Predicting attitudes towards fusion energy in Europe: Results of a cross-national public survey in Austria, Finland, Spain and the UK

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HIGHLIGHTS

- Study investigates public attitudes towards fusion in four European countries
- Attitudes towards fusion found to be generally favourable, particularly in Finland
- Impact of information provision on attitudes is shaped by existing attitudes
- Attitudes in Finland more belief-based; attitudes in Austria more affect-based
- Results have implications for public communication and engagement practices

Abstract

The aim of the study was to examine the nature and antecedents of public attitudes towards fusion in Europe. Data were collected using an online information-choice style questionnaire distributed to diverse samples from Finland (N = 849), Austria (N = 830), Spain (N = 872) and the UK (N = 849). Participants received some general information about fusion energy, and some specific information about some anticipated consequences associated with investment in fusion that they were required to evaluate (i.e. a *consequence evaluation* task). The study aimed to: (1) gauge participants' assessment of fusion following the general information; (2) investigate any change in attitudes following the consequence evaluation task; and (3) use multiple regression analysis to model the psychological antecedents of participants' attitudes following the consequence evaluation task. The modelling was informed by existing psychological models of technology acceptance. Results showed that attitudes towards fusion were generally favourable: Finnish participants were most favourable, followed by the British and Spanish participants, and finally the Austrian participants. Participation in a consequence evaluation task had only a small effect on participants' attitudes, with the extent of any change correlated with their initial attitudes. Analysis of the Finnish (most favourable) and Austrian (least favourable) participants revealed qualitative differences in the make-up of their attitudes. While Finnish attitudes were more belief-based, Austrian attitudes were more affect-based. The findings confirm that public attitudes towards fusion differ across Europe and that programmes of public engagement within different countries should vary to reflect these differences.

Keywords

Nuclear fusion; Public perception; Attitude; Public acceptance; Survey; Europe

1. Introduction

1.1 Nuclear fusion energy

World energy consumption is expected to grow considerably over the next fifty years as the world's population expands and developing countries become more industrialised [1]. To meet this growing energy demand in a clean, secure, and affordable way, governments are looking to invest in (or to incentivise private investment in) innovative ways of producing energy. Although varying between countries, these efforts have tended to include: (a) attempts to make fossil sources of energy, like coal and natural gas, cleaner (e.g. through carbon capture and storage); (b) investment in nuclear fission power plant; and (c) a rapid expansion of renewable energy capacity [1], [2]. Alongside this, there has also been interest in the research, development, demonstration and deployment (RDD&D) of nuclear fusion energy (hereafter 'fusion') [3], [4], [5], [6].

While still an experimental energy technology, fusion has been touted as a potentially sustainable, safe and clean source of energy [7], [8]. This is because the fuel used to run fusion (two isotopes of Hydrogen called deuterium and tritium) is available and abundant, fusion is 'carbon neutral' at point of generation, and while fusion does produce some radioactive waste, it is significantly lower-volume, shorter-lived and less-radioactive than that produced via nuclear fission power plants. Furthermore, due to the way fusion operates, there is no prospect of catastrophic nuclear meltdown.

The potential of fusion has led to considerable international collaboration and investment in developing the technology and demonstrating its commercial viability. For example, a prominent experimental demonstration of the technology – the International Thermonuclear Experimental Reactor (ITER) – is currently being built in the south of France. ITER is a collaboration between 35 nations (including China, US, Russia, Japan, Korea, India and the European Union) and when constructed it stands to be the first fusion plant capable of producing sustained, net-surplus energy during operation. ITER is due to be fully commissioned in December 2025 and is anticipated to be the forerunner to 'DEMO', which is anticipated to be a fully functioning demonstration power plant capable of supplying electricity to the grid (due to be operational by around 2050) [9], [10], [11], [12].

While fusion has its proponents, the financial backing that it has received (and continues to receive) has proven divisive. Some question whether controlled fusion power generation will ever be possible [13], others query the potential risks to the environment and human-health associated with fusion, and still others argue that the vast sums of money spent on fusion might be put to better use on more proven, more readily-available technologies (e.g. renewables, demand-reduction technologies) [14]. Even among the fusion-research community there is a recognition of the political, economic, sociocultural and technological challenges of developing and deploying fusion technologies as a global asset (e.g. the need for 'buy in' from countries in the Global South not involved in ITER) [5], [15], [16]. The disagreement that exists over the feasibility and desirability of fusion as a power generating option raises important questions about the nature of public and broader social acceptability of the technology.

1.2 Public perceptions of fusion

Within westernised democracies, publics are known to provide a steering influence on policy and siting decisions relating to prospective energy technologies and projects [17], [18], [19]. It is therefore important to understand public perceptions about energy technologies [20].

Considerable social scientific research has been conducted into the nature and antecedents of public acceptance towards myriad industrial-scale energy technologies, including conventional power plant (e.g. coal-fired plant [21]; nuclear fission plant [22], [23], [24]), renewable energy technologies (e.g. on and offshore wind farms [25], [26], [27]), and emerging ancillary technologies (e.g. grid-scale electrical energy storage [28], [29], [30], [31]), carbon capture storage and utilisation [32], [33]). The findings of this research have not only led to debates as to what the term 'acceptance' should mean [34] but have also proven invaluable in highlighting the psychological and socio-demographic constructs that drive a willingness among publics to endorse, tolerate or reject such technologies at the national and/or local level [17], [35].

Accordingly, there have also been attempts to review and synthesise these core constructs into theoretical frameworks designed to model and explain the causal relationships that govern 'acceptance'. A prominent example of this is the *Comprehensive Framework of Energy Technology Acceptance* which was derived from a review of relevant psychological theory (e.g. Theory of Planned Behaviour [36]; Norm Activation Model [37]) and empirical studies of technology acceptance [38]. This framework, which has been highly cited (for recent examples, see [39], [40], [41]), identifies a person's intention to accept a technology as being the most proximal determinant of acceptance. In turn, intentions are hypothesised to be predicted by personal and social norms, perceived behavioural control and attitudes, with attitudes and personal norms directly or indirectly mediating the impact of several additional feeling (i.e. positive and negative affect) and belief-based (e.g. perceived risks, costs, benefits, and procedural and distributive fairness) constructs.

Alongside personal norms, then, attitudes are thought to play a pivotal role in governing a person's acceptance of energy technologies. Consequently, attitudes towards technological innovation within the energy sector (and their relation to acceptance) have become a topic of academic scrutiny [38], [42]. According to attitude theory, attitudes are a person's positive or negative evaluations of something (in this case a person's evaluation of a given energy technology or a behaviour relating to the technology, e.g. advocacy). As highlighted above, attitudes are derived from a synthesis of cognitive and affective informational inputs (e.g. a person's positive or negative feelings about the attitude object, their beliefs about whether the object has personal costs or benefits, and behavioural representations of interactions with the attitude object [43], [44]). Attitudes vary upon many qualitative dimensions: for example, attitudes differ in strength, with stronger attitudes typically being more accessible and robust and thus be more likely to influence thoughts and behaviour and less open to change than weaker attitudes. Attitudes can also differ in terms of their cognitive and affective make-up, which is to say that some attitudes can be more based upon cognitive beliefs and others more feeling based [43], [44].

Specific research into public attitudes towards fusion is currently very limited, with only a handful of scientific articles, reports and conference proceedings on the subject published to date. The research that has been completed tends to highlight the relatively low levels of public awareness and understanding of fusion but the generally high levels of support for the concept, at least in principle [45], [46]. For instance, in 2002 a pan-European survey on energy options, issues and technologies showed that while respondents had significant difficulties in understanding fusion, the majority supported research into the technology [47].

This generally positive image of fusion has been also found in public discourse about the technology on the Internet. A study on the nature of online content about fusion by Oltra et al. [14] found that this content was predominantly positive, with fusion generally presented as a solution to the energy and environmental challenges of future society and a superior form of nuclear energy (versus nuclear fission). Similar results were found in a media analysis of fusion content by Schmidt et al. [48]. Contrary to nuclear fission, fusion was generally portrayed as a safe, clean and unlimited source of energy, although reservations were aired about the research costs, technological feasibility and the timescales for commercial demonstration and deployment.

The research conducted to date has also shed some light on the conditions underpinning public support for fusion. Qualitative research by Prades et al. [46] on lay perceptions of nuclear fusion, for example, showed that people are willing to accept financial investment in nuclear fusion research to the extent that it is not seen to affect investment in renewable energies. Thus, people's preferences for alternatives to fusion could be seen to shape their attitudes towards the technology. The study also showed that when participants were presented with information about fusion from fusion scientists and environmentalists, they tended to adopt a more ambivalent position towards the technology. This would suggest that exposure to information about the pragmatic realities of fusion served to quell some of the general, less-informed enthusiasm for the technology.

Other studies have investigated the branding effect that the terminology associated with fusion can have on perceptions of the technology. For instance, Horlick-Jones and colleagues [49] illustrated the stigmatizing effect that the 'nuclear' label tends to exert upon people's attitudes to fusion, due to the powerful collection of negative images and ideas (e.g. catastrophic nuclear disaster and nuclear proliferation) that come associated with the term. This work on 'branding' has been recently extended to investigate other potentially stigmatising properties of the terminology associated with fusion. For instance, Jones, Yardley and Medley [50] investigated lay-public perceptions of the proposed use of depleted uranium as a means of storing the tritium (Hydrogen-3) used to power fusion reactions. The authors found generally positive attitudes towards fusion in samples from two European countries (i.e. UK and Germany) but also a mildly stigmatizing effect of the term 'depleted uranium' on these attitudes. This stigmatizing effect was, though, partially reversed by the provision of information clarifying the actual nature and purpose of depleted uranium within fusion processes.

