PUBLIC ATTITUDES TOWARDS FUSION ENERGY IN EUROPE

Key findings of the second edition of the EUROFUSION Survey

FINAL REPORT

SES-EUROFUSION 2024

The Project Socioeconomic Studies on FUSION is part of EUROFUSION

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Important disclaimer

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Executive summary

This report, produced by the Socio-Economic Studies (SES) Programme at EUROFUSION, provides a detailed analysis of public attitudes towards fusion energy in Europe. The report is based on a comprehensive survey research conducted to map out the public's attitudes towards fusion energy as well as their overall acceptance and support for further development in this field.

Our methodology included a self-administered questionnaire survey. The study involved 19,144 respondents from 21 European countries. The survey was designed to capture informed opinions by providing participants with comprehensive background information on fusion energy, including its benefits, risks, and potential socioeconomic and environmental implications. This approach aimed to overcome the challenges associated with measuring public attitudes towards complex and emerging technologies, where awareness and understanding may be limited.

Key Findings:

- Awareness and initial attitudes: The study revealed a low to moderate awareness of fusion energy among the general public, with 72% of respondents indicating very little or no knowledge of the technology. Initial attitudes were mostly neutral or undecided.
- Perceptions of fusion energy: Respondents evaluated fusion energy favourably in terms of its environmental and socioeconomic benefits, despite some concerns regarding safety and feasibility.
- Perceptions of post-Information: Exposure to detailed information about fusion energy led to a generally positive shift in perceptions.
- Attitude, acceptance, and support: The majority of respondents displayed supportive or neutral stances towards fusion energy, with a high overall acceptance and a strong preference for its continued research and development. Sociodemographic factors such as age, gender, and education level were found to influence support.
- Trust and information sources: The study highlighted a strong trust in scientists and environmental NGOs as information sources on fusion energy. A collaborative approach between governments and the private sector in developing fusion energy was overwhelmingly favored by respondents.
- Country-Specific Differences: Acceptance and support for fusion energy varied across countries, with the UK, Finland, and Poland showing the highest levels of enthusiasm. Austria presented the lowest levels of acceptance and support, indicating the importance of tailoring public engagement strategies to national contexts.

The findings of this report underscore the importance of addressing the low to moderate public awareness and understanding of fusion energy in Europe. While initial attitudes are neutral, the provision of factual, comprehensive information has a positive impact on public perception, leading to a recognition of fusion's potential environmental and societal benefits. As fusion technology advances, fostering informed public discourse and engagement will be critical in shaping the future role of fusion energy in Europe's energy landscape. Targeted strategies, aligned with national contexts and leveraging trusted information sources, will be essential in cultivating broad-based support and acceptance for fusion energy development.

Introduction

Understanding public attitudes towards fusion energy and research is crucial for stakeholders within the fusion community and energy policymakers across Europe. This report, developed as part of the Socio-Economic Studies (SES) Programme within EUROFUSION, aims to investigate European citizens' familiarity with fusion energy, their perceptions of its potential benefits and risks, and the level of acceptance and support for further fusion development.

Survey methodology has long been used to gauge public attitudes towards emerging technologies (Gupta, Fischer, and Frewer, 2012). However, it faces the challenge of distinguishing between genuine opinions and 'pseudo-opinions' or 'non-attitudes' (De Best-Waldhober & Daamen, 2006), particularly when the public's awareness and knowledge of a specific technology, such as fusion, is limited. Our research aimed to capture informed opinions on fusion energy, including its potential implications, by providing participants with comprehensive information.

This report emanates from extensive survey research conducted in 2018 within the Socio-Economic Studies (SES) Programme at EUROFUSION, aiming to gather nuanced, cross-national data on public attitudes towards fusion energy and research (Oltra et al., 2019; Jones et al., 2021; Turcanu et al., 2020). Previous qualitative research conducted within the programme (Prades et al., 2009a; Prades et al., 2009b; Delicado et al., 2020; Jones et al., 2024) has also been a valuable foundation for the preparation of this second edition of the survey.

The research objectives of this survey were threefold. Firstly, to examine public perceptions of the benefits and risks of fusion energy, as well as broader attitudinal dimensions such as affect, acceptance and support. Secondly, to conduct cross-country comparisons to map out the diverse European public opinion landscape on fusion energy acceptance. Thirdly, to analyse how these attitudes evolve post-exposure to expert information on fusion's consequences relative to various message frames. Data for this study was collected in the last quarter of 2023.

