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Unpacking public support for nuclear energy: A twin conjoint experiment on innovative nuclear fusion and next-generation fission technologies

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ABSTRACT

The transition to sustainable energy systems is a critical priority for European countries. Among the most debated solutions are nuclear technologies, including innovative fusion and next-generation fission power plants. However, public support for these technologies is complex and influenced by a range of factors, including economic considerations, environmental concerns, and perceived social impacts; yet the majority of the studies conducted on these technologies are observational and mono-dimensional. To address this gap, we conduct the first-ever twin conjoint experiment designed to assess public support for both fission and fusion nuclear energy development plans. The conjoint fielded among a highly representative sample of the French, German, Italian, British, Spanish and Polish populations in May 2025. Our results reveal that public preferences for nuclear energy development plans, whether for innovative fusion or next-generation fission technologies, are shaped by place (topos), governance (nomos) and effectiveness (logos) oriented considerations. Respondents slightly favored fusion rather than fission development plans.

1. Introduction

The Russian invasion of Ukraine in 2022, resulting disruption of energy supplies have placed significant and unexpected pressure on Europe's energy system. As Russian gas flows declined sharply, energy prices surged, revealing structural vulnerabilities, particularly in the EU's energy infrastructure. This crisis forced a rapid re-evaluation of Europe's energy dependencies and strategic choices. In response, the European Commission (EC) launched the REPowerEU initiative, designed to fast-track the goals of the European Green Deal and aiming to diversify energy sources, increase energy efficiency, and increasing investment in low-carbon technologies to mitigate the climate related challenges. However, this fast transition has re-opened a controversial debate about which technologies are socially and politically viable. The center of these debates lies on nuclear energy developments, a low carbon, but historically polarizing source of energy to reach the twin goals of energy security and decarbonization. As Burgoon et al. (2022) and Nicoli et al. (2023) argue, energy is no longer viewed solely through a technical or environmental lens, but increasingly as a geopolitical asset, with concerns over sovereignty and climate urgency shaping citizen preferences.

On the one hand, nuclear power is recognized for its capacity to produce stable, large-scale energy without producing direct greenhouse gas emissions. On the other hand, it remains the subject of long-standing public skepticism due to its associations with radioactive waste, long-term storage challenges, large capital costs, safety concerns, and institutional distrust (Pampel, 2011; Sonnberger et al., 2021). Despite strong scientific endorsements of nuclear energy's potential role in climate mitigation, citizens' views still shaped by affective risk perceptions of past disasters (e.g., Three Mile Island, Chernobyl, Fukushima), and mistrust in political and regulatory institutions (Bird et al., 2014; Guo and Ren, 2017). Thus, these high-profile disasters and the health risks linked to radioactive exposure have contributed to Not-In-My-Backyard (NIMBY) reactions, especially when nuclear projects are proposed near residential areas (Bird et al., 2014; Guo and Ren, 2017; Uji et al., 2021).

Although public attitudes toward nuclear energy have been studied extensively, major gaps remain. Much of the existing literature addresses support for nuclear power at a general level, treating it as a uniform object of support or opposition. Research has shown that public opinion is shaped by perceived benefits (e.g., low-carbon energy, energy independence, price stability), perceived risks (e.g., accidents, radiation exposure, waste management), and perceptions of institutional

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competence, particularly trust in governments and regulators to manage those risks (e.g., Stoutenborough et al., 2013; Bird et al., 2014; Guo and Ren, 2017). Yet, to our knowledge, no studies have systematically examined how citizens evaluate different types of project features (e.g., size, location, employment type, governance design, fuel origin, emissions) affect support. In addition, while growing political interest in fusion as a symbol of cleaner, safer, and future-oriented technology (still technically challenging and commercially uncertain), cross-national comparative evidence remains scarce, particularly on how national context shapes these preferences, specifically in difference with next generation fission technology. This study refers innovative nuclear fusion as hypothetical, first-generation grid-connected fusion power plants based on magnetic or inertial confinement concepts, informed by research programs such as ITER for magnetic confinement. These designs remain pre-commercial and represent the fusion technologies most commonly proposed in long-term energy planning. By contrast, next-generation nuclear fission refers to advanced fission reactor concepts, including small modular reactors (SMRs) and related designs, that incorporate enhanced passive safety mechanisms, modular construction, and reduced waste generation relative to conventional large reactors. Thus, understanding how this symbolic distinction shapes public opinion is essential, since governments and international bodies increasingly invest in fusion research as a prospective long-term solution.

To address these gaps, this study moves beyond the largely observational designs of past work and conducts the first multi-country conjoint experiment on nuclear fission energy and nuclear fusion more in detail.[1] Our conjoint experiment focuses on six European countries, France, Germany, Italy, Spain, Poland, and the United Kingdom, which represent diverse nuclear legacies and energy strategies. [2] France continues to invest in both traditional fission and future-oriented fusion technologies, although extreme droughts in 2022 impaired the cooling of reactors, jeopardizing energy security beliefs despite the country's traditionally strong nuclear infrastructure (Plackett, 2022). In contrast, Germany completed its nuclear phase-out, but paradoxically faced energy instability due to its dependence on Russian gas and increased reliance on fossil fuels, raising concerns about both energy independence and carbon lock-in (Wiertz et al., 2023). Meanwhile, Poland, with no operational nuclear capacity to date, is moving toward nuclear development as part of its strategy to exit coal and enhance energy independence. Italy and Spain remain more cautious: both countries maintain a nuclear suspension, though debates around lifetime extensions and energy diversification have re-emerged amid rising prices and shifting public sentiment. While the primary focus of this paper is on public attitudes within the European Union, the United Kingdom is included in the analysis for both substantive and methodological reasons. The UK, although no longer an EU member, maintains deep, institutionalized ties to European energy innovation, particularly in the field of nuclear fusion. This offers valuable insight into whether the legitimacy of EU-led governance models extends beyond membership boundaries, particularly in areas of shared scientific endeavor and energy security. Thus, our study emphasizes not only the national differences in policy directions but also the varying levels of public support, historical experiences, and responses to perceived energy security threats.

The findings offer several key insights. First, we observe, on average and across all designs, a modest but consistent preference for fusion over fission technologies, suggesting that symbolic framing and perceived innovation matter in shaping support. This difference is stronger among respondents who self-report[3] a higher degree of understanding of the difference between fusion and fission, suggesting that information campaigns do indeed play a role in shaping public support for nuclear fusion. Second, place oriented (i.e. topocentric) considerations significantly influence preferences: respondents are more supportive of nuclear projects located farther from their homes and those with smaller plant sizes, highlighting the persistence of NIMBY concerns. Place-oriented considerations, however, are not limited at NIMBY-related concerns but also affect the way people think about the potential economic impact on their territory of these large projects, significantly preferring those projects described as employing primarily scientific (white-collar) staff rather than technical (blue-collar) staff. Third, governance oriented (i.e. nomocentric) design features also matter, though with variation: projects governed at the EU level and those using domestically, or EU-sourced combustibles attract greater support. Yet, joint EU procurement does not consistently boost support, suggesting some uncertainty toward shared control. Finally, effectiveness oriented (i.e. logocentric) considerations strongly shape evaluations: low consumer electricity prices have the largest effect on support, followed by lower CO_2 emissions, while construction cost has a weaker but still positive effect. Overall, the results underscore that public support for nuclear energy is contingent, multidimensional, and responsive to policy design, challenging simplistic assumptions about nuclear attitudes and offering concrete guidance for designing socially acceptable nuclear energy strategies in Europe.

2. Public attitudes toward nuclear energy sources

Public attitudes toward nuclear energy are complex and driven by both its potential role in mitigating climate change and its perceived environmental and safety risks. Thus, this creates a complex landscape of public perception, which shapes heavily by the historical disasters like Chernobyl and Fukushima as they are still vivid in public memory and creates concerns over safety, radioactive waste, environmental damage, and health risks (Bisconti, 2018; Latré et al., 2017; Sonnberger et al., 2021; Pampel, 2011). As a result, scholars find that despite its low-carbon footprint, in particular, nuclear fission, faces significant public resistance across many national contexts (Bohdanowicz et al., 2025; Johnstone and Stirling, 2020; Uji et al., 2021).