Taken together, the small volume of research conducted into lay-perceptions of fusion to date indicates that people are generally unfamiliar with fusion and – while typically positive to the concept of fusion and investment in the technology – attitudes at this time are relatively weak and are susceptible to the subtleties in how the technology is presented or described (i.e. 'framed') (e.g. [24], [32], [51], [52]). This argues in favour of employing research approaches that reflect the challenges of reliably and validly assessing lay-perceptions of unfamiliar topics. For instance, a methodological challenge associated with investigating lay-attitudes towards unfamiliar and complex attitude objects (like fusion) is the likelihood of measuring 'pseudo opinions' [53], [54]. Pseudo opinions are essentially weak evaluative judgements that are based upon a person's incorrect beliefs and/or assumptions about the attitude object in question. Research shows that such opinions are highly changeable in response to new information and not particularly directive of behaviour, making them potentially unhelpful as a guide to 'true' (i.e. informed) public opinion towards the attitude object [55], [56].

The risk of assessing pseudo opinions in the context of energy technologies has generated research interest. For instance, de Best-Waldhober and colleagues [55] assessed uniformed vs. informed attitudes towards Carbon Capture and Storage (CCS) using a traditional survey vs. information-choice questionnaire (ICQ), respectively. An ICQ counters the likelihood of assessing pseudo opinions by first presenting respondents with a policy-relevant decision context (e.g. future generation of clean, secure and affordable energy) and structured, textual information relevant to the problem [57]. Participants are then helped to evaluate the attitude object (e.g. fusion) in relation to the policy problem, thus providing responses from a more informed standpoint. Within de Best-Waldhober et al.'s study [55], participants within the ICQ condition formed more stable attitudes towards the technology vs. the traditional survey condition.

In sum, alongside qualitative methodologies (e.g. interviewing, focus groups) that afford researchers with opportunity to provide substantive information to participants before assessing attitudes, ICQs are often seen as a viable means of assessing attitudes towards novel technologies, while reducing the prospect of assessing pseudo opinions.

1.3 The current research

The current study sought to build upon the existing literature on public perceptions of fusion by examining *informed* public attitudes in large, demographically-representative samples of four European countries (i.e. Austria, Finland, Spain and the United Kingdom). These four countries were selected based on national attitudes towards nuclear fission energy that had been previously registered in international polls [32]. These polls register Finland as being most favourable to nuclear energy, Austria to be least favourable and Spain and the UK to have more intermediate levels of support (as well as being the home nations of the authors). To the extent that prior research has revealed that people's attitudes towards fission and fusion are often correlated (e.g. due to shared 'nuclear branding' [49]), we anticipated that attitudes toward fusion among the samples from these four nations would show a similar pattern (i.e. Finland > Spain / UK > Austria).

In addition to providing descriptive details of the extent of support (or opposition) for fusion in these countries, we also statistically examined the key determinants of this support and investigated what impact the information provided within the survey had upon participants' attitudes.

Our study had three core aims:

1) To provide a first assessment of attitudes (Time 1, T1) towards fusion in each of the four countries after the receipt of a small amount of descriptive information about the technology, and to provide a comparative analysis of the affective (feeling-based) and cognitive (belief-based) determinants of these attitudes. As outlined, we anticipated that attitudes would likely follow the pattern observed with nuclear fission, although this prediction was tentative due to the exploratory nature of the study. Our decision to contrast the affective and cognitive (i.e. perceived risks, costs and benefits) determinants of attitudes was based upon the registered importance of these constructs in explaining attitudes towards other energy technologies [38].
2) To investigate the extent of any attitude-change in each country following the provision of information about some key advantages and drawbacks of investment in fusion and fusion research (i.e. a *consequence evaluation* task). While our primary rationale for providing this information was to enable participants to engage in a more informed evaluation of fusion (rather than to alter the valence of participants' attitudes, *per se*), we anticipated that the receipt of this information could affect people's attitudes. In line with Prades et al. [46] we anticipated the information could result in greater ambivalence towards the technology; however, this prediction was tentative as prior research into the provision of information on attitudes towards energy technologies has yielded positive, negative and null effects [38].
3) To model some key antecedents of participants' *informed* attitudes (Time 2, T2) towards fusion, including: (a) their Time 1 (T1) attitudes to fusion; (b) the affective and cognitive determinants of attitudes; (c) their responses to the items in the *consequence evaluation* task; and (d) their comparative preferences for other options (i.e. renewables and energy efficiency). Modelling the impact of (a) and (b) alongside (c) allowed us to gauge more about the qualitative impact that *consequence evaluation* task had on participants' attitudes at T2. The decision to include (d) stemmed from research identifying that, for

some, endorsement of fusion is contingent on it not affecting investment in renewables [46].

2. Materials and Methods

2.1 Participants and recruitment

An online ICQ style survey of lay-public attitudes towards fusion and fusion research was administered to 900 people in each of four countries within the European Union (November 2018): Finland, Austria, Spain and UK. Distribution to a representative sample of each country population (by age and gender) was coordinated by an established survey company (Norstat UK Ltd.) via their online participant panels.[1] All participants were required to be aged 16 or over.

Table 1 outlines the general demographics of the realised sample of participants in each country and their initial self-claimed awareness and familiarity with fusion. The figures serve to confirm the large and diverse sample of participants recruited in each country. Indeed, there was good balance of male and female participants in each country and good spread of participants across the different age groups. Overall, the modal participant was male, aged 50-64, had not received a university education and was unfamiliar with fusion. The general pattern held across the four country groups but with some differences. Notably, the modal Austrian participant was female, a greater proportion of Spanish participants had a university versus non-university education, and most Finnish participants claimed to have heard for fusion.

Care should be taken when drawing conclusions from the realised sample, see [59]. While online distribution of the survey was chosen due to the size and geographically distributed nature of participants; and while the invited sample size was deemed adequate (via conversation with the survey company) for drawing broadly generalisable conclusions given the research objectives, the representativeness of the realised sample could be questioned. For example, the socio-

[1] The nations selected for inclusion in this study were four of 21 countries comprising a broader European survey of attitudes to nuclear fusion. Summary, descriptive details of the findings for each country are available, see [73].

demographic dimensions upon which the sample were selected were restricted due to the resources available to the study and there are possible coverage errors associated with a reliance on online participant panels. Also, the realised sample size in each country was slightly lower than the invited sample size, which could indicate a non-response bias. These limitations are not unique to the current study but should be used to caveat any conclusions drawn.

[TABLE 1 ABOUT HERE]

2.2 Survey design

In addition to assessing some basic demographic details (including gender, age, education) and a closing debrief, the ICQ consisted of four core sections designed to investigate public attitudes toward fusion energy and research. We provide details of the items of direct relevance to the current paper only. Fuller details of the survey can be found in the Supplementary Material associated with this article.

2.2.1 Baseline awareness and familiarity with fusion

Participants were informed that the survey would focus on fusion, described as *"…an experimental technology that could be used for power generation and that works by fusing together atoms in order to release energy"*, before being asked if they had heard of fusion (Yes, No) and how familiar they were with fusion (1 = not at all familiar; 4 = very familiar). For the full text and questions provided to participants in this section, see Appendix 1.

2.2.2 Assessment of Time 1 (T1) attitudes

Section 2 provided participants with a very basic outline of the characteristics of fusion before inviting them to state their attitudes towards the technology for the first time. The information (377 words) provided was selected from websites, factsheets and newspapers and aimed to represent the type of information that a citizen could acquire via a basic information search for fusion online. The information was produced alongside technical experts from EUROfusion (www.euro-fusion.org) to ensure appropriate balance and accuracy in the claims being made about the technology. Fusion was introduced as something that *"…could be an important long-term energy source to complement other options"* and a short description of how fusion generates power (including efforts to delineate it from nuclear *fission*) was provided. The benefits of fusion as *"…an almost inexhaustible and clean source of energy"* were outlined alongside the drawbacks of fusion being a complex and commercially unproven technology. For the full text and questions provided to participants in this section, see Appendix 2.

Participants' T1 attitudes to fusion as a potential energy source were then assessed (1 = very poor; 5 = very good), followed by a series of 5-point semantic differential scales designed to assess participants' affective responses to fusion (4-items, e.g. *"To what extent does fusion energy evoke the following feelings in you: worry --- tranquility"*) and their beliefs of the relative costs, risks and benefits of the technology (7-items, e.g. *"What are your beliefs and expectations regarding fusion technology? I think that fusion would be: "technologically unviable --- technologically viable"*). The four affect items had excellent internal reliability (Cronbach's α = 0.9) and so were combined to form a single composite variable (*fusion-affect*). The same was true for the belief-based items (Cronbach's α = 0.9) and so these were combined to form a single composite variable (*fusion-beliefs*).

2.2.3 Consequence evaluation task

Section 3 was designed to aid participants in evaluating some of the anticipated consequences associated with investment in fusion, thereby providing them with a deeper (i.e. more informed) understanding of the advantages and drawbacks of investment in the technology. Participants were provided with information on, and were required to rate, six characteristics of fusion on a 5-point scale (1 = very negative; 5 = very positive). These included: (1) Long timescales to commercial deployment (*timescales*); (2) Low dependency on scarce resources (*resource reliance*); (3) Low contribution to climate change (*climate change*); (4) Price/cost of electricity (*cost of generation*); (5) The necessity for new installations, including new prototype power plant (*new installations*); and (6) the low risk from radioactive waste (*radioactive waste*).