Overview of the study

A self-administered questionnaire survey was conducted in 21 European countries to gain insight into public attitudes towards fusion energy. The questionnaire was developed specifically for this survey and data was collected via online panels.

The questionnaire design followed the format of the 2018 edition of the survey. The study was based on the technology acceptance model (Huijts, Molin, and Steg 2012), which is an analytical psychosocial framework that explains public acceptance of energy technologies. Previous studies on public acceptance of energy technologies (Gupta et al., 2012) and the Information Choice Questionnaire (De Best-Waldhober & Daamen, 2006) were also used. Specific questions and items were derived from previous studies, when possible, to ensure the validity and reliability of the measures.

The questionnaire presented information and measured various dimensions. The first questions measured prior attitudes, including problem perception (energy trilemma), familiarity with and attitude towards various energy options.

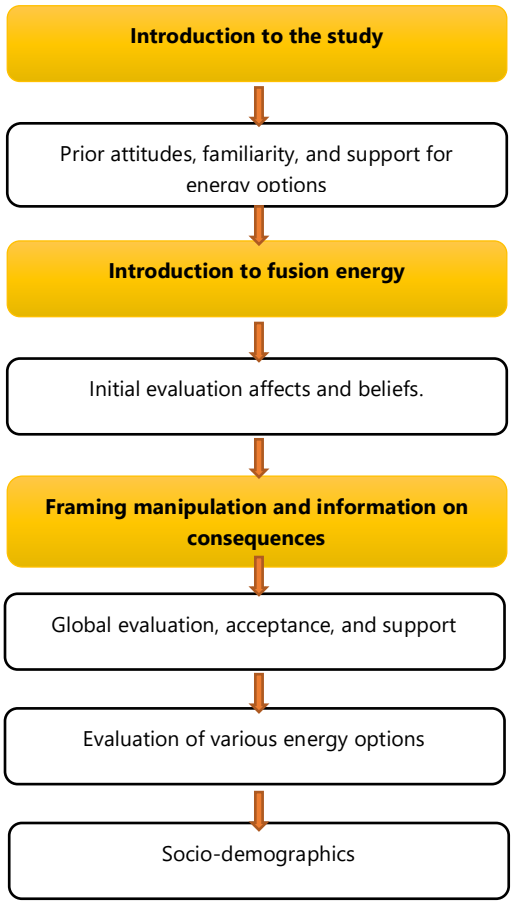

Figure 1. *Design of the questionnaire*

Respondents were then provided with introductory information about fusion energy and asked to rate it on a scale from 1 to 5, from very bad to very good. In this section, an experimental manipulation was conducted. Half of the respondents were asked to read a list of consequences of developing fusion energy (evaluation of consequences condition). The other half of

respondents were divided into four message framing conditions: innovation, socio-economic benefits, climate change, and global cooperation. An additional message was added to the introductory information about fusion, emphasizing a potential benefit of developing fusion energy.

After this information, participants in the framing conditions were asked to report their *feelings* and *beliefs* about fusion energy. For participants in the evaluation of consequences condition, we provided participants with expert information about seven potential consequences of the development of fusion energy. To stimulate information processing and to help respondents reach a more stable attitude, they were requested to give a quantitative evaluation of each consequence.

After this, participants answered questions measuring *global evaluation of fusion energy*, *acceptance* and *support*. Finally, all participants were asked about their level of trust in the various actors providing information about fusion energy.

Variables

Some of the variables included in the questionnaire were derived from the dimensions shown in Table 1. For a full version of the questionnaire, see the Annex.

Table 1. *Dimensions included in the questionnaire*

DIMENSION	DEFINITION
PROBLEM PERCEPTION (ENERGY TRILEMMA)	Level of concern about the reliability, the environmental impact, the cost and affordability and the safety of how electricity is generated and supplied
FAMILIARITY	Subjective familiarity with various energy technologies
INITIAL ATTITUDE	Initial support for various energy technologies before being informed about potential consequences
PERCEPTION OF BENEFITS AND COSTS	Beliefs about the potential benefits and costs of fusion energy in a number of dimensions (from economic to environmental or social)
AFFECT	Degree in which the technology generates various emotions in participants
EVALUATION OF CONSEQUENCES	Degree in which individuals consider potential consequences an advantage or a disadvantage
OVERALL ATTITUDE	Attitude towards the technology
ACCEPTANCE AND SUPPORT	Degree in which the individual accepts and supports further developments in the technology

Provision of information

The provision of information was a crucial element in constructing the questionnaire. Two pieces of information were given to the respondents:

An introduction to the main characteristics of fusion energy, which was provided after the study introduction and the questions on prior attitudes. This background information was based on a selection of materials from websites and newspapers, and aims to provide citizens with factual information that they could acquire through the media, factsheets, and websites.