In contrast, nuclear fusion has received very little attention in the public opinion literature; when scholars have paid attention to public opinion towards nuclear fusion, they have done so primarily in observational studies (Oltra et al. 2019, 2025; Turcanu et al., 2020; Jones et al., 2019, 2021). Unlike traditional nuclear fission, nuclear fusion is increasingly framed as a cleaner, safer, and innovative solution to future energy demands, yet receives very few scholarly attentions for its public attitudes. Fusion differs from fission by eliminating the risk of meltdown, producing less radioactive waste and relying on more sustainable fuel sources (Fischer et al., 2018; Carayannis et al., 2024). Moreover, nuclear fusion technologies benefit from international scientific collaborations, such as ITER, which foster a public image of strong global cooperation and scientific expertise (Jones et al., 2019, 2021). However, it is important to recognize that fusion's technological pathway remains

[1] Throughout the survey and the paper, we use interchangeably "nuclear fusion" and "fusion energy". In the survey itself, we conducted a mini experiment (see appendix C.2) assessing whether support for "nuclear fusion" was different from "fusion" (without nuclear), finding no statistically significant effect.

[2] The design, conceptualization and experimental hypotheses have been pre-registered on the Open Science Framework pre-registration portal as "Europe's strategic choices survey" of the following pre-registration: https://osf.io/5htws.

[3] In appendix, figure B.2, we provide the distribution of the self-reporting of the difference between nuclear fusion and nuclear fission. About 10 % of the sample believes to know the difference on technical grounds; about 19 % believes they have a non-technical understanding of the difference; about 44 % of the sample knows they are different but would not be able to explain how; and about 27 % did not know they were different. Male and female respondents follow different distributive patterns, with males over-represented in the first category, and females over-represented in the last category.

far more uncertain than that of next-generation fission reactors. While advanced fission designs are already being prototyped or deployed in some countries, fusion remains a long-term, hypothetical technology, with commercial viability unlikely before mid-century. Despite this fundamental asymmetry in technological readiness, fusion carries fewer historical burdens than fission, being largely disconnected from the legacy of disasters like Chernobyl and Fukushima and is increasingly perceived as a future-oriented energy solution (Nicoli et al., 2023). Given that public perceptions are often shaped less by technical feasibility and more by symbolic framings, narratives of risk and safety, and institutional trust, it is plausible that attitudes toward fusion and fission diverge substantially (Bohdanowicz et al., 2025; Nicoli et al., 2023). Accordingly, we argue that ***(H1)*** *respondents confronted with a fusion framing will on average have more positive assessment of policy packages than respondents confronted with a fission framing.*

2.1. Place (topos), governance (nomos), effectiveness (logos) and public support for nuclear energy projects

As mentioned above, while the existing literature has extensively examined public attitudes toward policy initiatives and large-scale infrastructure projects, it has typically addressed different dimensions of concern in isolation. Building on these strands, we argue that people form opinions vis à vis public policy and infrastructural projects which are informed by their motivated reasoning on the grounds of three fundamental concerns: the *topos,* which captures the effects of policy or infrastructure on the place they live in (to be intended both in geographical but also social sense); the *nomos,* which captures the governance, developmental norms and oversight profile of a project or policy and the *logos,* which captures the rational, efficiency and effectiveness-related considerations.[4] We report a full range of pre-registered hypotheses in a dedicated appendix A, where we also discuss in detail their anchorage in the literature; in the following section, we provide a parsimonious overview of our hypothetical framework.

More in detail, place-related considerations capture how local factors influence acceptance of related energy technology. These factors are, overall, expected to play a substantial role, in line with the well-established literature surrounding the so-called “not in my backyard” (NIMBY) phenomenon and the literature on local employment effects of infrastructural investment. We model this topocentric considerations by focusing on three dimensions: proximity, size, and local employment effect. To start with, we expect that proximity will play a fundamental role in determining support or opposition for plant projects. Proximity masks both considerations about local safety, as well as considerations about the impact that large industrial development projects might have on lifestyle disruptions and local property valuation. Hence, we argue that greater distance from residential areas reduces perceived threats to safety and property values. Secondly, and on the same line of reasoning, smaller-scale plants are likely to be perceived as less intrusive, posing lower environmental and safety risks, and are therefore more acceptable to local communities. As discussed in the next sections, we link the plant’s size to the type of technology used. Most individuals would not hold preference per se towards different nuclear fusion technologies but might react differently to plant projects with fundamentally different plant sizes. In turn, it is plausible (although not a necessity, we wish to stress it) that hypothetical fusion plants making use of magnetic confinement technology would be larger than hypothetical fusion plants making use of inertial confinement. Finally, we expect that the quality of local employment creation associated with these infrastructural projects will also play an important role. In particular, we expect that, on average, facilities offering high-skilled, white-collar jobs are likely to be viewed more favorably, as they signal economic upgrading and sustainable employment opportunities rather than dependency on manual, lower-skill labor (see hypotheses **H2a, H2b, H2c**; detailed discussion in Appendix A.1).

Next, governance-related considerations (*nomos*) center on institutional trust, governance legitimacy, and normative alignment. Citizens are more likely to accept high-risk or complex technologies when they perceive the governing institutions as competent, transparent, and independent (e.g., Giacometti et al., 2025), and when they perceive that they contribute not only to material advancement but also to security and international cooperation (see hypotheses H3a–H3e; detailed discussion in Appendix A.2). Thus, we expect citizens tend to prefer projects developed and monitored by supranational or international bodies, such as the European Union or International Atomic Energy Agency (IAEA), over those led by national governments or private actors as these supranational bodies are often perceived as more neutral, technically competent, and less driven by short-term political or commercial interests. Moreover, recent geopolitical developments, including energy security crises and the weaponization of energy supplies, have heightened public sensitivity to fuel origin. As such, projects relying on domestically or EU-sourced fuel are likely to be perceived as more secure, stable, and geopolitically responsible compared to those dependent on external, particularly non-European, supply chains.

Finally, we advance several effectiveness-oriented considerations, we reflect rational, outcome-driven assessments of the project’s economic feasibility and environmental performance (see hypotheses **H4a–H4d;** detailed discussion in Appendix A.3). Among these, we argue that the most salient consideration for the public is the impact on household electricity cost. Energy affordability represents a direct and highly tangible issue for individuals, often outweighing other considerations in shaping support for energy infrastructure projects. While construction costs, especially when funded through public subsidies, also matter, they are generally perceived as a more distant concern compared to monthly utility bills. In addition, environmental concerns, especially in terms of CO_2 emissions, constitutes another crucial element within the logos dimension. However, consistent with prior research (Stokes and Warshaw, 2017), we posit that emissions concerns generally become a decisive factor only when strongly embedded within broader climate action narratives or during moments of heightened climate salience, such as extreme weather events or energy transition debates. In the absence of such contexts, climate-related concerns often play a secondary role relative to more immediate economic considerations. Consequently, we expect that electricity price has the strongest influence on public attitudes toward nuclear energy projects, with construction costs and CO_2 emissions serving as important, but comparatively less dominant, factors. Together, these three variables form the rational, cost-benefit-oriented basis upon which individuals assess the desirability of nuclear energy development projects.