Table 2 outlines the text that participants received relating to each of the six consequences for investment in fusion. Each characteristic was evaluated individually, with the presentation order of the characteristics being randomised. The information was translated into the national language of each country studied.

[TABLE 2 ABOUT HERE]

2.2.4 Assessment of Time 2 (T2) attitudes and comparative preferences

Participants ended the survey by restating their attitude (T2) towards fusion as a potential energy source (1 = very poor; 5 = very good) and how much they (dis-)agreed that with statements designed to register their relative preference for fusion over each of three different technology options: *"Instead of investing in fusion energy, we should focus on alternative solutions, like: (a) renewable energies (e.g. solar, wind, biomass); (b) energy efficiency and saving; and (c) conventional energies (e.g. nuclear, gas, coal)* (1 = strongly disagree; 5 = strongly agree). For the full questions provided to participants in this section, see Appendix 3.

3. Results

3.1 Initial awareness, familiarity and Time 1 (T1) attitudes towards fusion

Consistent with prior literature, most participants in Austria, Spain and the UK claimed *not* to have heard of fusion *before* commencing the survey (51.1-60.0%, see Table 1). The exception to this was in Finland where a small majority (53.6%) claimed to be aware of fusion. Despite most participants in Austria, Spain and UK purporting not to have heard of fusion, they still claimed to have some familiarity with the technology. It is possible that this 'familiarity' was derived from the outline information provided about fusion at the start of the survey.

Respondents' T1 attitudes towards fusion in Finland, Spain and the UK were, on average, moderately positive. The exception was in Austria where mean attitudes were ambivalent and did not differ significantly from the attitude-scale mid-point (3.0), $t(829) = .534$, $p = .594$ (see Table 3) The same pattern held for both the *fusion-affect* and *fusion-beliefs* measures, also.

[TABLE 3 ABOUT HERE]

Welch's one-way between-subjects ANOVAs (with Bonferroni post-hoc comparisons) were used to compare mean *fusion-affect* and *fusion-belief* constructs in each of the four countries. The analysis of differences in *fusion-affect* was significant, $F(3, 1880.97) = 64.97$, $p < .001$. Austrian participants had significantly less positive feeling (i.e. were more ambivalent) about fusion than those in each of the other nations (Mean Diffs. ≥ .48, SE = .04, *ps* < .001). Finnish participants felt most positive about fusion, although they were statistically comparable to those in Spain and the UK (Mean Diffs. < .09, SE = .04, *ps* > .256). There was no difference in the Spanish and British participants (Mean Diff. = .00, SE = .04, $p = 1.000$).

The analysis of differences in *fusion-beliefs* was also significant, $F(3, 1882.95) = 163.19$, $p < .001$. Austrians held more ambivalent beliefs about the value of fusion relative to those in other nations (Mean Diffs. ≥ .56, SE = .04, *ps* < .001). Finnish participants held significantly stronger positive beliefs about the value of fusion than those in Spain (Mean Diff. = .10, SE = .04, $p = .029$) and the UK (Mean Diff. = .12, SE = .04, $p = .007$). There was no difference in the Spanish and British participants (Mean Diff. = .02, SE = .04, $p = 1.00$).

3.2 Consequence evaluation task findings

Welch's one-way between-subjects ANOVAs were used to compare mean responses to each of the six *proposed consequences* of fusion that participants were asked to evaluate during the survey (see Table 3). The analysis revealed significant differences between the four countries on each of the six items (*Fs* ≥ 23.29, *ps* < .001), which were explored with reference to the post-hoc comparisons (using Bonferroni adjustment).

3.2.1 Timescales to development

On average, timescales to commercial deployment were viewed ambivalently by participants (Overall Mean = 2.93, SD = 1.03). The post-hoc comparisons revealed that Austrians were more likely to agree this was a drawback (Mean Diffs. ≥ .26, SE = .05, *ps* < .001), with the

Spanish, Finnish and UK participants being statistically equivalent in their evaluations (Mean Diffs. ≤ .13, SE = .05, *ps* ≥ .05).

3.2.2 Climate change mitigation, resource reliance and cost of generation

Participants in all countries were generally positive about fusion in relation to its capacity to: (a) address climate change (Overall Mean = 3.99, SD = 1.02); (b) generate electricity at a competitive price (Overall Mean = 3.61, SD = 1.00); and (c) because of its low reliance on scarce resources (Overall Mean = 3.91, SD = 0.94). In terms of *climate change*, Finnish participants were significantly more favourable than participants in the other countries (Mean Diffs. ≥ .26, SE = .05, *ps* < .001). UK participants were more favourable than the Spanish (Mean Diff. = .14, SE = .05, *p* = .031), and the Austrians and Spanish being statistically comparable (Mean Diff. = .03, SE = .05, *p* = 1.00). With regards to *cost of generation*, the Finnish were most favourable (Mean Diffs ≥ .30, SE = .05, *ps* < .001). The Austrians were significantly least favourable (Mean Diffs. ≥ .14, SE = .05, *ps* ≤ .020). The UK and Spanish participants were comparable (Mean Diff. = .06, SE = .05, *p* = 1.00). In terms of *resource reliance*, Austrians were least positive (Mean Diffs. ≥ .60, SE = .05, *ps* < .001). Finnish participants were most positive – although statistically comparable to UK participants (Mean Diff. = .11, SE = .05, *p* = .071) – and the Spanish and UK participants responses were comparable (Mean Diff. = .02, SE = .05, *p* = 1.00).

3.2.3 Need for new installations

Participants were generally favourable about the need for more installations (Overall Mean = 3.39, SD = 0.99), although Austrians were ambivalent on this measure and were least positive overall (Mean Diffs. ≥ .37, SE = .05, *ps* < .001). The Finnish were most positive (Mean Diffs. ≥ .16, SE = .05, *ps* ≤ .005) and the UK and Spanish participants were comparable (Mean Diff. = .09, SE = .05, *p* = 1.00).

3.2.4 Production of radioactive waste

In contrast to the other measures, there was a more distinct hierarchy in participants' responses about the production of radioactive waste (Overall Mean = 3.07, SD = 1.35). Austrian participants evaluated this consequence negatively and were statistically distinct from the more ambivalent Spanish participants (Mean Diff. = .42, SE = .06, $p < .001$). The UK participants were mildly positive and significantly distinct from the Spanish (Mean Diff. = .26, SE = .06, $p < .001$), while the Finnish participants were significantly more positive than the UK participants (Mean Diff. = .45, SE = .06, $p < .001$).

3.3 Attitude change: Time 1 (T1) attitude versus Time 2 (T2) attitude

A 4 (country: Austria, Finland, Spain, UK) x 2 (Time: T1 attitude, T2 attitude) repeated measures ANOVA with Greenhouse-Geisser correction (including Bonferroni corrected comparisons) was conducted. This analysis was designed to test whether participants' general attitudes to fusion were affected by participating in the survey. For the relevant means and standard deviations associated with these analyses, see Table 3.

There was a small but significant main effect of Time, $F(1, 3396) = 23.55$, $p < .001$, $\eta^2 = .007$, with T2 attitudes being significantly more positive than those at T1. There was also a small but significant main effect of country, $F(3, 3396) = 88.98$, $p < .001$, $\eta^2 = .073$. These main effects were qualified by a significant time*country interaction, $F(3, 3396) = 4.62$, $p < .003$, $\eta^2 = .004$. Analysis if the estimated means revealed that there was a nominal change in attitudes among the Austrian participants (Mean Diff. = .011); a small enhancement in attitudes within the UK (Mean Diff. = .035) and Spain (Mean Diff. = .052); and a more notable improvement in attitudes among the Finnish participants (Mean Diff. = .127).

3.4 Preference for alternative energy options

Welch's one-way between-subjects ANOVAs (with Bonferroni post-hoc comparisons) were used to compare mean *preferences for alternatives* in each of the four countries. For the relevant means and standard deviations, see Table 3.

3.4.1 Energy efficiency and saving

The analysis of preferences for energy efficiency and saving proved significant, $F(3, 1880.79) = 36.20$, $p < .001$. On average, participants were generally preferable to investment in energy efficiency (Overall mean = 3.45, SD = 0.98); however, the Austrian participants rated this option as being more preferred than those in the other nations (Mean Diffs. ≥ .22, SE = .05, *ps* < .001). Finnish and UK participants were statistically comparable in their evaluations of this option (Mean Diff. = .01, SE = .05, *p* = 1.000) and were both significantly *less* preferable to this option as compared with the Spanish (Mean Diffs. ≥ .20, SE = .05, *ps* < .001).

3.4.2 Renewables

The analysis of preferences for this option proved significant, $F(3, 1881.41) = 56.53, p < .001$. Overall, participants were more favourable to investment in renewables over fusion (Overall mean = 3.62, SD = 1.00). The Spanish and Austrian participants were statistically comparable in their preferences for this option (Mean Diff. = .06, SE = .05, *p* = 1.000) and the Finnish and UK participants were comparable (Mean Diff. = .11, SE = .05, *p* = .164). The Spanish and Austrian participants' preferences significantly exceeded those in the other two countries (Mean Diffs. ≥ .34, SE = .05, *ps* < .001).

3.4.3 Conventional generation

The analysis of preferences for this option were also significant, $F(3, 1880.38) = 60.71, p < .001$. Overall, participants disagreed that this option was preferable to fusion (Overall mean = 2.34, SD = 1.07). Interestingly, the Finnish and Austrian participants agreed in their evaluations of this option (Mean Diff. = .10, SE = .05, *p* = .290) and were significantly *less* favourable to those in the other nations (Mean Diffs. ≥ .38, SE = .05, *ps* < .001). The Spanish and UK participants were comparable in their evaluation of this option (Mean Diff. = .09, SE = .05, *ps* = .463).