Information on the potential consequences of fusion, such as costs, risks, and benefits. The information regarding the potential consequences of fusion energy was developed in collaboration with Eurofusion experts to ensure its validity and impartiality. The final document, which includes background information and details about the consequences, was reviewed by three fusion experts. Participants were asked to assess the significance of each consequence.

Sample

The total research sample consisted of 19144 European citizens, ages 18 and older. Samples of the general population in the study countries were recruited from large national panels (see table 1) in November 2023. The use of panels allowed achieving a representative sample of the general population in terms of sex and age. Other quota (region and education) were considered as soft quota.

Table 2. Details of the sample

Country	n
United Kingdom	918
Italy	914
France	939
Germany	891
Austria	916
The Netherlands	935
Denmark	910
Finland	911
Sweden	913
Latvia	894
Lithuania	921
Poland	884
Belgium	919
Spain	944
Portugal	908
Bulgaria	875
Czech Republic	942
Romania	908
Slovenia	891
Ukraine	913
Greece	913
Total	19160

Results

Awareness of fusion relative to other sources of energy

In the entire sample, which includes participants from all study countries, familiarity levels with fusion energy were lower compared to renewable energy sources like solar and wind. Familiarity with residential solar panels was reported to be higher. Conversely, familiarity with nuclear energy was lower, with 55% of respondents indicating little or no knowledge of this technology. Similarly, 62% of respondents reported little or no knowledge of gas power plants. In regard to fusion energy, 72% reported little or no knowledge about it, 20% of respondents reported having a moderate amount of knowledge about it, while only 6% claimed to have a lot of knowledge. This indicates that familiarity with fusion energy is moderate to low, which is consistent with the findings from 2018 when only 7% of respondents considered themselves 'familiar' with fusion energy.

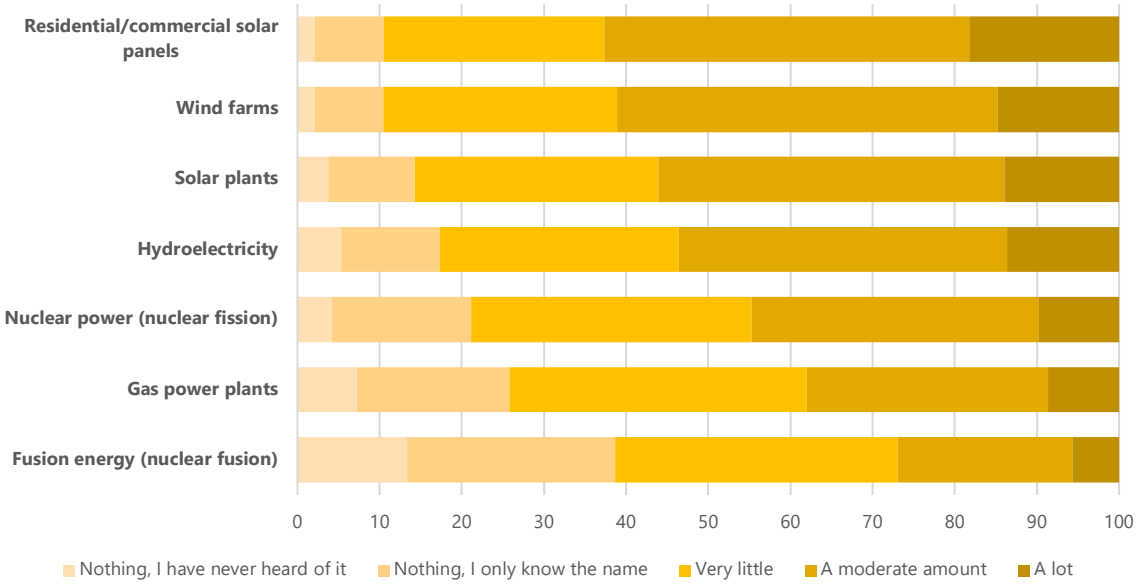

Figure 2. *Familiarity with various energy options (in % of total sample, n= 19160)*

Initial attitude

Prior to reading general information about fusion energy, respondents were asked to rate their level of support for expanding various energy technologies in their country on a scale of 1 (strongly oppose) to 5 (strongly support). This initial attitude can be considered a measure of how individuals generally evaluate fusion energy before being informed about its main characteristics and challenges.