2.2. Subjective knowledge and military application concerns

Public knowledge is often described as crucial in shaping attitudes toward complex, technical, and unfamiliar technologies like nuclear energy. According to the knowledge-deficit model (KDM), low levels of public understanding are associated with heightened perceptions of risk and lower support for new technologies, particularly when technical uncertainty is high (Stoutenborough et al., 2013). In such cases, individuals often rely on heuristics or prior beliefs rather than technical information, which can lead to disproportionate risk perceptions (Slovic, 1987). This dynamic is especially relevant for nuclear fusion, a technology that remains experimental and largely absent from mainstream public discourse. Unlike fission, which is generally well understood, it is deployed in many countries, and it carries a well-known historical burden due to disasters like Chernobyl and Fukushima, fusion is often unfamiliar to the public. It is therefore reasonable to expect that

[4] The terms topos, nomos, and logos originate from classical political theory; for readability, we use their English equivalents, place, governance, and effectiveness factors.

knowledge plays an even more decisive role in shaping support for fusion. Thus, we argue that individuals who report a greater understanding of the differences between nuclear fusion and nuclear fission are better equipped to assess their respective risks and benefits. As a result, we argue that (**H5**), *all else equal, respondents with self-reported understanding of fission/fusion differences will, on average, rate nuclear fusion plans higher than respondents with low or absent self-reported understanding of the differences between nuclear fusion and nuclear fission.*

Furthermore, beyond technical and environmental risks, nuclear energy projects are often entangled with broader security anxieties, particularly regarding the potential military applications of nuclear technology (e.g., Johnstone and Stirling, 2020). In the U.S. context, Baron and Herzog (2020) demonstrate that public attitudes toward nuclear energy and nuclear weapons are tightly interconnected. They identify a stable "nuclear attitude nexus," where individuals who support nuclear weapons for deterrence also tend to support nuclear energy. Conversely, those who associate nuclear technology with destruction or geopolitical instability are generally more skeptical of both. In the European context, however, this relationship is more fragmented. Nuclear energy's ambiguous identity, fluctuating between a symbol of climate solution and a shadow of past conflicts, makes it especially vulnerable to shifts in public sentiment during security crises (Johnstone and Stirling, 2020). Following the 2022 Russian invasion of Ukraine, Onderco et al. (2023) show that public support for nuclear deterrence increased significantly in countries like Germany and the Netherlands. However, this surge reflected heightened fear and threat perceptions, not a generalized support of nuclear technology. Crucially, support for nuclear weapons did not necessarily translate into greater public support for nuclear energy initiatives. Taken together, this suggests that when concerns over the military applications of nuclear research intensify public support for nuclear energy may decline. We therefore argue that (**H6**) *respondents who express higher concern about the potential military applications of nuclear fusion research will show lower levels of* support *for nuclear fusion plans.*

3. Design and fielding of a nuclear fusion/fission conjoint experiment

3.1. Experimental design

As previously discussed, nuclear energy policy encompasses highly complex, multidimensional debates. Therefore, simple questions about support or opposition are insufficient to fully capture nuanced public preferences, particularly when comparing innovative nuclear fusion with next-generation nuclear fission technologies. To address this challenge, recent research employs conjoint experiments, which provide simplified yet detailed representations of complex policy issues (e.g., Burgoon et al., 2022; Beetsma et al., 2021, 2022; Bremer et al., 2021; Nicoli et al., 2023). These studies highlight that public support is significantly shaped by specific policy attributes rather than generalized attitudes toward a policy concept.

Building upon this methodological framework, we designed a novel split-sample conjoint experiment to systematically compare public attitudes toward innovative nuclear fusion and next-generation nuclear fission plants development plans. Specifically, respondents in each country were randomly assigned into two groups, with one group evaluating nuclear fusion development scenarios and the other evaluating nuclear fission development scenarios. This approach allows us to independently analyze how specific policy dimensions influence public preferences while simultaneously exploring whether framing the technology differently (fusion vs. fission) affects levels of support. As shown in Table 1, the two experiments were introduced with nearly identical explanatory texts, varying only slightly in the context-specific details relevant to each technology type. Random assignment ensures respondents are not able to select their preferred domain, thereby providing unbiased exposure to the policy scenarios and enhancing the reliability of our findings.

Table 1
Introductory framing.

Many believe that European countries need to develop innovative energy sources. These may help contain costs and support the energy transition. Among these innovative energy sources, many consider innovative Nuclear Fusion plants.	Many believe that European countries need to develop innovative energy sources. These may help contain costs and support the energy transition. Among these innovative energy sources, many consider Next-Generation Nuclear Fission plants.
While some support nuclear fusion as a source of clean and limitless energy, others believe that it could be too costly and lengthy to develop.	While some support nuclear plants as a source of clean and limitless energy, others believe that it could be too costly and lengthy to develop.
These plans to develop innovative nuclear fusion power plants vary with regard to the scientific development, the construction, and the operations of the powerplant.	These plans to develop next-generation nuclear fission power plants vary with regard to the scientific development, the construction, and the operations of the powerplant.
On the next page, you will see two such alternative plans. Please first indicate which of the two plans you prefer and then how much you support or oppose each of them, regardless of the alternative shown on the next page.	On the next page, you will see two such alternative plans. Please first indicate which of the two plans you prefer and then how much you support or oppose each of them, regardless of the alternative shown on the next page.

As Nicoli et al. (2023) highlight, a key challenge in designing energy policy related survey experiments is keeping a balance among realism, theoretical clarity, and ease of understanding for respondents. This typically involves simplifying complex policy debates into clearly defined dimensions representing ideal-type policy options. Therefore, while multidimensional conjoint experiments offer greater detail compared to single-question surveys, they nevertheless must simplify actual policy discussions to maintain practicality and respondent manageability. A further design consideration concerns the level of technical detail we provided in both the introductory framing and in the wording of the conjoint dimensions. Nuclear fusion and fission involve highly complex engineering concepts that most respondents are not familiar with. In survey experiments, such complexity imposes a high cognitive burden and can produce heuristic answering, and measurement error when respondents struggle to process technical information (e.g., Tourangeau et al., 2000). For this reason, we intentionally simplified, non-technical language that carries the relevant policy trade-offs without requiring expert-level knowledge. This is a standard and recommended practice in conjoint designs preserve internal validity (e.g., Mullinix et al., 2015) and it enhances usability of the task, reduces respondent fatigue, and improves the reliability of expressed preferences.

To address these challenges, conjoint experiments usually limit the number of policy dimensions to between three and six (Beetsma et al., 2021; Vandenbroucke et al., 2018; Burgoon et al., 2022). In our study, we employed nine dimensions grouped into three clusters (development, construction, and operations), with each dimension ranging from two to four levels. This design ensures sufficient statistical power (approximately 80 %) for robust within-country and within-framing analyses (see: Schleusser and Freitag, 2020 for a discussion of power analysis in conjoint experiments).

Table 2 summarizes these experimental dimensions and their levels. Notably, a key issue with developing these types of experiments, especially on technically challenging issues, is to ensure that the cognitive burden for survey respondents remains manageable. For this reason, we opted for anchoring, whenever possible, our experimental dimensions into a language respondents might find familiar, introducing comparisons and associations with things and concepts they are likely to have experience of, even if this implies moderate losses in the scientific precision of the experiment.

The first group of dimensions pertain to development, namely (1) which technology is used in the power plant (which, as discussed, we convey as a proxy for plant size) and (2) whether such technology was

Table 2
Overview of nuclear conjoint experiment dimensions and characteristics.