Taken together, participants considered investment in fusion to be preferable to conventional power generation (e.g. Coal, Gas, Nuclear Fission), but less preferable to renewables and energy efficiency. The biggest preference for alternatives to fusion was observed among the Austrian and Spanish participants.

3.5 Predicting Time 2 (T2) attitudes towards fusion in Finland and Austria

We ran a multiple linear regression analysis (pairwise deletion) to identify what predicted T2 attitudes towards fusion among the countries most (Finland) and least (Austria) favourable to the technology. It was reasoned that it would be between these two countries where the biggest contrasts in T2 attitudes would be observed. The independent variables included in the analysis were: (1) T1 attitudes; (2) the *fusion-affect* and *fusion-beliefs* items; (3) perceived consequences for developing fusion (6-items); and (4) preferences for renewables and energy efficiency (2-items).

For both countries, all 11 items shared significant correlation with dependent variable and so were included in the analysis final analysis. We excluded 25 and 14 participants from the Finnish and Austrian samples, respectively, based upon high Mahalanobis distance estimates. Otherwise the assumptions for linear regression were met.

3.5.1 Finland

The regression model (see Table 4) accounted for 69% of the variance in T2 attitudes. Analysis of the beta-coefficients identified T1 attitude to be the strongest unique predictor. Beyond this, participants beliefs about the value of fusion (*fusion-belief*), alongside their consequence evaluations for the *resource reliance*, *radioactive waste*, *climate change*, and *cost of generation*, were retained as significant positive predictors. Evaluations of *timescales* and *new installations* were not retained in the model, nor was *fusion-affect* or preferences for renewables or energy efficiency.

3.5.2 Austria

The regression model (see Table 4) accounted for 77% of the variance in T2 attitudes. T1 attitudes were again the single strongest predictor. Beyond this, *fusion-affect* and participants' consequence evaluations (except for *timescales*) were retained as positive predictors. Participants' preference for renewables was retained as a significant negative predictor, and preferences for energy efficiency was a marginal (although non-significant) negative predictor. *Fusion-beliefs* were not retained in the model.

[TABLE 4 ABOUT HERE]

4. Discussion

4.1 Key findings

Consistent with the findings of previous studies (e.g. [45], [46]), our representative survey of lay-publics in four European countries (Austria, Finland, Spain, UK) revealed that: (1) overall awareness and familiarity with fusion was low-moderate; but (2) that attitudes (at Time 1, T1) were generally favourable. The exceptions to these general trends were in Finland, where a small *majority* of participants claimed to be aware of fusion; and in Austria, where overall attitudes were ambivalent. Overall, T1 attitudes to fusion between the countries followed the pattern anticipated during their selection (which was driven by historical polls on preferences for nuclear energy [58]): Finnish participants were most favourable, followed by the British and Spanish participants, and finally the Austrian participants. This contrasted with participants' preferences for alternatives to fusion, where the trend was reversed. Specifically, while participants in all nations showed a preference for investment in renewables and energy efficiency/saving over fusion, this preference was strongest in Austria, and weakest in Finland.

The overall hierarchy in preferences for fusion was mirrored in the participants' T1 cognitive (*fusion-belief*) and affective (*fusion-affect*) appraisals of fusion, as well as their appraisals of the various characteristics of fusion presented within the *consequence evaluation* task. Critically, though, the findings from the *consequence evaluation* task illustrated that the Austrian participants were *not* categorically objectionable to fusion on all grounds. While negative on the measures of *timescale* and *radioactive waste*, Austrians saw benefits to fusion in the context of *climate change*, *cost of generation* and *resource reliance.* These three dimensions interestingly map to the three components of the so-called 'energy trilemma' (i.e. the national need to invest in affordable, secure, and low-carbon forms of energy) [60].

Consistent with research critiquing the knowledge-deficit hypothesis of attitudes towards science and technological innovation, participation in the *consequence evaluation* task appeared to have only a small effect on participants' attitudes (T1 vs. T2) [61], [62], [63], [64]. The extent of any change appeared to correlate with the existing T1 attitudes of participants, i.e. Finnish participants showed the biggest change (+ 0.12); Spanish and British participants showed a small-moderate change (+ .03; + .05) and Austrian participants only a negligible change (+ .01). Akin to a form of confirmation bias [65] – and running counter to our predictions, which anticipated there would be inflated ambivalence towards fusion following the receipt of more information – participation in the *consequence evaluation* task appeared to further enhance the attitudes of those who were most positive towards the technology. This finding also fits with the observation that participants who were most favourable towards fusion tended to evaluate all *perceived consequences* (except for *timescales*) positively, while those who were least favourable showed a more mixed response to the information provided.

The regression analysis – conducted solely on the Finnish and Austrian participants where the biggest difference in attitudes towards fusion was observed – provided further insight into the nature of participants' attitudes to fusion. The findings offer explanations for the cross-national differences in these attitudes, as well as insight into the impact that the *perceived consequence* task had on these attitudes.

Finnish attitudes appeared to be principally belief-based, as feelings towards fusion (i.e. *fusion-affect*) were not retained in the regression model. The retention of *resource reliance*, *climate change*, *radioactive waste* and *cost of generation* – all of which were positively evaluated – suggested that these attributes were not accounted for in participants' T1 attitudes or beliefs about fusion. It is likely that these attributes became seen by the Finnish participants as further reasons to support fusion, which could account for the moderate enhancement of attitudes between T1 and T2. Notably, Finnish participants' preferences for energy efficiency and renewable technologies did *not* significantly detract from their T2 attitudes towards fusion. This could be taken as evidence that these participants saw fusion to be an important part of the future energy portfolio, alongside efforts to reduce demand and expand renewable generating capacity.

In contrast, Austrian T2 attitudes towards fusion appeared to be more affect-based: being significantly predicted by participants' feelings about the technology (i.e. *fusion-affect*) but *not* by their T1 beliefs (*fusion-beliefs*). As participants' feelings towards fusion were generally negative, this can help to account for the lower preferences observed for the technology (vs. Finland). As in Finland, *timescales* were not uniquely predictive of T2 attitudes. It is possible that the long lead-in times for commercialisation of fusion – being a commonly cited concern with the technology – were accounted for in T1 attitudes in both countries. The prospect of investing in *new installations* was predictive of T2 attitudes, although people were generally ambivalent on this characteristic. By contrast, *climate change*, *resource reliance*, and *cost of generation* were positively evaluated and were retained as predictors of T2 attitudes. While this could be taken as a direct endorsement of fusion on these grounds – and therefore could be leveraged by proponents of fusion as a means of engendering support for the technology (see below) – we argue that this might represent participants' more general desire for investment in a more sustainable energy system. Evidence for this conclusion comes from the retention of preferences for energy efficiency/saving and the (marginal) retention of a preference for renewables within the regression model.

While *radioactive waste* was retained as a positive predictor in the model, mean evaluations of this characteristic were unambiguously negative among the Austrian participants. Indeed, it was evaluations of this characteristic that most clearly delineated the Austrians from the Finnish. When traded-off against the perceived benefits of fusion as an affordable, sustainable generating option, we feel that the prominence of concerns about *radioactive waste* can help explain the nominal overall change in attitudes observed among this sub-sample (T1 to T2).

The differences observed between the two countries in terms of their responses to the information about *radioactive waste* can also, perhaps, be taken to illustrate something about the assimilative vs. comparative way in which Austrians and Finnish processed this information. The text provided to participants about *radioactive waste* differentiated fusion from fission in a positive way (asserting that any radioactive by-products of fusion would be short-lived in comparison to fission). While Finnish participants responded favourably to this comparative framing (*"fusion is like fission, only better"*), the Austrians apparently responded in a more assimilative way (*"fusion is a hazardous nuclear technology, like fission"*), perhaps due to the common 'nuclear branding' these technologies share [49], [50]. This hypothesis about comparative vs. assimilative processing of information about *radioactive waste* requires further investigation though, as participants were not specifically asked to directly contrast fusion vs. fission when evaluating this attribute.

4.2 Implications

The current study represents the first detailed cross-national experimental survey of public perceptions of fusion energy research and, as such, there are several implications arising from the findings.

First, the findings of this study concur with those of prior research, surveys and polls (e.g. [47], [45], [50]) confirming that extant attitudes towards fusion across Europe are generally favourable. This was the case in all countries studied. Even among those who were least favourable to the technology (i.e. Austrians), T1 attitudes to fusion were generally ambivalent and not negative. The findings also confirm that these favourable attitudes stem from a relatively ill-informed position, with awareness and self-claimed knowledge of the technology generally low-moderate. We argue that this latter finding not only vindicates our use of an ICQ style survey method (such that participants were commenting from a more informed position [55]), but is indicative of the potential 'fragility' of positive attitudes towards fusion in Europe. For example, it appears that there is already a reasonable level of public awareness about the potentially long timescales to commercial deployment of fusion. Commercial fusion is often maligned as being always around 30 years in the future [66] and while correlated with T2 attitudes, concern over *timescales* within our study was not retained as a predictor when controlling for T1 attitudes. While raising peoples' awareness of the climate change, affordability and sustainability benefits of fusion might help to engender positivity towards the technology (even among those who are more ambivalent, e.g. Austria), we feel that in the case of climate change mitigation there is now (ironically) a time-limit on fusion proving itself commercially. If fusion continues to remain unproven commercially, then its potential contributions to decarbonising power generation will wane, as will peoples' positivity towards it. This is particularly likely in a context where renewables and energy saving/demand reduction are favoured options.