In general, respondents had a neutral initial reaction to fusion energy (nuclear fusion). According to Figure 3, 26% of respondents opposed expanding fusion energy in their country, 42% were undecided, and 32% were in favour of expanding fusion energy. The level of support was generally higher for residential and commercial solar panels, solar plants, and wind farms. In the total sample, over 70% of respondents expressed their support for expanding these three energy technologies compared to 32% of respondents expressing their support for expanding fusion energy.

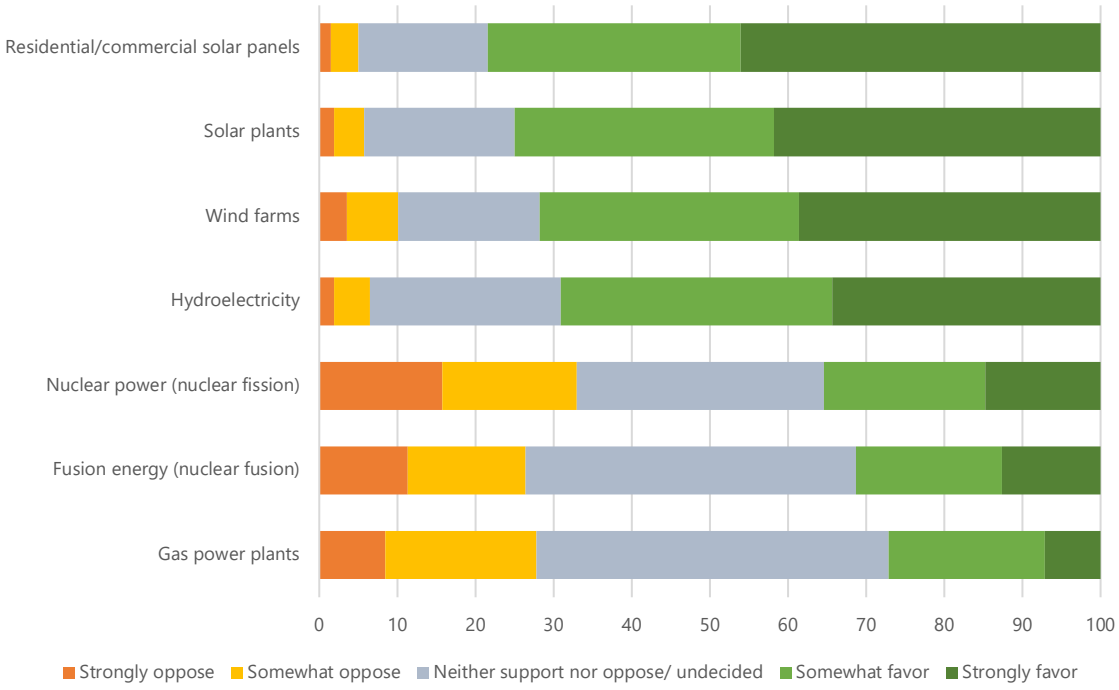

Figure 3. *Initial support to various energy options (in % of total sample, n= 19160)*

Initial support for fusion energy varied across Europe, with Finland, Poland, Bulgaria, and Romania showing higher levels of support (averaging almost 3.4 on a 1 to 5 scale) and Austria, Portugal, Italy, Ukraine, and Greece showing lower levels of support (averaging less than 2.9).

