 2026 tobacco consultation shows that a substantial proportion of the high-effort pdf submissions carried a policy signal that departs from the precautionary framing often assumed to dominate EU tobacco debates. Evidence-based argumentation was near-universal across stakeholder groups. Pro-flexible regulatory positions outnumbered calls for stricter rules by approximately five to one, with support for harm reduction extending well beyond industry to consumer organizations, academic institutions, and self-identified scientist-citizens. A vocal minority centered on NGOs and public authorities framed the same evidence around precaution and youth protection, indicating a conflict between two internally coherent, evidence-invoking paradigms. Methodologically, the near-perfect agreement with manual coding and the strong performance in the thematic re-analysis using the same model and prompt show that an appropriate large-context-window LLM may

perform census-level, policy-relevant analysis to technical submissions previously excluded from consultation analytics due to their volume and length. For the ongoing revision of the EU regulation on tobacco and nicotine products, this record should not be read as evidence of consensus for stricter rules alone. However, it shows that the technical submissions show that risk-proportionate, harm-reduction positions are widely and substantively argued, and discounting them would leave much of the available technical evidence unaddressed in the Commission's impact assessment.

Declarations

Data availability. The dataset is publicly available through Zenodo public repository: Farsalinos, K. (2026). EU Public Consultation - Tobacco products and Advertising public call for evidence 2026 - Attached submissions [Dataset]. Zenodo. <https://doi.org/10.5281/zenodo.21782376>

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Conflict of Interest statement. KF is a research associate at the Smoking Behavior Research Unit of the University of West Attica and a post-doc researcher at the Laboratory for Molecular Biology and Immunology of the University of Patras in Greece. He reports no COI for tobacco cigarettes, e-cigarettes, snus and heated tobacco products. During 2025, he consulted and contributed to the development of research protocols for an independent manufacturer exclusively producing nicotine pouches.

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Tables

Table 1. Baseline characteristics of the 682 submissions analyzed in this study.

Characteristic	N	%
Total Submissions	682	100%
Submission Length (combined text)		
Minimum	196	
Maximum	2879798	
Mean	32849	
Stakeholder Type		
Company	158	23.2
EU citizen	140	20.5
Business association	96	14.1
NGO (Non-governmental organisation)	93	13.6
Academic / research institution	88	12.9
Non-EU Citizen	36	5.3
Other	36	5.3
Consumer Organization	14	2.1
Public authority	12	1.8
Trade union	9	1.3
Scientific / Healthcare Professionals among Citizens		
<i>EU Citizens (n=140)</i>		
Self-identified Scientists/Healthcare Professionals	24	17.1
General Citizens (Non-scientists)	116	82.9
<i>Non-EU Citizens (n=36)</i>		
Self-identified Scientists/Healthcare Professionals	17	47.2
General Citizens (Non-scientists)	19	52.8
Top 7 Countries of Origin		
Spain	77	11.3
Poland	69	10.1
Italy	61	8.9
Belgium	48	7.0
Germany	47	6.9
France	36	5.3
Greece	31	4.6
Other Countries	313	45.9
Submission Language		
English	349	51.2
Spanish	69	10.1
Polish	56	8.2
German	46	6.7
French	32	4.7
Italian	29	4.3
Greek	26	3.8
Other	75	11.0

(1) Scientists were defined by the LLM as EU-citizens and non-EU citizens who explicitly self-identified themselves with professional credentials (e.g., MD, PhD, pharmacist, researcher, or scientist).

Table 2. Prevalence of the 9 main thematics identified by the LLM.

Thematic	N	%
Evidence-Based Governance & Scientific Rigor	499	73.2
Harm Reduction & Risk-Proportionate Regulation	447	65.5
Product Innovation, Characterization & Consumer Information	419	61.4
Market Integrity, Illicit Trade & Enforcement Capacity	410	60.1
Fiscal Architecture & Economic Impact	215	31.5
Regulatory Harmonization & EU Legal Competence	200	29.3
Global Value Chains, Development & Agricultural Livelihoods	97	14.2
Environmental Sustainability & Product Lifecycle Management	66	9.7
Health Equity & Distributional Justice	54	7.9

Table 3. Thematic pillars according to stakeholder classification. Cells show number and proportion. Pearson's chi-square $P = 0.040$ for "Fiscal Architecture & Economic Impact", $P = 0.002$ for "Health Equity & Distributional Justice", $P < 0.001$ for the rest.