We would also argue that the time is ripe for proponents of fusion to engage and educate publics about the technology. There is certainly evidence of the value of programmes of meaningful engagement on enhancing public understanding of other innovative technologies (e.g. Carbon Capture Utilisation and Storage [67]). Moreover, it would appear from our findings that framing fusion in terms of its abilities to combat all angles of the energy trilemma would likely have broad appeal (even among those less favourable to the technology). However, while this suggestion does resonate with the ongoing efforts being made by the fusion community to communicate with publics about the technology (e.g. planned European Fusion Expo 2021), and while there is often a positive correlation between knowledge and attitudes [68]), there are recognised hazards to a belief that a knowledge deficit underpins rejection of technological innovation (e.g. [64], [62]). Rather, in addition to perceived and/or actual knowledge, public acceptance of technology is guided by myriad factors (e.g. perceived social norms, values, trust, etc.) [38]. Evidence for this was identified within this study where, among our Austrian sub-sample, (extant) visceral concerns about *radioactive waste* appeared to counteract the positive evaluations of fusion stemming from participants' assessments of the *climate change*, *cost of generation* and *resource reliance* attributes. Taken together we feel this finding provides further evidence of the need to tailor public communication efforts to recognise the context-specific circumstances of their planned introduction. For example, in the case of fusion, a significant national reliance upon nuclear *fission*, would appear to leave publics more amenable to the technology than in a country context where there no such historical and/or current reliance exists. These differences have been observed in other cross-national studies on fusion [50].

4.3 Limitations and future directions

Some limitations of our study should be discussed. First, while we provided participants with key information about fusion and helped them to evaluate the technology using the *consequence evaluation* task, we failed to include any checks to be sure that participants had understood and processed the information provided. Also, the information in the *consequence evaluation* task was largely narrative and did not include many quantitative indicators that could have been used by participants to aid their evaluation of the consequences. For instance, the outline details of the cost of generation would have been aided by the addition of details outlining the cost per MWh of electricity generated and/or the capital costs associated with developing and operating a fusion power plant. We feel that future research would benefit from the addition of more specific, quantifiable indicators to aid participants in assessing the characteristics of fusion. Relatedly, based upon the findings of previous research (e.g. [55], [56]) we assumed that the use of the ICQ methodology would have engendered stronger, more stable attitudes towards fusion. This assumption was, however, not explicitly tested and so it is not possible to assess whether participants' attitudes were stronger and/or more stable following the study. As such, it would be valuable in future studies to include attention check and attitude strength measures to gauge: (a) participant engagement with the information provided, and (b) to examine any qualitative changes to attitude strength and stability resulting from participation.

Second, the information provided within the study was concise (equivalent to about two A4-pages of text) and only described a handful of the technology's attributes. The extent and type of information provided was designed to reasonably equate to that which might be gleaned from a quick internet search about fusion. One could conclude, though, that the impact (or lack thereof) of the information included in our study on participants' attitudes might have been stronger (or qualitatively different) should participants have been given more and/or more thorough details about fusion. As alluded to in the introduction, the context within which a technology or issue is framed can influence how it is received by publics [69]. It could be that Austrian participants' responses within our study constituted a form of 'reluctant neutrality' (c.f. *reluctant acceptance*, Bickerstaff et al. [70]) fostered by couching fusion as a means of affordably and sustainably combatting climate change. In the absence of such framing, it is feasible that concerns about the production of radioactive waste might have engendered more negative attitudes among our Austrian sub-sample. As such, we feel that studies into the impact of framing on relative (i.e. comparative) preferences for fusion as a generating option (versus alternative investment options, e.g. renewables) would be a valuable avenue for future research.

Relatedly, it could be argued that there was a pro-fusion bias in the pitch and balance of the information provided to participants. This is most notable within the *consequence evaluation* task, where there was a preponderance of positive over negative statements about fusion but is also evident within the opening text used to introduce fusion to participants. This issue likely stems from working with representatives of the fusion research community when compiling the information for this study. While this collaboration was useful, since it enabled us to provide participants with technically robust descriptions of fusion, it arguably imbued the information generated with a positive tone and an underrepresentation of the risks and challenges in commercialising the technology. Our findings do mirror the general positivity towards fusion identified in other research (e.g. [45], [50]), which might attest to there having been a relatively nominal impact of this bias on participants' attitudes. However, akin to the issues of framing outlined above, it remains an empirical question as to whether the same results would have been achieved if the survey had been more formally vetted for implicit or explicit pro-fusion bias. There is also an outstanding question as to whether the general optimism surrounding fusion would be retained in a study where the information was mostly (or exclusively) negative in tone. We assert that future research needs to carefully consider what information is provided to participants and how it is framed, to mitigate the introduction of evaluative bias into studies on fusion.

Third, within our analysis of the impact of the *consequence evaluation* task on T2 attitudes, we draw conclusions about causality in the absence of an appropriate control condition. While we feel confident that the *consequence evaluation* task was the cause of any changes between T1 and T2 attitudes, due to: (a) the short time-lapse between participants answering the dependent measures about T1 and T2 attitudes; and (b) the fact that we controlled for the influence of T1 attitudes when assessing the impact of the *consequence evaluation* task on T2 attitudes, the absence of a control group in the analysis does leave some room for doubt. Future research should look to correct for this limitation, to bolster our assumptions of causality.

Fourth, there is the question of how representative, and thus how generalisable, the four study populations are. While there is no disputing the size and diversity of sub-populations recruited in each country, there is not guarantee that our use of quota sampling (based on age, sex and education) via internet panels means we recruited study samples that is truly representative of the national populations from which they are derived. We argue that further research to corroborate (or dispute) the current findings among independent samples of the nations investigated in this study is warranted.

Finally, there are questions pertaining to the internal validity of the measures used within this study, particularly as some of these measures comprised relatively few items and/or were adapted using items from research into technologies other than fusion. For example, one issue could be with how comparative preferences for fusion vs. alternative options (e.g. renewable energies) were assessed. In this study, a set of three items assessed participants' prioritisation for investment in fusion vs. a focus on alternative options (or vice versa) as a rough gauge of relative preferences. In hindsight, inclusion of a more robust measure of comparative preferences that more clearly delineated the extent of people's relative preferences (e.g. by separating the rough categorisations of renewables and conventional energies into their constituent technologies) and that allowed for a simultaneous prioritisation of investment in different options, might have been preferable. We argue that more quantitative studies designed to formally investigate how: (a) attitudes towards other energy technology options predict endorsement of fusion; and (b) how preferences for fusion compare with those for other technologies (e.g. in future electricity generating portfolio scenarios [24], [71], [72]) would be timely. Overall, though, the measures used in this study were selected for their high face-validity and have proven to have acceptable internal consistency (Cronbach's alpha). Moreover, there are recognised commonalities in the factors assessed in this study and those found to govern lay-public acceptance toward other large, power-generating technologies [17], [38]. Special attention was also paid to the translation of the questionnaires into the various languages to ensure that the questionnaire was measuring the same concepts in the same ways across various populations of respondents.

5. Conclusion

The findings of this study provide critical, quantitative insight into public attitudes towards fusion in four European countries. Our findings confirm that while generally favourable, these attitudes vary significantly between countries, both in terms of overall preference for the technology and qualitive make-up. Notably, attitudes among those who were most favourable (Finland) tended to be more belief-based, with more affective influence shown among those least favourable (Austria). While our study indicated that the provision of information about fusion (via a *consequence evaluation* task) had a nominal impact on stated preferences for the technology, there was some evidence that participants' T2 attitudes were more informed (and thus potentially more stable) than upon beginning the questionnaire.

This study makes several contributions to the extant literature. Quantitative, cross-national research into public attitudes on fusion technology is currently scarce: this applied, yet theoretically-grounded, study sheds new light on both the nature and antecedents of fusion technology in several European countries. In doing so, it reveals that there are qualitative differences in how different nationalities think and feel about fusion as a technology option, ostensibly related to societal perceptions of nuclear fission in each country (although this needs to be more formally examined). While care should be taken in generalising the findings of this study beyond fusion technology, we argue that our findings: (1) emphasise the importance of considering cultural factors within models of energy technology acceptance (which are notably absent in some popular psychological frameworks, e.g. the *Comprehensive Framework of Energy Technology Acceptance* [38]); and (2) question the common tendency for the findings of social scientific studies into energy technology acceptance to be generalised between different countries, before assumptions of transferability have been established.

There are several limitations with the current research design that provide potentially fruitful avenues for future investigation. In recognition of these limitations, though, we recommend that the findings of this research are interpreted, generalised and applied with caution. We encourage future researchers to think carefully about the balance of information provided to participants to circumvent criticisms of pro-fusion bias and provide a more robust examination of the apparent perennial optimism surrounding fusion.

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Appendix 1.

The key text and survey questions provided to participants upon entering the survey.

***"Have you ever heard of Fusion Energy?** The search for alternative methods of energy supply and use has led governments and companies to develop a portfolio of **energy technologies** such as solar, wind, and geothermal energy. Among these potential solutions to future energy challenges, here we are focusing on **fusion energy**, an experimental technology that could be used for power generation and that works by fusing together atoms in order to release energy. We will provide you more information regarding **fusion energy** in the next section."*

Construct	**Item**	**Scale**
Awareness	Before participating in this study, had you ever heard of fusion energy?	Yes / No
Familiarity	How would you rate your familiarity with fusion energy? Are you...? • Not at all familiar – You know nothing about fusion power (1) • Slightly familiar – You've heard about fusion power, read an article or watched a television feature about the technology, or participated in a casual conversation about the technology (2) • Familiar – You've some experience with fusion power, researched the subject for school, work, or personal interest, or learned about the technology in a class or workshop (3) Very familiar – You consider yourself an expert in fusion power (4)	1 to 4

Appendix 2.