Hypothesized rationale	Dimensions/Questions	Levels
Dimension 1–2: Development		
Place-oriented	Which technology is used in the power plant?	- The power plant uses magnetic technology; therefore, it will be large in size [fusion framing]. - The power plant uses laser technology; therefore, it will be small in size [fusion framing]. **OR** - The power plant uses standard nuclear technology; therefore, it will be large in size [fission framing]. - The power plant uses modular technology; therefore, it will be small in size [fission framing].
Governance-oriented	Is there international cooperation in the development?	- The technology is developed solely by [RESP_COUNTRY] - The technology is developed as a European effort (e.g. with the EU countries) - The technology is developed as a global effort (e.g. with the US and China)
Dimension 3–4: Construction		
Place-oriented	How close is the powerplant to your home?	- Relatively close: within 20 km or less. - Relatively far: 80 km or more.
Effectiveness-oriented	How much does it cost to build the powerplant?	– 2.5 million € per megawatt (about half as offshore wind farms) – 5 million € per megawatt (about the same as offshore wind farms) – 10 million € per megawatt (about twice as offshore wind farms)
Dimension 5–9: Operations		
Effectiveness-oriented	How much CO_2 emissions does the powerplant produce over its entire life cycle, from production to operations, to recycling?	– 7.5 g CO_2 per kWh (about half as offshore wind farms) – 15 g of CO_2 per kWh (about the same as offshore wind farms) – 30 g CO_2 per kWh (about twice as offshore wind farms)
Effectiveness-oriented	How expensive for consumers is the electricity generated by the powerplant?	– 5 cents per kWh (about half as offshore wind farms) – 10 cent per kWh (about the same as offshore wind farms) – 20 cents per kWh (about twice as offshore wind farms)
Governance-oriented	Where is the nuclear fuel produced?	- The fuel is imported from another continent. - The fuel is imported from another EU country. - The fuel is produced domestically in [RESP_COUNTRY].
Governance-oriented	Who monitors the powerplant's safety?	- A national agency of [RESP_COUNTRY] monitors safety - An EU agency monitors safety - An international agency (e.g., International Atomic Energy Agency (IAEA)) monitors safety. - A private company monitors safety
Place -oriented	What type of workers are hired in the powerplant?	- -Mostly technical staff (e.g., plant operators and maintenance workers) - -Mostly scientific staff (e.g., engineers and physicists)

developed as a national, European, or global effort. In dimension 1, we introduce the only difference between the fission and fusion framings. Respondents under the fusion framing can see plant variations described as *using magnetic technology, and therefore larger in size,* or *using laser technology, and therefore smaller in size.* Similarly, respondents under the fission framing can see plant variations described as using *standard nuclear technology, and therefore larger in size* or using *modular technology, and therefore smaller in size* (see Table 2 for the exact text). We are, of course, aware that while the distinction is straightforward for nuclear fission technology, the relationship between magnetic confinement/ large size and inertial confinement/small size is weaker, albeit plausible. NIF, for instance, is several times smaller than ITER, and even though neither is a commercially operative facility, it is not implausible to assume that the hypothetical first plants in operation, if ever, would reproduce similar patterns.[5] Given this, the technology/size dimension, as discussed, is deemed to respond to place-oriented considerations. The second dimension in this cluster pertains the level of international cooperation development of said technology, namely whether it was developed as a national, European or global effort; it therefore responds to governance-related considerations.

The second cluster of dimensions pertains to the actual construction of the putative nuclear fusion/fission powerplant. Here, we focus on two dimensions: the first pertains to the plant's proximity to residents reflecting potential opposition due to NIMBY concerns, following a topocentric logic. The second dimension in this cluster pertains instead the development costs of the powerplant, which are compared to renewable energy alternatives. It is therefore expected to respond to an efficiency-oriented rationale. The same applies to some of the dimensions in the next cluster, covering the plant's operations. The first two dimensions of the operations cluster evaluates environmental impact (CO_2 emissions) and economic feasibility (electricity costs), directly responding to an efficiency logic. While, in the context of the survey experiment, there is no particular need of providing respondents with realistic numbers, we attempted to provide a direct comparison in development and operation costs with the costs and performance of a well-known renewable generation technology, offshore wind-farms, thus allowing respondents to anchor the meaning of each attribute into something they have an understanding of. In turn, we sourced estimates for construction and installation costs from Rubio-Domingo and Linares (2021), Hill et al. (2024), Lindley et al. (2023), and Beckerman et al. (2020); environmental impact data (in terms of life-cycle CO_2 emissions) from Mohamed et al. (2024); and levelized cost of electricity (LCOE) estimates from Lindley et al. (2023) and Schlömer et al. (2014).

The remaining dimensions of the operations pertain to source security, regulatory oversight (national, EU, or international monitoring), and employment dynamics (technical vs. scientific workforce). Source security is a complex dimension that attempts to model the geopolitical trade-offs associated with energy development plans. Of course, nuclear "fuel" is present in both fission and fusion power plants, although in very different quantities. The geopolitical concerns regarding the origin of materials used in the reaction are, in principle, more pronounced in the case of fission framing. However, such concerns are not entirely absent

[5] The dimension presents however a second vulnerability, since it is a compound dimension: we cannot, ultimately, be certain as of whether the effects are driven by stated size or stated technology per se. This was not a trivial decision to make. On the one hand, we believed that including a dimension on technology was critical. On the other hand, the risk associated with including a dimension on technology on its own was that uninformed respondents – the majority -would have found cognitively too taxing to assess technology on its own merits.

The choice of associating size and technology was therefore made to ensure that even uninformed respondents could associate certain technologies with a plausible factor they could relate with. While we are confident that the results do indeed capture the effect of *size,* the effect of *technology* here is more blurred and conditional on size.

from the fusion framing, at least conceptually, even if they are not currently relevant in practical terms. It is not impossible to visualize a future, for instance, where only some countries produce at scale the Deuterium-Tritium pellets to be used in inertial confinement facilities, or have access to hypothetical Helium-3 mining facilities on the Moon. Regardless, the goal of this dimension is to capture the geopolitical implications associated with the energy source discussed, and respondents are expected to follow a governance related logic when considering these dimensions. The same applies for the dimension capturing safety oversight, which we model as private, national, European or global, while – finally – we expect respondents follow a place-oriented logic when assessing the local employment effects of building the new power plants.

3.2. Fielding of the survey

The experiment was fielded in the first module of the fourth wave of a multi-year panel survey, "European Strategic Choices," designed to explore European citizens' attitudes toward strategic policy choices across several policy domains (see Nicoli et al., 2023 for an earlier application to energy security issues). The previous waves were conducted in Germany (DE), France (FR), the Netherlands (NL), Italy (IT), and Spain (ES) in March 2020 (wave 1), July 2020 (wave 2), and November–December 2022 (wave 3). The fourth wave expands the country pool by including the United Kingdom (UK) and Poland (PL). The distribution of respondents by country in the conjoint experiment is presented in Appendix Table B.1. Data collection was conducted in April–May 2025 in all six countries by the firm IPSOS.

Country selection is strategically guided primarily by the needs of the nuclear conjoint experiment. France is included as Europe's primary user of nuclear energy and as host of the ITER experimental fusion reactor. Spain is chosen due to its relevance to nuclear discussions despite limited fusion investments. Germany provides insight as a country actively phasing out nuclear energy despite strong fusion research initiatives, notably in stellarator technology. Poland represents a contrasting case as a nation recently initiating nuclear power development. Italy, which abandoned nuclear power decades ago yet continues to debate its revival, provides insights into changing public attitudes. Finally, the UK is selected as a prominent nuclear power with substantial investment and expertise in nuclear fusion technology, and a long history in the development of such technology.

The sample ensures representativeness across four primary quotas: regional distribution (based on NUTS 1 regions), education level (categorized into low, middle, and high from ISCED 8 categories), gender, and age groups. Additionally, IPSOS employs soft quotas for income levels (low, middle, high) and professional categories (10 distinct categories) but does not condition the completion of fieldwork on meeting these quotas. The large sample size per country ensures sufficient statistical power for robust analysis within each experimental setup. Therefore, with this strategically designed sampling and the rigorous conjoint experimental approach, we aim to generate insights to inform European policy discussions on nuclear energy and the factors shaping public support across diverse national contexts.