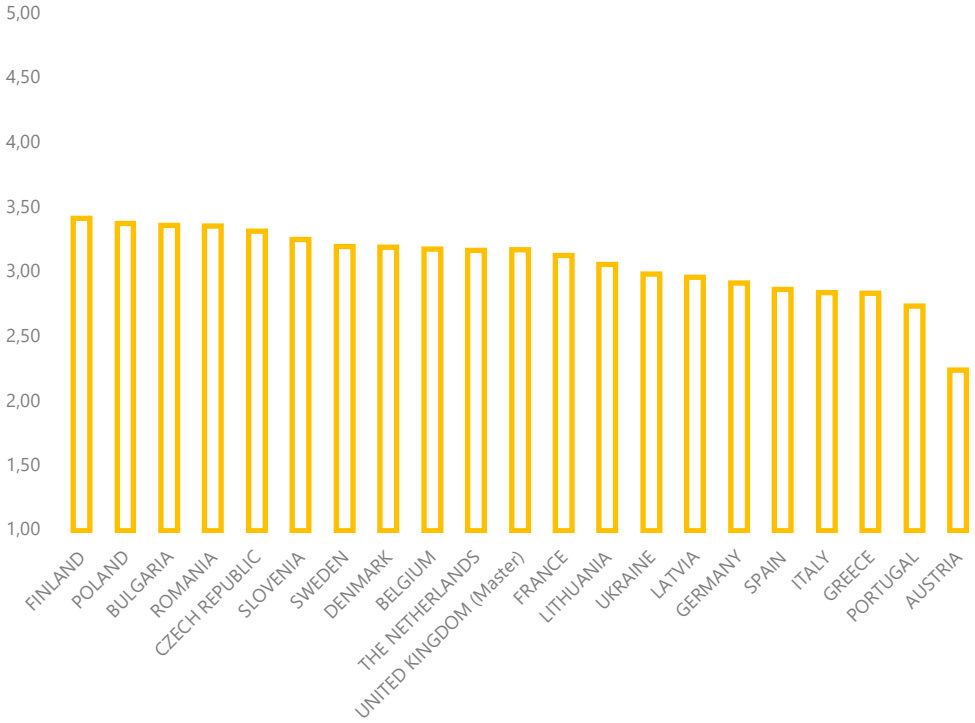

Figure 4. *Initial support to various energy options (in % of country sample)*

Evaluation of fusion

After presenting general introductory information about fusion energy (see the Annex), we asked respondents to rate it on a scale from 1 (very poor) to 5 (very good). This initial evaluation measures how individuals generally perceive fusion energy after briefly reflecting on its main characteristics and challenges. Respondents generally reported a positive reaction to fusion energy.

Figure 5. *Evaluation of fusion energy (in % of total sample, n= 19160)*

Figure 5 shows that fusion energy was generally well-received by respondents, with an average evaluation of 3.68 on a 1 to 5 scale. Across the 21 countries surveyed, over 58% of respondents rated fusion as good or very good, while less than 10% considered it bad or very bad. Initial average evaluations of fusion energy ranged from 3.24 in Austria to around 3.90 in the United Kingdom, Finland, Bulgaria, and Romania.

Feelings associated to fusion energy

The participants were asked to evaluate their emotional and cognitive responses to fusion energy. The results, as illustrated in the figure below, indicate that the affective associations with fusion energy were generally neutral to positive among the study population. Respondents were asked to rate the extent to which fusion energy evoked various emotions on a scale of 1 to 5, including worry or tranquillity, aversion or enthusiasm, disinterest or interest, and pessimism or optimism. On average, the respondents reported feeling neutral about worry and tranquillity (3.12), slightly more enthusiastic than averse (3.34), significantly more interested than disinterested (3.67), and slightly more optimistic than pessimistic (3.43).

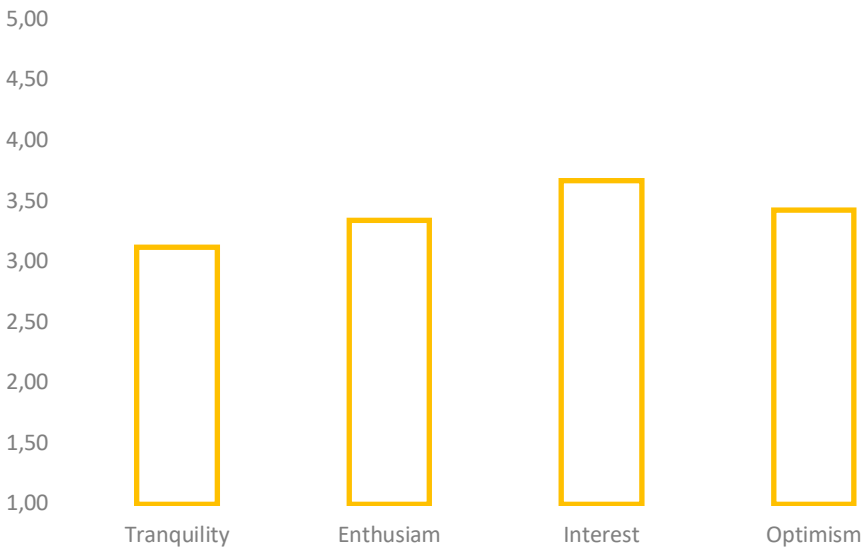

Figure 6. *Emotional associations to fusion energy (average, total sample, n= 19160)*

Beliefs about the benefits and negatives of fusion energy

In general, respondents perceived fusion as having positive to neutral impacts on the environment, public health, and society. Almost 50% of respondents had a positive view on the environmental and socioeconomic impacts of fusion, compared to around 10% who had a negative view. In terms of public health impacts, 18% of respondents held a negative view, 29% were undecided, and 34% had a positive outlook. As for the three impacts, nearly 30% of respondents were either undecided or perceived a potentially neutral impact of fusion.