The key text and survey questions provided to participants having answered the questions about their initial awareness and familiarity with fusion.

"In this section we will provide you more information about fusion energy and why it might be relevant for energy and science policy, and ask you about what features you like and dislike in this technology.

Energy consumption is expected to grow dramatically over the next fifty years as the world's population expands and developing countries become more industrialised. ***Governments and companies are looking for alternative ways of producing energy****. Coal and natural gas contribute to air pollution and climate change; Governments are divided over whether to include nuclear energy in the energy mix; and renewable sources might not be enough by themselves to reliably meet the demand.*

In this sense, ***nuclear fusion energy could be an important long-term energy source to complement other options****. Fusion energy is created by fusing two atomic nuclei. The heat produced by the reaction turns water into steam, which drives turbines to generate electricity. The foundation of fusion energy is similar to fission energy, the one produced in current nuclear power plants. Both fission and fusion are nuclear processes by which atoms are altered to create energy. But while nuclear fission is the division of one atom into two, nuclear fusion is the combination of two lighter atoms into a larger one. They are opposing processes, and therefore very different.*

Fusion energy promises to be an almost inexhaustible and clean source of energy*. Fuel for fusion energy (deuterium and tritium) is readily available and abundant (it can readily be extracted from seawater). The nuclear fusion reaction produces helium, which is an inert gas – no greenhouse gases or acid rain are emitted; and the irradiated products, once the plant is decommissioned, are short lived (50-100 years) compared to the waste from a conventional nuclear power plant (which lasts for thousands of years). Fusion reactions are intrinsically safe as the reaction terminates itself in the event of the failure of any sub-system.*

However, fusion power also presents scientific and engineering challenges very difficult to overcome*. Fusing two nuclei together requires a massive amount of energy, and so far, scientists haven't been able to figure out a way to get more energy out of a reaction than they put in. Physicists and engineers have been at work on this question for decades. Although many breakthroughs have been made and there are a number of major projects under development that may bring fusion closer to commercialization, fusion energy is yet unproven as a reliable energy source."*

Construct	**Item**	**Scale**
Attitude (T1)	Overall, how do you feel now about fusion as a potential energy source? I think it is a [ ] option	Very Poor (1) Poor (2) Fair (3) Good (4) Very Good (5)
Affect	To what extent does fusion energy evoke the following feelings in you, if at all? • Worry (1) --- Tranquility (5) • Aversion (1) --- Enthusiasm (5) • Disinterest (1) --- Interest (5) • Pessimism (1) --- Optimism (5)	1 to 5 for each option
Perceived costs, risks and benefits	What are your expectations with respect to this technology? I expect that it would be… • Technologically unviable (1) --- Technologically viable (5) • Cost too much to develop (1) --- have acceptable costs (5) (in terms of the investments in research, development and demonstration) • Contribute very negatively (1) --- very positively to the energy system (5) (in terms of energy security, diversification of the supply, etc.) • Have a very negative effect (1) --- very positive effect on the environment (5) (thinking about potential impacts on land, the atmosphere, water, etc.) • Very dangerous (1) --- very safe for human health (5) • Not economically competitive (1) --- economically competitive (5) (in terms of the price of the electricity produced) • Have other very negative (1) --- very positive social impacts (5) (other potential social and economic impacts that you might think)	1 to 5 for each option + don't know

Appendix 3.

The key survey questions that were provided to participants following the *consequence evaluation* task.

Construct	**Item**	**Scale**
Attitude (T2)	Taking into account your previous evaluation of the consequences of fusion energy, how would you rate fusion as a potential energy source? I think it is a [ ] option.	Very Poor (1) Poor (2) Fair (3) Good (4) Very Good (5)
Preference over other technologies	To what extent do you agree with the following statement: • Instead of investing in fusion energy, we should focus on alternative solutions, like renewable energies (solar, wind, biomass, etc.) • Instead of investing in fusion energy, we should focus on alternative solutions, like energy efficiency and saving. • Instead of investing in fusion energy, we should focus on alternative solutions, like conventional energies (e.g. nuclear, natural gas, coal).	Strongly disagree (1) Disagree (2) Neither agree nor disagree (3) Agree (4) Strongly agree (5)

Table 1. Key demographic characteristics of the study samples and initial self-claimed awareness and familiarity with fusion

Variable	Category	Austria (N = 830)		Finland (N = 849)		Spain (N = 872)		UK (N = 849)		TOTAL (N = 3,400)	
		n	%	n	%	n	%	n	%	n	%
Sex	Female	432	52.0	417	49.1	415	47.6	409	47.7	1,673	49.2
	Male	397	47.8	432	50.9	456	52.3	438	52.1	1,723	50.7
Age	18-29	149	18.0	166	19.6	144	16.5	151	17.8	610	17.9
	30-39	128	15.4	136	16.0	180	20.6	144	17.0	588	17.3
	40-49	171	20.6	149	17.6	185	21.2	165	19.4	670	19.7
	50-64	229	27.6	230	27.1	196	22.5	203	23.9	858	25.2
	65+	153	18.4	168	19.8	167	19.2	186	21.9	674	19.8
Education[a]	Non-university	631	76.0	431	50.8	388	44.5	483	56.9	1,933	56.9
	University	199	24.0	418	49.2	484	55.5	366	43.1	1,467	43.1
Awareness[b]	Yes	332	40.0	455	53.6	374	42.9	350	41.2	1,511	44.4
	No	498	60.0	394	46.4	498	57.1	499	58.8	1,889	55.6

Familiarity[c]	Not at all	45	13.6	29	6.4	38	10.2	39	11.1	151	10.0
	Slightly	221	66.6	334	73.4	268	71.7	223	63.7	1,046	69.2
	Familiar	60	21.9	82	18.0	60	16.0	72	20.6	274	18.1
	Very familiar	6	15.0	10	2.2	8	2.1	16	4.6	40	2.6

Notes. Where figures do not add up to 100%, this is due to respondents answering 'other'

[a] Non-university includes: None completed; Up to GCSE/O-Level (or equivalent); Up to A-Level (or equivalent); Other qualifications/apprenticeships. University includes: Degree level or higher; Undergraduate (not Bachelor's degree); Graduate (Bachelor's degree); Postgraduate (Master's, doctorate, PhD, etc.)

[b] Awareness of fusion: Before participating in this study, had you ever heard of fusion energy? (Yes; No)

[c] Familiarity with fusion: How would you rate your familiarity with fusion? (Not at all familiar – you know nothing about fusion power; Slightly familiar – You've heard about fusion power, read an article or watched a television feature about the technology; Familiar – You've some experience with fusion power, researched the subject for school, work, or personal interest; Very familiar – You consider yourself very well informed or expert in fusion power).

Table 2. Information provided to participants relating to the consequences of investing in nuclear fusion

Short theme title[1]	Full theme title[2]	Description provided
Timescales	***It will take years to build the technology***	Fusion power presents significant scientific and engineering challenges. So far, the main problem with fusion power generation is that it doesn't produce more energy than the electrical energy required to keep the reaction going. The first commercial fusion power plant, if ITER -the larger fusion experiment going on now- succeeds, is not expected to enter the energy mix before 2050.
Resource reliance	***Less dependence on scarce resources***	In a commercial fusion power station the fuel will consist of a mixture of deuterium and tritium. Deuterium is a stable hydrogen isotope. It is very abundant and may be cheaply extracted from seawater. Tritium can be produced from lithium, which is widely distributed in the Earth's crust. If used to fuel a fusion power station, the lithium in one laptop battery would produce the same amount of electricity as burning 40 tons of coal.
New installations	***New installations needed***	In order to implement this technology, demonstration plants would have to be built in the coming years. The next step for fusion research is the construction of the ITER, a large international fusion experiment in the south of France. The results will help guide the choice

		of materials for the design of DEMO, the prototype power plant that will follow the ITER experiment.
Radioactive waste	***Radioactive waste***	The fusion reaction releases neutrons. The neutrons would be quite dangerous to humans, but when the plant is turned off the production of neutrons ceases within milliseconds. The radioactivity in a fusion power plant will be confined to the power plant itself, there will not be any waste. Once the plant is decommissioned, the radioactive products are short lived (50-100 years) compared to the waste from a fission power plant (which lasts for thousands of years).
Climate change	***Contribution to climate change***	The only byproduct that is created during the nuclear fusion process is helium, which is not a greenhouse gas. So the contribution to climate change by generation of electricity would be greatly reduced through the use of this technology.
Cost of generation	***Price/Cost***	Although it is difficult to estimate the future cost of the electricity generated by means of fusion power, recent calculations suggest that a fusion power plant could generate electricity at a similar price to a conventional nuclear power station.