In each country, a representative sample of 1500 respondents was obtained from citizens enrolled in IPSOS Access Panels. Respondents were then randomly assigned to either the Fusion Conjoint or the Fission Conjoint, resulting in 750 respondents per experiment. With each respondent evaluating six policy packages in total, the effective sample size per conjoint analysis amounted to 27000 assessed packages in each branch. Each respondent, regardless of the assigned conjoint module, was provided with an introductory text describing the relevant nuclear energy technology. They were then presented with pairs of randomly generated policy packages displayed side by side. Each policy package was constructed using predefined dimensions, with specific levels that randomly assigned to each dimension (see Table 2 for details). The order of the dimensions was randomized at the respondent level to avoid ordering biases; every respondent saw a different order, but such order remained constant for each respondent across the three iterations of the experiment.

Thus, respondents were confronted with two randomly generated policy packages at a time and completed three tasks: (1) which of the two nuclear development plans they preferred, (2) they rated each package individually on a 5-point Likert scale ranging from "strongly against" to "strongly favor," generating a proposal rating variable, and (3) they answered follow-up questions for the second proposal how much they favor it compared to the first proposal. Each respondent repeated the experiment three times, evaluating a total of six policy packages. An illustration of how the experiment appeared to respondents is provided in Appendix B.1.

3.3. Analytical strategy

Given that respondents evaluate multiple packages and their individual characteristics (e.g., ideology, sociodemographic, etc.) remain constant across all package evaluations, we account for within-respondent correlation by clustering standard errors at the respondent level. This randomized, experimental design enables us to identify causal effects of specific nuclear development policy features on individual preferences. Thus, we begin our analysis by estimating experimental OLS regressions for each experiment group (fusion and fission framing) separately, where the dependent variable is package choice or package rating. The key independent variables are the randomly assigned levels of each policy dimension in the conjoint design. This setup enables us to estimate the causal effect of each individual policy feature on the likelihood of a package being chosen, comparatively for both the fission and fusion energy experiments.

To facilitate interpretation of the conjoint results, we report both Average Marginal Component Effects (AMCEs) and Marginal Means (MMs) because they capture distinct but complementary aspects of public preferences. While AMCEs identify the causal effect of switching an attribute from its baseline to an alternative level while holding all other attributes constant (Hainmueller et al., 2014), they are sensitive to the choice of the reference category, which can complicate interpretation, particularly in subgroup analyses where baselines may differ (Leeper et al., 2020). MMs, by contrast, provide the absolute probability that a profile containing a given attribute level is chosen, averaging over all other dimensions. Therefore, it offer a more intuitive, baseline-free summary of support for each attribute level and are especially useful for communicating substantive patterns across complex designs. Reporting both metrics follows best practice in conjoint analysis and ensures us to understand both the causal structure of attribute effects (via AMCEs) and the overall desirability of each attribute level (via MMs).

In addition, to compare preferences between fusion and fission nuclear development scenarios, we estimate a pooled model that includes all respondents, regardless of framing. In this specification, we interact each policy dimension with an indicator for the framing condition. These interaction terms allow us to assess whether the effect of each policy attribute differs significantly depending on whether the package was framed as a fusion or fission development plan. All results presented in the next sections are based on these two model specifications.

4. Results

4.1. Descriptive results

We first present the average levels of support, neutrality and opposition towards nuclear energy policy packages, aggregated across all scenarios and irrespective of the specific policy attributes presented in the conjoint experiment. As can be seen in Fig. 1, while respondents predominantly exhibit neutral or favorable attitudes, with approximately above 40 %, explicit opposition is significantly less dominant,

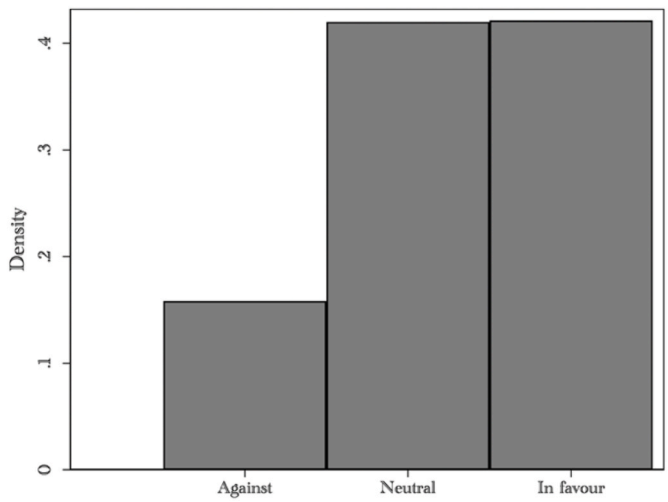

Fig. 1. Average levels of support: Share of packages supported or opposed.

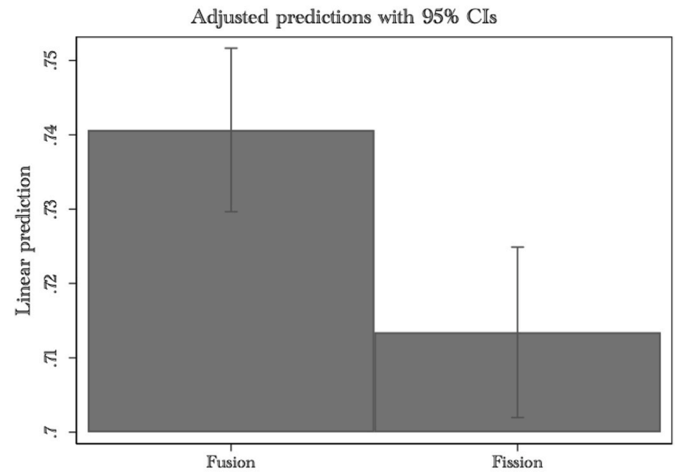

Fig. 2. Levels of support, independent of policy details.

only for about 15 % of total responses. This shows that most respondents did not reveal strong opposition to nuclear technology development plans. However, the substantial proportion of neutral respondents highlights the importance of careful consideration of specific policy attributes that could shift respondents from neutrality to explicit support or opposition.

Therefore, to capture the depth of public opposition to nuclear energy development, Appendix figure B.3 shows the percentage of respondents who rejected a given number of packages out of the six they evaluated. The results show that 60 % of respondents did not reject any of the six proposed packages, while only 3.8 % rejected all indicating that most respondents found at least some nuclear energy scenarios acceptable. Intermediate levels of rejection were also visible, with 14.7 % rejecting just one package and roughly 10 % rejecting two or three. Yet, fewer than 5 % of respondents rejected five or more packages. This pattern suggests that public attitudes are generally flexible rather than rigidly opposed, with the number of rejections serving as a proxy for the degree of constraining dissensus (Hooghe and Marks, 2009).

4.2. *Framing effects: fusion vs. fission*

Second, to begin the empirical analysis, we estimate a simple regression on the level of program support. This measure is calculated as the proportion of policy packages supported out of the total number of packages evaluated, excluding those that received a neutral rating. At this stage, we isolate the effect of technological framing by focusing solely on whether the plans pertain to fusion or fission energy development, without incorporating any of the detailed policy dimensions included in the conjoint design. The results support our expectations. We argued that as the nuclear fusion is often symbolically framed as a future-oriented and innovative response to climate and energy crises, it is associated with reduced long-term environmental risks, the absence of meltdown potential, and lower radioactive waste levels compared to traditional nuclear fission technologies. In contrast, nuclear fission continues to carry historical and emotional associations with large scale disasters like Chernobyl and Fukushima. Despite fusion not yet being commercially available, its reputation as a "clean" and "next generation" technology is expected to positively shape public attitudes, as we discussed in H1.

While both fusion and fission technologies receive robust levels of support, there is a small but consistent and statistically significant difference between them. In Fig. 2, we estimate the level of support for fission and for fusion projects, regardless of their specific policy content, using as dependent variable a transformation of *package rating* (where respondents indicate whether they support or oppose a specific package) that excludes neutral evaluations, pitching positive evaluations against negative ones. As shown, nuclear fusion receives an average level of support of approximately 73.5 %, while nuclear fission reaches 71.5 %. Although the difference is modest, the results align with the theoretical assumption that fusion carries more favorable perceptions (H1).