	-2	-1	0	1	2	
Very negative effect on the environment	5%	8%	26%	28%	18%	**Very positive effect on the environment**
Be very dangerous for human health	6%	12%	29%	22%	12%	**Be safe for human health**
Very negative socio-economic impacts	4%	7%	26%	29%	18%	**Very positive socio-economic impacts**

Figure 7. *Assessment of fusion energy based on pairs of benefits/costs (in %, scale from -2 to 2, sample, n=9580)*

Regarding the costs of developing fusion, 47% of respondents were unsure or undecided. On the positive side, 33% of respondents considered that developing fusion would have acceptable costs, but 20% considered that it would be too expensive.

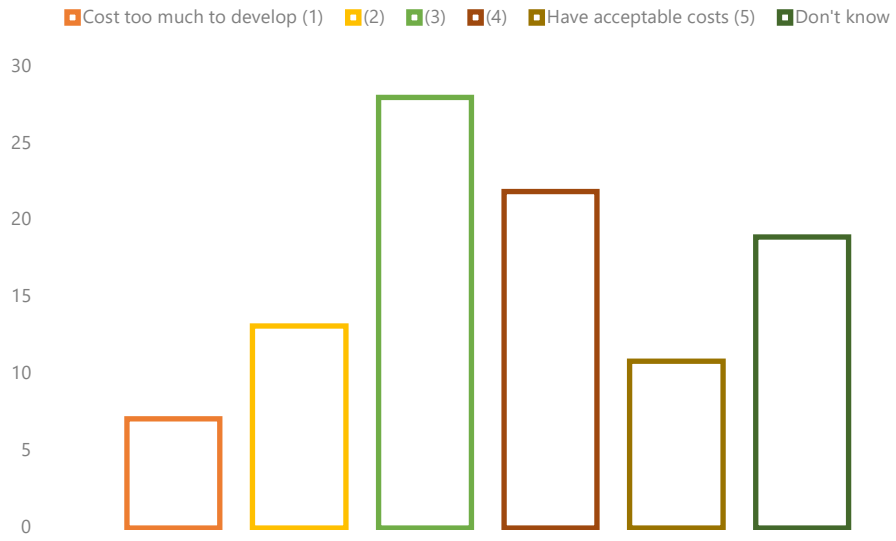

Figure 8. *What are your expectations with respect to this technology? I belief that it would… (in %, sample, n=9580)*

Regarding the feasibility of fusion energy, almost 50% of respondents believed that fusion energy will be feasible in the future. 30% of respondents were undecided about its feasibility, and less than 10% believed that it will not be feasible. 16% of respondents did not provide an answer.

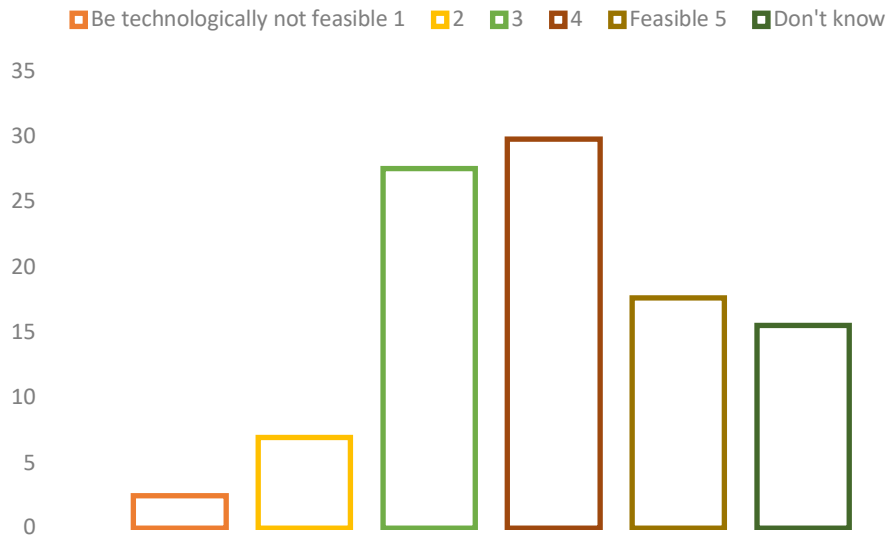

Figure 9. *What are your expectations with respect to this technology? I belief that it would be…*

(in %, sample, n=9580)

Evaluation of consequences of developing and implementing fusion energy

For the respondents who evaluated the consequences of developing fusion (50% of respondents), Table 3 below presents the average evaluation of each consequence of developing fusion, as provided to participants in the questionnaire. It also shows the correlation between the evaluation of a consequence and the overall evaluation of fusion energy.