Notes. [1] Title used with the analysis; [2] Title as presented to participants

Table 3. Pre-information and post-information evaluations of fusion

	Austria (*N* = 830)	Finland (*N* = 849)	Spain (*N* = 872)	UK (*N* = 849)	Total (*N* = 3,400)
Fusion-affect (T1)	3.01 (0.97)	3.59 (0.81)	3.50 (0.94)	3.50 (0.88)	3.40 (0.93)
Fusion-belief (T1)	2.87 (0.67)	3.55 (0.70)	3.44 (0.84)	3.43 (0.81)	3.33 (0.88)
Fusion Consequences					
• Timescales	2.70 (1.00)	3.08 (0.99)	3.00 (1.04)	2.95 (1.05)	2.93 (1.03)
• Resource reliance	3.59 (1.06)	4.09 (0.84)	3.95 (0.89)	3.98 (0.90)	3.91 (0.94)
• New installations	3.06 (1.08)	3.61 (0.79)	3.45 (0.99)	3.43 (0.98)	3.39 (0.99)
• Radioactive waste	2.51 (1.36)	3.63 (1.12)	2.93 (1.35)	3.18 (1.32)	3.07 (1.35)
• Climate change mitigation	3.83 (1.06)	4.26 (0.79)	3.86 (1.12)	4.00 (1.04)	3.99 (1.02)
• Cost of power generation	3.40 (1.05)	3.90 (0.81)	3.54 (1.03)	3.59 (1.03)	3.61 (1.00)
Preference for alternatives					
• Energy efficiency and saving	3.72 (1.06)	3.28 (0.88)	3.50 (0.96)	3.30 (0.97)	3.45 (0.98)
• Renewable generation	3.86 (1.04)	3.35 (0.91)	3.80 (0.95)	3.46 (1.01)	3.62 (1.00)

• Conventional generation	2.05 (1.05)	2.15 (0.90)	2.53 (1.12)	2.62 (1.07)	2.34 (1.07)
Pre-information fusion attitude (T1)	2.98 (1.12)	3.63 (0.94)	3.40 (1.00)	3.54 (0.96)	3.39 (1.03)
Post-information fusion attitude (T2)	2.99 (1.12)	3.75 (0.87)	3.45 (1.00)	3.57 (0.96)	3.44 (1.03)
Mean Diff. in fusion attitude (T1 vs. T2)	+ 0.01	+ 0.12	+ 0.05	+ 0.03	+ 0.05

Table 4. Multiple linear regression model results for Finland and Austria

	Finland (*N* = 824)				Austria (*N* = 814)			
	Mean (SD)	Beta	*t*	Sig.	Mean (SD)	Beta	*t*	Sig.
T1 Attitude	**3.63 (0.92)**	**.48**	**16.45**	**< .001*****	**2.98 (1.10)**	**.45**	**14.212**	**< .001*****
Fusion affect	3.61 (0.77)	.02	0.73	.465	**3.03 (0.96)**	**.08**	**2.55**	**.011***
Fusion belief	**3.57 (0.68)**	**.14**	**4.40**	**< .001*****	2.88 (0.66)	.01	0.40	.690
Timescales	3.11 (0.96)	.01	0.53	.597	2.70 (1.00)	.01	0.67	.506
Resource reliance	**4.13 (0.76)**	**.06**	**2.28**	**.023***	**3.62 (1.03)**	**.06**	**2.68**	**.008****
New installations	3.62 (0.76)	.04	1.84	.066	**3.07 (1.07)**	**.13**	**5.27**	**< .001*****
Radioactive waste	**3.65 (1.10)**	**.11**	**4.57**	**< .001*****	**2.52 (1.36)**	**.09**	**4.10**	**< .001*****
Climate change	**4.29 (0.73)**	**.10**	**3.60**	**< .001*****	**3.85 (1.03)**	**.10**	**4.23**	**< .001*****
Cost of generation	**3.91 (0.77)**	**.08**	**3.35**	**.001****	**3.41 (1.04)**	**.12**	**5.25**	**< .001*****
Efficiency pref.	3.36 (0.89)	.01	0.19	.851	**3.87 (1.02)**	**- .05**	**2.07**	**.039***
Renewable pref.	3.28 (0.87)	- .01	0.52	.602	3.75 (1.04)	- .05	1.92	.055
Model statistics	Adj. R^2 = .69, $F(11, 812) = 169.00$, $p < .001$				Adj.R^2 = .77, $F(11, 802) = 247.74$, $p < .001$			

Notes. * $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Material

Outline of the online questionnaire-based survey. Survey conducted in November 2018, distributed via Norstat UK Ltd.

Dear participant, *Through this survey, we want to know your first impressions of an* ***experimental energy source*** *that could bring important changes to the energy sector in the future.* *During your progression through this survey—which should last no longer than 15 minutes—you will receive information that will introduce you to technology, after which you will be asked to provide answers to some simple questions about your opinions.* *We just want to know* ***your personal view****, based upon what you currently know or understand.* *It is important that you provide your best answers to each question in this survey. Your participation is much appreciated as it may help improve the future decisions relating to the development of this technology.* *Please note that all responses will be anonymous.* ***The data will be used exclusively for research purposes****. You have the right to withdraw from the study at any time.* *Thanks!*

Demographic questions

Are you?	1. Female 2. Male 3. Other
Please indicate your age range	18-29 30-39 40-49 50-64 65 and above
What is the highest level of education that you have completed?	Did not graduate from high school\ High school graduate, 2-year college degree or Technical education\ 4-year college degree or Postgraduate degree
Size of place of residence (city, town, village)	• *Less than 1.000 inhabitants (village)* • *Between 1.000 and 20.000 (town)* • *Between 20.000 and 100.000 (town, small city)* • *Between 100.000 and 300.000 (city)* • *Between 300.000 and 1 million (medium sized city)* • *More than 1 million inhabitants (big city)*
How would you describe your household's current income?	1. Finding it very difficult to live on current income 2. Finding it difficult to live on current income 3. Coping on current income 4. Living comfortably on current income 5. Living very comfortably on current income

How would you describe your political orientation?	(1 = extremely left, 7 = extremely right)

Initial questions

Before introducing the technology, we would like to ask you some questions about your general views on energy and technology issues.

Construct	*Item*	*Scale*
Prior knowledge/ issue involvement	Q1. How would you describe your level of knowledge about energy technologies (technologies to generate, store and manage energy such as wind, nuclear, biofuels, hydrogen, etc.) in general? *“I know_____about energy technologies”*	Scale 1-5 1. Nothing 2. A little 3. Something 4. Quite a lot 5. A lot
Attitude towards science	Q2. What do you think about the following statement? *“Even if it brings no immediate benefits, scientific research that advances the frontiers of human knowledge is…”*	Scale 1-7 1. Unnecessary and should not be supported by the government--- 7. Necessary and should be supported by the government
Attitude towards nuclear energy	Q3. “*I am personally in favour of using nuclear energy to generate electricity*”.	Scale 1-5 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree
Values	Q4. How much you disagree or agree with the following statements: • *“Humans have the right to modify the natural environment to suit their needs”* [Ecocentrism] • *“Technology alone will solve many environmental problems”* [Technocentrism]	Scale 1-5 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree
Attitudes towards new energy technologies	Finally, please tell us how much you disagree or agree with the following statement: *“We can adequately meet current and future energy demand by using the technologies that are currently available, there is no need to develop new options”.*	Scale 1-5 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree

First section

Have you ever heard of Fusion Energy? The search for alternative methods of energy supply and use has led governments and companies to develop a portfolio of **energy technologies** such as solar, wind, and geothermal energy. Among these potential solutions to future energy challenges, here we are focusing on **fusion energy**, an experimental technology that could be used for power generation and that works by fusing together atoms in order to release energy. We will provide you more information regarding **fusion energy** in the next section.

Construct	*Item*	*Scale*
Awareness of fusion	Q5. Before participating in this study, had you ever heard of fusion energy?	• Yes • No If 'No', filter to Q7
Familiarity with fusion	Q6. How would you rate your familiarity with fusion energy? Are you...?	Scale 1-4 1. Not at all familiar – You know nothing about fusion power 2. Slightly familiar – You've heard about fusion power, read an article or watched a television feature about the technology, or participated in a casual conversation about the technology 3. Familiar – You've some experience with fusion power, researched the subject for school, work, or personal interest, or learned about the technology in a class or workshop 4. Very familiar- You consider yourself very well informed or expert in fusion power
Personal relevance	Q7. How important is the development of fusion energy to you?	Scale 1-5 1. Non-relevant 2. Only slightly relevant 3. Somewhat important 4. Important 5. Very important

Second section

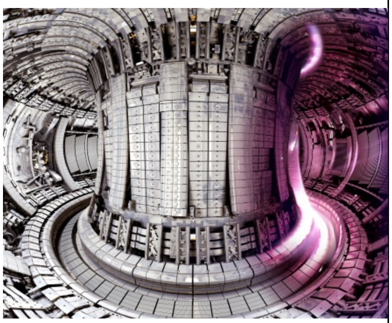
In this section we will provide you more information about fusion energy and why it might be relevant for energy and science policy and ask you about what features you like and dislike in this technology.

Please read the information carefully before proceeding

Energy consumption is expected to grow dramatically over the next fifty years as the world's population expands and developing countries become more industrialised. **Governments and companies are looking for alternative ways of producing energy**. Coal and natural gas contribute to air pollution and climate change; Governments are divided over whether to include nuclear energy in the energy mix; and renewable sources might not be enough by themselves to reliably meet the demand.

In this sense, **nuclear fusion energy could be an important long-term energy source to complement other options**. Fusion energy is created by fusing two atomic nuclei. The heat produced by the reaction turns water into steam, which drives turbines to generate electricity. The basis of fusion energy is similar to fission energy, the one produced in current nuclear power plants. Both fission and fusion are nuclear processes by which atoms are altered to create energy. However, while nuclear fission is the division of one heavy atom into two, nuclear fusion is the combination of two lighter atoms into a larger one.