In addition, we explore whether the framing effect identified in H1 holds consistently across countries. Fig. 3 shows that the difference between fusion and fission development plans varies notably across national contexts. In Italy and Germany, fusion receives significantly higher predicted support than fission, suggesting a clear framing effect. This suggests that the symbolic appeal of fusion is especially potent in these contexts might be due to Germany's post-Fukushima phase-out or Italy's decades-long suspension of nuclear projects. In contrast, countries like France, Poland, and the UK exhibit similar support levels across both technologies, indicating that the fusion advantage is not uniform across all national samples. Interestingly, Spain shows a modest preference for fusion but indicating limited robustness.

4.3. *Treatment effects: experimental results*

Next, we turn to the assessment of our hypotheses modeling place, governance, and effectiveness-oriented considerations, by comparing the Average Marginal Component Effects (AMCEs) of relevant policy attributes across the conjoint experiments (see Figs. 4a-4b). In this analysis, we use package choice as the dependent variable, which offers a clearer measure of preference than subjective ratings. Results from OLS regressions, here, can be interpreted as the change in probability *causally determined* by certain feature in a dimension, vis à vis the baseline feature of that dimension, keeping all other policy dimensions fixed at their average level (see Hainmueller et al., 2014; Bansak et al., 2023 for full derivation of the causal properties of conjoint experiments). We control the package ordering as respondents exhibit a "learning effect" when exposed to multiple iterations of the experiment (e.g. Nicoli et al., 2023; Burgoon et al., 2022; Beetsma et al., 2021, 2022). We also restrict the analysis to those who passed an attention check and address the non-independence of repeated evaluations by the same individual, standard errors are clustered at the respondent level. In addition to reporting AMCEs, which quantify how switching a given attribute from its baseline level changes the likelihood of choosing that package, we also present Marginal Means (MMs), which reflect the average probability that a package containing each specific level is chosen when all other features are drawn at random. We present these results by framing (fission or fusion), even though the differences in attribute effects are minimal. These results are displayed in Fig. 4a (average marginal component effects) and 4.2 (marginal means). Finally, in appendix C.1 we report results by country, for fission and

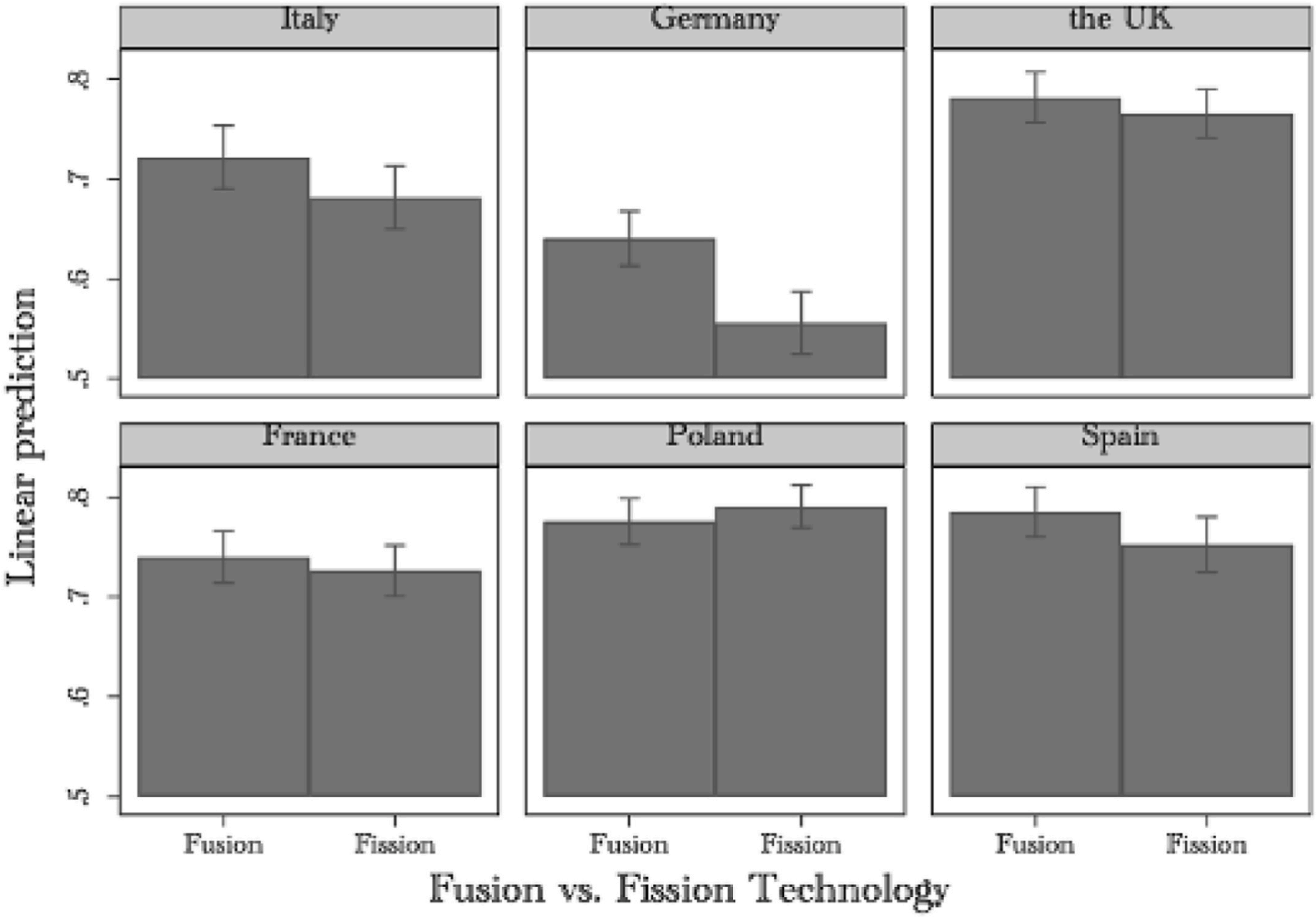

Fig. 3. Levels of support by country, independent of policy details.

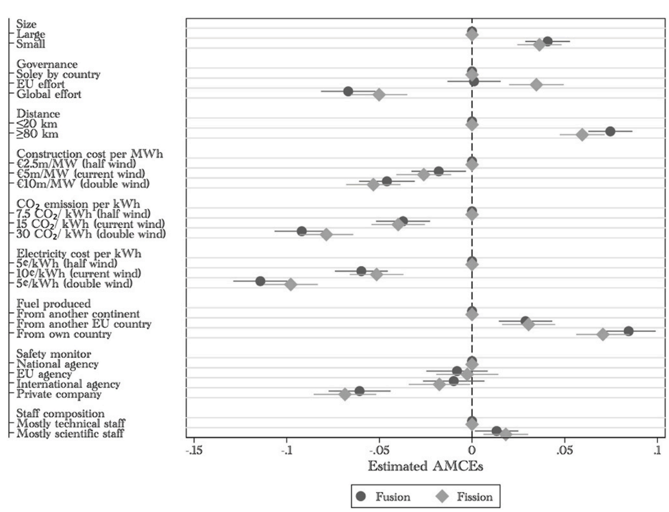

Fig. 4a. Effects of dimensions on support for nuclear development plans: AMCEs with 95 % CIs.