Consequence	Average evaluation (1 to 5)	Correlation (-1 to 1)	Average overall evaluation of fusion
The success of fusion energy is uncertain.	2,87	.29	3.64
Fusion energy does not produce long-lived radioactive waste like nuclear fission (current nuclear power plants).	3,71	.57	
Fusion energy has the potential to contribute significantly to climate change mitigation.	4,01	.58	
Building technology to harness fusion power will take many years.	3,10	.33	
Fusion power uses abundantly available resources.	3,59	.55	
Investing in fusion energy research and development does come with substantial costs.	2,89	.35	
Nuclear fusion has potential applications beyond electricity production.	3,72	.59	

Table 3. *Evaluation of the consequences of developing fusion and correlation with overall evaluation ((mean, n=19160)*

All consequences were evaluated as neutral (with a value of 3 on a 1 to 5 scale, where 1 is very negative and 5 is very positive) or positive. The positive consequences included the potential contribution of fusion to climate change (4.01), potential applications of fusion beyond electricity production (3.72), and low production of long-lived radioactive waste (3.71). On average, participants evaluated the potential environmental and societal consequences of fusion positively. However, they evaluated the uncertain success of fusion energy (2.87) and the costs of investing in fusion development (2.89) less positively.

The correlations between the evaluations of the consequences and the overall evaluation of fusion energy were medium to strong. The consequences that had the highest correlation were 'Nuclear fusion has potential applications beyond electricity production' (r = .59), 'Fusion energy has the potential to contribute significantly to climate change mitigation' (r = .58), and 'Fusion energy does not produce long-lived radioactive waste like nuclear fission (current nuclear power plants)' (r = .57). These consequences had the most influence on the overall evaluation of fusion. The consequence that had the lowest correlation with the overall evaluation was 'The success of fusion

energy is uncertain' (r = .29). This suggests that this consequence had very little impact on the overall evaluation. Although this consequence was evaluated as less positive than others, it did not affect the overall rating of the option.

Attitude towards fusion

To categorise attitudes towards fusion energy, respondents were presented with three statements about nuclear fusion and asked to select the one that best represented their view. As shown in the figure below, 46% of respondents reported a neutral or ambivalent position towards fusion energy, stating that 'Fusion might or might not be a viable source of electricity, so we should keep researching fusion energy but prioritise other sources of energy'. 45% of respondents reported a positive attitude towards fusion and believed that fusion power could be an important source of electricity in the future. They suggested that interested countries should fund research on fusion. Only 9% of respondents believed that fusion power is unnecessary and suggested reducing or cancelling the nuclear fusion program and investing in other energy sources or alternative programs. Notably, the results are almost identical to those of the 2018 survey.