Fusion energy promises to be an almost inexhaustible and clean source of energy. Fuel for fusion energy (deuterium and tritium) is readily available and abundant in seawater. The nuclear fusion reaction produces helium, which is an inert gas – no greenhouse gases or acid rain-causing particles are emitted. The radioactive products, once the plant is decommissioned, are short lived (50-100 years) compared to the waste from a conventional nuclear power plant (which lasts for thousands of years). Fusion reactions are intrinsically safe as only a few grammes of fuel are ever in the reactor. The reaction stops in the event of the failure of any sub-system. There is no chance of a chain reaction.



The JET fusion reactor with plasma

However, fusion power also presents scientific and engineering challenges very difficult to overcome. Fusing two nuclei together requires heating the fuel to very high temperatures into a *plasma*, and so far, scientists have not been able to figure out a way to get more energy out of a reaction than they put in. Physicists and engineers have been at work on this question for decades. Many breakthroughs have been made, fusion energy has been produced in laboratories, and there are a number of major projects under development that may bring fusion closer to commercialization. However, fusion energy is yet unproven as a reliable energy source.

Construct	*Item*	*Scale*

<table>
<tr><td>Attitude
(Time 1)</td><td>Q8. Based upon what you know or have just read, how do you feel about fusion energy?

“I think that fusion is a _____ energy option”</td><td>Scale 1-5
1. Very Poor
2. Poor
3. Fair
4. Good
5. Very Good</td></tr>
<tr><td>Affect

(Fusion-affect)</td><td>Q9. To what extent does fusion energy evoke the following feelings in you?

▪ Worry---Tranquility
▪ Aversion---Enthusiasm
▪ Disinterest---Interest
▪ Pessimism---Optimism</td><td>Scale 1-5 for each affective dimension</td></tr>
<tr><td>Perceived costs, risks and benefits

(Fusion-beliefs)</td><td>Q10. What are your beliefs and expectations regarding fusion technology:

“I think that fusion would be/have…”

• Technologically unviable --- Technologically viable

• Cost too much to develop (in terms of the investments in research, development and demonstration) --- Have acceptable costs (in terms of the investments in research, development and demonstration)

• Contribute very negatively to the energy system (in terms of energy security, diversification of the supply, etc.) --- Contribute very positively to the energy system (in terms of energy security, diversification of the supply, etc.)

• Have a very negative effect on the environment (thinking about potential impacts on lands, the atmosphere, water, etc.) --- Have very positive effect on the environment (thinking about potential impacts on lands, the atmosphere, water, etc.)

• Be very dangerous for human health --- Be safe for human health

• Be economically not competitive (in terms of the price of the electricity</td><td>Scale 1-5 for each belief dimension (+ don’t know) option</td></tr>
</table>

	produced) --- Be competitive (in terms of the price of the electricity produced) • Have other very negative social impacts (other potential social and economic impacts that you might think) --- Have very positive social impacts (other potential social and economic impacts that you might think)	
Epistemic trust (fusion specific)	Q11. To what extent do you agree with the following statement: *''Science knows all of the conditions important for judging the risks of developing nuclear fusion''*	Scale 1-5 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree

Third section

Fusion energy on a large scale will probably not be possible to implement before 2050. The necessary technical advances are expected to have been realized by then, but this is not a complete certainty. Please read and evaluate the following potential consequences of developing fusion energy

Construct	*Item*	*Scale*
Evaluation of consequences	Q12. Please evaluate how positive or negative you find each consequence of fusion energy [One consequence shown per screen in a randomized order] ***It will take years to build the technology*** *Fusion power presents significant scientific and engineering challenges. So far, the main problem with fusion power generation is that it doesn't produce more energy than the electrical energy required to keep the reaction going. The first commercial fusion power plant, if ITER -the larger fusion experiment going on now- succeeds, is not expected to enter the energy mix before 2050.*	Scale 1-5 1. Very negative 2. Negative 3. Not important 4. Positive 5. Very positive

	Less dependence on scarce resources *In a commercial fusion power station the fuel will consist of a mixture of deuterium and tritium. Deuterium is a stable hydrogen isotope. It is very abundant and may be cheaply extracted from seawater. Tritium can be produced from lithium, which is widely distributed in the Earth's crust. If used to fuel a fusion power station, the lithium in one laptop battery would produce the same amount of electricity as burning 40 tons of coal.* ***New installations needed*** *In order to implement this technology, demonstration plants would have to be built in the coming years. The next step for fusion research is the construction of the ITER, a large international fusion experiment in the south of France. The results will help guide the choice of materials for the design of DEMO, the prototype power plant that will follow the ITER experiment.* ***Radioactive waste*** *The fusion reaction releases neutrons. The neutrons would be quite dangerous to humans, but when the plant is turned off the production of neutrons ceases within milliseconds. The radioactivity in a fusion power plant will be confined to the power plant itself, there will not be any waste. Once the plant is decommissioned, the radioactive products are short lived (50-100 years) compared to the waste from a fission power plant (which lasts for thousands of years).* ***Contribution to climate change*** *The only byproduct that is created during the nuclear fusion process is helium, which is not a greenhouse gas. So the contribution to climate change by generation of electricity would be greatly reduced through the use of this technology* ***Price/Cost*** *Although it is difficult to estimate the future cost of the electricity generated by means of fusion power, recent calculations suggest that a fusion power plant could*	

	generate electricity at a similar price to a conventional nuclear power station.	
Attitude (Time 2)	Q13. Based upon what you have just read, how do you feel about fusion energy? *"I think that fusion is a _____ energy option"*	Scale 1-5 1. Very Poor 2. Poor 3. Fair 4. Good 5. Very Good
Acceptance	Q14. Overall, do you personally consider the research and development of fusion energy to be…?	Scale 1-5 1. Totally unacceptable 2. Unacceptable 3. Neither acceptable nor unacceptable 4. Acceptable 5. Totally acceptable
	Q14b. [filter If answered totally unacceptable or unacceptable] Why is this?	(open answer)

Fourth Section

In this last section, we would like to know your personal view on the following policy problem: *Should we keep investing efforts to make fusion energy happen or should we rely on other solutions to meet our future energy needs?*	
Attitude (categorical)	Q15. Which of the following statements best expresses your views on fusion energy? *select one* a. Fusion power might be an important source of electricity in the future, and interested countries should fund research on fusion b. Fusion might or might not be a viable source of electricity. We should keep research on fusion energy but prioritize other sources of energy. c. Fusion power is unnecessary and dangerous. We should reduce or cancel the nuclear fusion program and invest on other energy sources or alternative programs

Concept	*Item*	*Scale*
Support for investment in fusion	Q16. How much do you support or oppose public financial investments in the nuclear fusion research program • Q16a. *In your country?* • Q16b. *At a European Union level?*	Scale 1-5 1. Strongly Oppose 2. Somewhat Oppose 3. Neither support nor oppose/undecided 4. Somewhat Support 5. Strongly Support

Preference over other technologies	Q17. To what extent do you disagree or agree with the following statements? Q17_1. *Instead of investing in fusion energy, we should focus on alternative solutions, like renewable energies (solar, wind, biomass, etc.)* Q17_2. *Instead of investing in fusion energy, we should focus on alternative solutions, like energy efficiency and saving* Q17_3. *Instead of investing in fusion energy, we should focus on alternative solutions, like conventional energies (nuclear, natural gas, coal)*	Scale 1-5 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree
Preference over other technologies	Q18. If you had to invest 100 Euros in the research and development of energy sources for the purposes of electricity generation, how would you distribute the money among the following options? You can assign all the money to one option or distribute it among all or some of the available options. Please distribute exactly 100 Euros ▪ *Wind and solar energy* ▪ *Bio energy (biomass and biofuels)* ▪ *Energy efficiency and saving* ▪ *Nuclear (fission) energy* ▪ *Fusion energy* ▪ *Natural gas* ▪ *Coal* *Please attribute money to at least one of the options*	0-100 EUROS (Sum 100)

Fifth Section

ITER, short for International Thermonuclear Experimental Reactor, is being built in the south of France to test that nuclear fusion can be controlled to generate power. ITER is a multinational effort, in which the European Union has a 45 percent stake and the United States, Russia, China and three other partners 9 percent each. It is a crucial step toward fusion power.

If it works — if it produces more energy than it consumes, which smaller fusion experiments so far have not been able to do — it could lead to plants that generate electricity from nuclear fusion. The cost of design and construction is estimated at 20 thousand million euros (around 20 euros per EU citizen).

Concept	*Item*	*Scale*
Awareness of ITER	Q20. Before participating in this study, had you ever heard about ITER?	Yes/No
Acceptance of ITER	Q21. What is your opinion about investing in ITER: Do you favor it, oppose it, or neither?	Scale 1-5 1. Strongly Oppose 2. Somewhat Oppose 3. Neutral 4. Somewhat Favor 5. Strongly Favor

Construct	*Item*	*Scale*
General trust	Q22. How much do you trust • Q22_1. *Nuclear fusion scientists to make good decisions about fusion energy?* ▪ Q22_2. Nuclear fusion research managers to make good decisions about fusion energy? ▪ Q22_3. Decision makers in your country to make good decisions about fusion energy? ▪ Q22_4. Decision makers in the European Union to make good decisions about fusion energy?	Scale 1 to 5 1. not at all 2. to a small extent 3. to some extent 4. to a moderate extent 5. to a large extent
Perception of information	Q23. To what extent do you think that the information we have provided about fusion was?	Scale 1-5 1-Totally biased --- 5-Totally balanced

Many thanks for your time!

This questionnaire is part of the project Socio-Economic Research on Fusion (SES), funded by EUROfusion. The data you have provided will be exclusively used for research purposes. If you have any query, please contact us at [ANONYMISED FOR REVIEW]