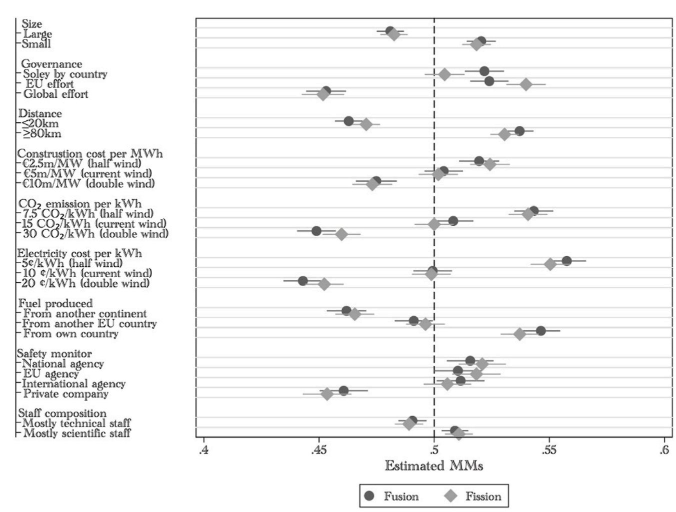

Fig. 4b. Substantive importance of nuclear policy attributes: Marginal Means with 95 % CIs.

fusion separately.

We begin by focusing on place considerations, which we captured in hypotheses 2a-2c. As shown in Fig. 4a, on average, smaller plants are significantly more likely to be chosen than larger ones, in line with our expectations (H2a). This suggests that perceived benefits of smaller-scale installations such as reduced environmental impact, easier local integration, and quicker deployment, play an important role in shaping preferences. The size effect is consistent across both fusion and fission framings (Fig. 4a). Yet, as expected, not only size but also proximity matters; in fact, as displayed in Figs. 4a and 4b, proximity plays a more important role than size. The results support our expectation that plant proximity triggers a NIMBY response (H2b). On average, power plants located further from the respondent's home (80 km or more) are substantially more likely to be supported than those situated closer (within 20 km), as shown in Figs. 4a and b. The proximity effect is also consistent across both fusion and fission framings, although the patterns vary slightly: the fission framing shows slightly higher support for nearby plants compared to fusion, while the opposite is true for more distant plants. This finding reflects the ongoing influence of perceived personal risk and landscape disruption in public attitudes toward nuclear infrastructure. In addition to these findings, we also observe a clear preference for scientifically oriented projects employing primarily engineers and physicists over projects emphasizing technical or maintenance staff, supporting our H2c, even though these effects are substantively smaller. As illustrated in Fig. 4a, packages featuring a predominantly scientific workforce receive slightly higher levels of support on average. This suggests that the public may associate such staffing profiles with greater prestige, enhanced safety standards, or more promising local development opportunities. This effect is consistent across both fusion and fission framings, although slightly stronger under the fission condition.

Next, we examine the AMCEs for our third hypothesis series, the influence of governance-related attributes on public preferences for nuclear development plans. As shown in Fig. 4a, the results support the view that governance design and geopolitical context shape public preferences for nuclear energy development. More specifically, our findings demonstrate that fission development plans with a European R&D are, on average, preferred over national or global ones (H3a), while the Europeanisation of the development effort seems to play no role in determining public support in fusion plans. This is a striking and unexpected result, in contrast with our pre-registered hypothesis (H3a), not last given the size of the difference, which is highly statistically significant. One possibility is that this may be due to the historical association of fission with higher perceived risks and past accidents, which makes it more reliant on the reassurances and collective oversight provided by European-level development and governance. By contrast, fusion already benefits from the international legitimacy and institutional backing of the ITER project, which may reduce the added value of EU-level involvement in shaping public support.

In general, in countries where fission remains politically sensitive, an EU framing might also help depoliticize the issue by presenting it as a technocratic or consensus-based initiative rather than a nationally contested one. By contrast, global development cooperations of these plans significantly reduces support on average and across both framings, as in line with H3a. This suggests that broad international collaboration may raise geopolitical concerns or dilute perceived project accountability, thus European cooperation is preferred to international cooperation, even though – at least in the case of fusion – European cooperation remains undistinguishable from nationally-developed plans.

Regarding supervision and operational governance, the results provide partial support for H3b. As expected, private supervision was strongly disfavored. A similar pattern emerges in cross-national work on fusion governance, where private leadership is viewed with caution (Giacometti et al., 2025). However, there was no significant preference for the EU or international agency compared to national control. In contrast, preferences regarding the source of nuclear fuel show a clear pattern: the public support closer and politically aligned fuel sourcing. In line with our expectation (H3c), respondents preferred fuel sourced domestically or from other EU countries over non-European sourcing. It can be seen from Fig. 4a; domestic fuel sourcing elicits the strongest positive response across both fusion and fission framings. This aligns with recent experiences of energy insecurity and heightened sensitivity to strategic autonomy, particularly in the wake of the 2022 Russian invasion of Ukraine as the war triggered a profound energy crisis across Europe, exposing the risks of overreliance on external especially non-European energy suppliers.

Finally, we examined Hypothesis group 4, whether public support for nuclear power plants is shaped by the perceptions of effectiveness across three key operational metrics: construction cost (H4a), electricity price to the consumers (H4b), and CO_2 emissions (H4c). This series also further investigates whether electricity price, representing consumer affordability, has a stronger impact than the other two factors (H4d). The results presented in Fig. 4a clearly support our expectations.

Specifically, as expected, higher construction costs significantly reduce the likelihood of a package being chosen (H4a). Projects with a cost of 5 million EUR per megawatt (comparable to offshore wind) are less preferred than cheaper ones, and support declines even further when costs rise to 10 million EUR per megawatt (see Fig. 4a). This negative effect is consistent across both fusion and fission frames. In addition, as predicted, higher electricity costs to the consumer result in significantly lower support (H4b). Packages priced at 10 cents per kWh and especially 20 cents per kWh see strong drops in support on average (Fig. 4a). These results are substantial and highly consistent, confirming that affordability to consumers is a primary driver of public approval regardless of fusion or fission framing. However, affordability is not the only concern. As predicted by H4c, respondents are also sensitive to the environmental impact of energy generation. Support declines as CO_2 emissions rise, indicating that perceived sustainability plays a clear role in shaping preferences and remains an important criterion in public evaluations of nuclear energy, regardless of the nuclear fusion or fission energy.

Most notably, electricity price exerts the strongest influence among the three metrics, as anticipated (H4d). The drop-in support from the cheapest to most expensive electricity option exceeds the effect sizes for either cost of construction or CO_2 emissions. This confirms H4d and suggests that consumer-side affordability outweighs environmental or fiscal considerations in shaping public judgments towards nuclear development plans.

4.4. Heterogenous effects

Before concluding, it is worth exploring how overall support for fusion projects in particular is modulated by the level of knowledge of the difference between fusion and fission, and by concerns with the weaponization of fusion research. To do so, we concentrate on those respondents who received a fusion framing, and we abstract from the individual dimensions of the experiment to look at how overall support levels vary depending on self-reported level of knowledge (Fig. 5) and self-reported concern with weaponization of nuclear fusion research (Fig. 6). For clarity, we use in both estimates a conservative transformation of the rating variable, whereby respondents who are against or neutral a certain package is coded as against, and respondents who favor are coded as in favor.

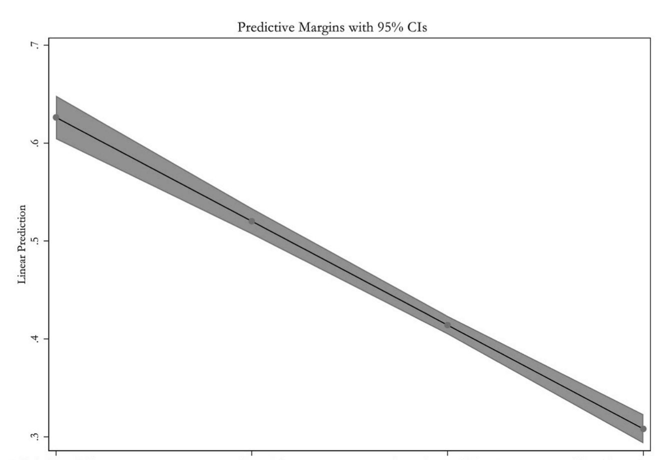

Fig. 5. Support for nuclear fusion plans at levels of individual self-reported knowledge, with 95 % confidence intervals.