	Company	EU citizen	Business association	NGO	Academic / research institution	Non-EU citizen	Other	Consumer organization	Public authority	Trade union
Evidence-Based Governance & Scientific Rigor	88 (55.7)	105 (75.0)	78 (81.2)	74 (79.6)	80 (90.9)	26 (72.2)	27 (75.0)	11 (78.6)	8 (66.7)	2 (22.2)
Harm Reduction & Risk-Proportionate Regulation	80 (50.6)	119 (85.0)	57 (59.4)	63 (67.7)	67 (76.1)	28 (77.8)	16 (44.4)	13 (92.9)	3 (25.0)	1 (11.1)
Product Innovation, Characterization & Consumer Information	94 (59.5)	98 (70.0)	57 (59.4)	67 (72.0)	48 (54.5)	20 (55.6)	15 (41.7)	14 (100.0)	5 (41.7)	1 (11.1)
Market Integrity, Illicit Trade & Enforcement Capacity	114 (72.2)	76 (54.3)	84 (87.5)	42 (45.2)	41 (46.6)	15 (41.7)	19 (52.8)	10 (71.4)	5 (41.7)	4 (44.4)
Fiscal Architecture & Economic Impact	49 (31.0)	43 (30.7)	43 (44.8)	31 (33.3)	20 (22.7)	9 (25.0)	10 (27.8)	4 (28.6)	1 (8.3)	5 (55.6)
Regulatory Harmonization & EU Legal Competence	49 (31.0)	36 (25.7)	48 (50.0)	37 (39.8)	9 (10.2)	4 (11.1)	10 (27.8)	3 (21.4)	3 (25.0)	1 (11.1)
Global Value Chains, Development & Agricultural Livelihoods	30 (19.0)	10 (7.1)	18 (18.8)	9 (9.7)	2 (2.3)	7 (19.4)	13 (36.1)	0 (0.0)	4 (33.3)	4 (44.4)
Environmental Sustainability & Product Lifecycle Management	7 (4.4)	14 (10.0)	8 (8.3)	22 (23.7)	3 (3.4)	1 (2.8)	6 (16.7)	3 (21.4)	2 (16.7)	0 (0.0)
Health Equity & Distributional Justice	6 (3.8)	13 (9.3)	2 (2.1)	12 (12.9)	9 (10.2)	6 (16.7)	2 (5.6)	4 (28.6)	0 (0.0)	0 (0.0)

Table 4. THR and regulatory stances by stakeholder classification.

	THR stance			Regulatory stance		
	Anti	Neutral	Pro	Pro-strict	Neutral	Pro-flexible
Total	97 (14.2)	253 (37.1)	332 (48.7)	108 (15.8)	26 (3.8)	548 (80.4)
Company	2 (1.3)	95 (60.1)	61 (38.6)	2 (1.3)	4 (2.5)	152 (96.2)
EU citizen	18 (12.9)	29 (20.7)	93 (66.4)	20 (14.3)	6 (4.3)	114 (81.4)
Business association	1 (1.0)	51 (53.1)	44 (45.8)	2 (2.1)	2 (2.1)	92 (95.8)
NGO	47 (50.5)	12 (12.9)	34 (36.6)	51 (54.8)	1 (1.1)	41 (44.1)
Academic / research institution	12 (13.6)	24 (27.3)	52 (59.1)	15 (17.0)	5 (5.7)	68 (77.3)
Non-EU citizen	1 (2.8)	10 (27.8)	25 (69.4)	1 (2.8)	4 (11.1)	31 (86.1)
Other	7 (19.4)	18 (50.0)	11 (30.6)	8 (22.2)	2 (5.6)	26 (72.2)
Consumer organization	2 (14.3)	0 (0.0)	12 (85.7)	2 (14.3)	0 (0.0)	12 (85.7)
Public authority	6 (50.0)	6 (50.0)	0 (0.0)	7 (58.3)	0 (0.0)	5 (41.7)
Trade union	1 (11.1)	8 (88.9)	0 (0.0)	0 (0.0)	2 (22.2)	7 (77.8)
Scientists (1)	2 (4.9)	2 (4.9)	37 (90.2)	2 (4.9)	1 (2.4)	38 (92.7)

(1) Scientists were defined by the LLM as EU-citizens and non-EU citizens who explicitly self-identified themselves with professional credentials (e.g., MD, PhD, pharmacist, researcher, or scientist).

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