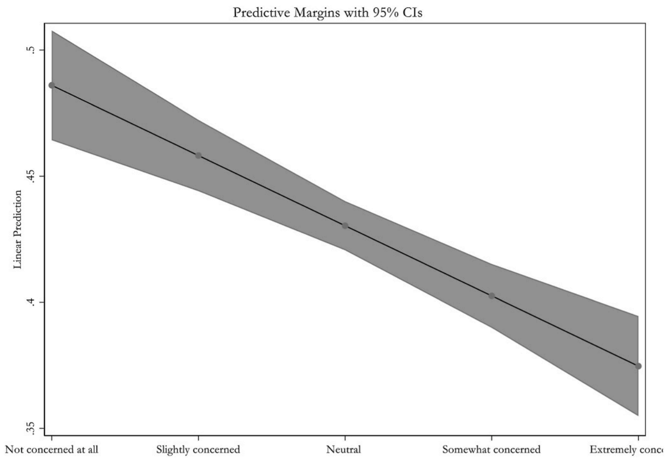

Fig. 6. Support for nuclear fusion plans at level of individual concern with weaponization, with 95 % confidence intervals.

The effects displayed in Fig. 5 are very strong and precise. There is a clear relationship between self-reported knowledge and support for nuclear fusion. Respondents who are unaware that fusion and fission are different are less than half likely to support a nuclear fusion package (regardless of its characteristics) compared to those who claim a technical understanding of nuclear fusion. This difference displays approximately 32 percentage points in support, providing validation for H5.

Similarly, Fig. 6 illustrates the relationship between support for nuclear fusion development and respondents' related concern about the military implications of nuclear fusion research. In simple terms, support declines as concern increases. Although the relationship is weaker and more dispersed compared to the effect of self-reported knowledge (as shown in Fig. 5), the impact remains meaningful. All in all, the effect is still overall quite sizeable, reducing support by up to 12.5 percentage points. This provides evidence in support of H6, albeit in a less pronounced manner.

5. Conclusions, limitations and policy implications

This paper presents the first multidimensional, cross-national conjoint experiment investigating public support for nuclear energy technologies, specifically next-generation fission and innovative fusion, across five EU member states France, Germany, Italy, Spain, Poland and the United Kingdom. The twin conjoint experiment, conducted in May 2025, offers unique insights into the causal effects of policy design on public support, employing a three-dimensional analytical framework grounded on place-based (topocentric), governance-based (nomocentric), and effectives-based (logocentric) considerations. The findings show that public support for nuclear energy is both contingent and structured, with distinct preferences emerging for different types of nuclear technologies and project designs.

First, our results show a modest but consistent preference for fusion over fission technologies across all six countries. This gap is particularly pronounced among respondents who self-report greater awareness of the differences between the two technologies, indicating that knowledge moderates the effect of framing on support. This suggests that fusion is symbolically perceived as safer, cleaner, and more innovative, reinforcing previous research emphasizing the importance of affective and informational cues in nuclear energy attitudes.

Second, we found that place related factors significantly shape public preferences. Consistent with the literature on NIMBY effects and proximity bias, respondents were more likely to support smaller-scale plants located farther from their residence. Furthermore, projects employing scientific (white-collar) rather than technical (blue-collar) staff received significantly more support, likely due to associations with prestige, safety, and long-term research orientation. Third, governance related features exhibited heterogeneous effects. Projects governed at the EU level consistently garnered higher support compared to those managed at national or international levels. Similarly, sourcing fuel domestically or from the EU increased support, likely reflecting citizens' heightened awareness of energy security in the post-Ukraine invasion context. However, joint EU-level procurement of fuel and materials, while intuitively aligned with solidarity goals, did not yield consistently higher support, suggesting some uncertainty regarding shared control mechanisms. Fourth, effectiveness related criteria proved to be the most powerful predictors of support. Low consumer electricity prices produced the strongest positive effects across all models, overshadowing both construction costs and carbon emissions. While low CO_2 emissions and lower plant costs also had positive impacts, their marginal effects were substantially smaller.

Country-specific trends further nuance the aggregate results. Germany and Italy displayed greater fusion preference and stronger aversion to fission, likely due to historical legacies of nuclear skepticism and reactor phase-outs. France and Poland showed higher overall support for both technologies, consistent with ongoing nuclear investments and energy strategy. The UK and Spain demonstrated moderate patterns, with clear fusion preference but less extreme opposition to fission.

Limitations. Against this backdrop, the paper presents several limitations. First, the dimension representing size and technology was combined into a single experimental attribute, making it challenging to disentangle the specific impacts of plant size from the chosen technology. This potentially conflates respondents' perceptions of technological novelty and risk with physical plant characteristics, limiting analytical clarity. Second, the sample is exclusively European. While these countries represent diverse energy histories and strategies, the external validity of findings beyond European contexts remains uncertain. Further research involving non-European populations is necessary to assess the broader applicability of the results. Third, despite clear statistical significance, the observed effect sizes were relatively modest, with limited explanatory power as indicated by low R-squared values. This suggests that, while informative, the policy attributes tested capture only a fraction of the determinants shaping public attitudes toward nuclear technologies. Fourth, it is important to acknowledge that public perceptions of these technologies are shaped by limited technical knowledge. As a result, part of the observed difference in support may reflect symbolic or affective associations, such as the perception of fusion as novel and "clean" or fission as historically risk loaded, rather than precise technological understanding. Our findings should therefore be interpreted with the recognition that respondents may evaluate the broader narratives surrounding these technologies rather than their specific engineering properties. Fifth, a further limitation concerns the fundamental technological uncertainty surrounding both fusion and next-generation fission. For fusion, multiple scientific routes remain under exploration, notably magnetic confinement and inertial confinement, each implying different plant sizes, risk profiles, and operational demands. Likewise, next-generation fission encompasses a heterogeneous set of designs, including SMRs, which vary in coolant type, moderator configuration, fuel cycle, and safety architecture. Because no clear technical trajectory has yet emerged in either domain, respondents necessarily evaluate stylized representations of these technologies rather than specific, well-established designs. As a result, some degree of conceptual uncertainty is inevitable when studying attitudes toward pre-commercial nuclear technologies.

Policy implications. Nonetheless, our findings carry a number of policy implications. To start with, they identify the critical role of knowledge dissemination and clear communication in shaping public acceptance of nuclear technologies. Public support significantly increases with greater understanding of the differences between fusion and fission technologies. Policymakers can therefore opt to prioritize educational campaigns aimed at clarifying technical distinctions, addressing misconceptions, and alleviating concerns about militarization. Our results demonstrate the long-held belief that accessible communication on safety and scientific rigor can mitigate public fears if such strategies are successful in accruing to citizens' understanding.

Furthermore, our results clearly demonstrate the importance of producing tangible, cost-effective outcomes to maintain public backing. Citizens prioritize affordability, directly associating support for nuclear projects with their impact on consumer electricity prices. Hence, policymakers should focus on delivering nuclear solutions with clear economic benefits, contained costs, and emission profiles that are comparable to renewable energy sources. Additionally, proactive engagement with local communities is crucial, since NIMBY-related concerns drive much of the opposition to nuclear development in our experiment. Given strong preferences for smaller, distant installations and employment that signals long-term economic upgrading, incorporating community concerns early in project planning can enhance acceptance and reduce opposition. Effective community integration strategies, transparent governance structures, and demonstrable local benefits are key elements in securing sustained public support.

All in all, our study indicates that, rather than viewing nuclear technologies as uniformly accepted or rejected, citizens evaluate projects based on an interplay of space, institutional, and economic attributes. These results offer actionable guidance for policymakers navigating the twin challenges of energy security and decarbonization.

CRediT authorship contribution statement

Merve Biten Butorac: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Francesco Nicoli:** Writing – review & editing, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Roberto Lalli:** Validation, Project administration, Funding acquisition.

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Declaration of competing interest

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.enpol.2025.115007.

Data availability

The authors do not have permission to share data.

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