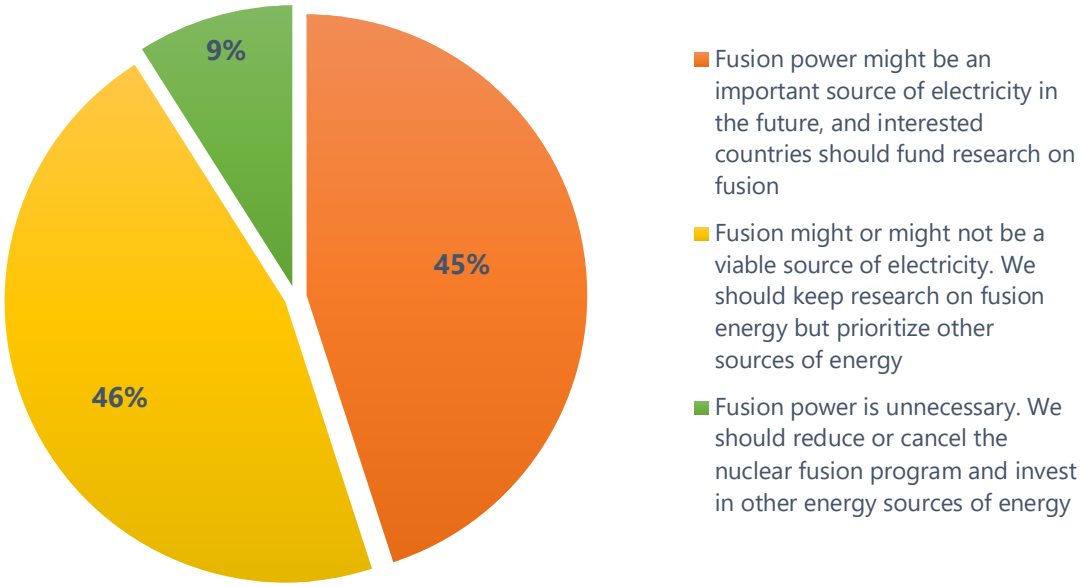

Figure 10. *Attitude towards fusion energy (in %, total sample, n=19160)*

In Romania, The Netherlands, Finland, and Slovenia, over 50% of respondents agreed that fusion power could be a significant source of electricity and that research on it should be funded. Conversely, in Austria and Italy, over 15% of respondents believed that fusion power is unnecessary.

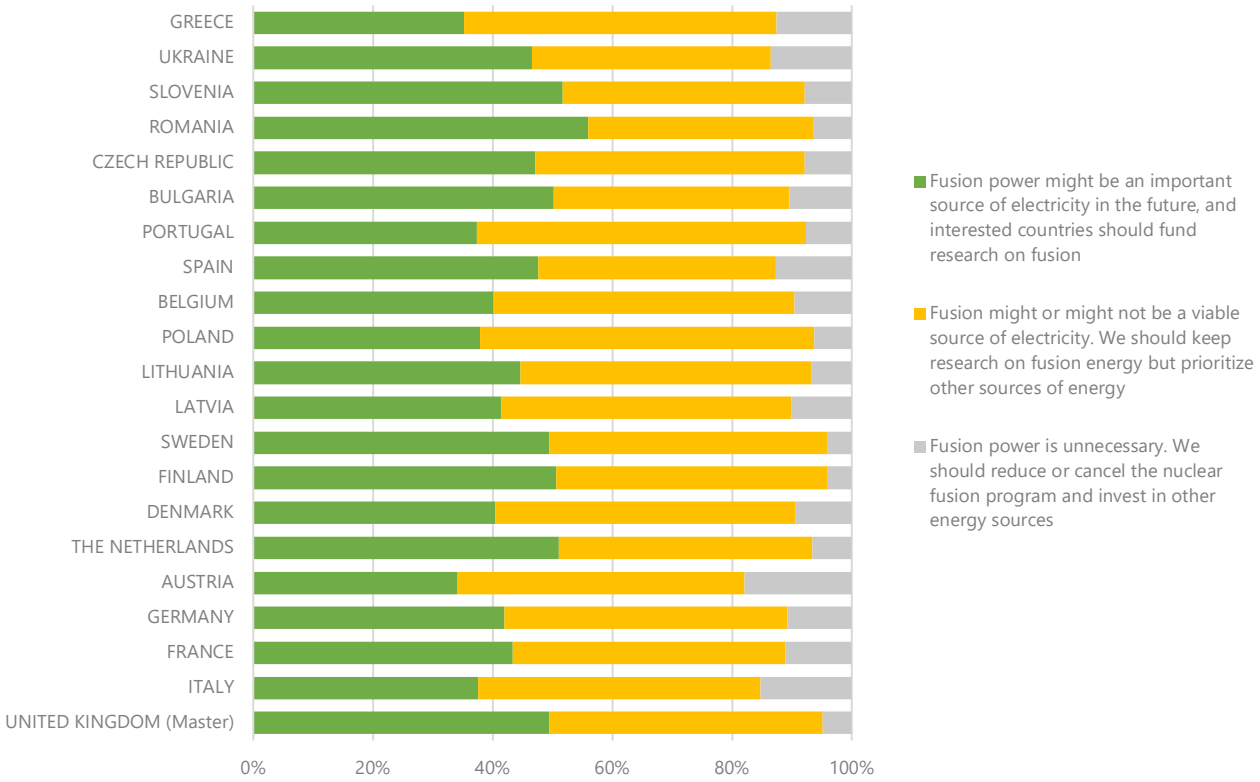

Figure 11. *Attitude towards fusion energy (in %, per country)*

Acceptance and support to fusion energy

In the total sample, 59% of respondents found the development of fusion power acceptable (43%) or totally acceptable (16%). 32% of respondents were unsure or undecided about the development of fusion power, and 9% considered it unacceptable. Compared to the 2018 survey, acceptance of fusion in 2023 has decreased to 59% from 65%, and more people report being undecided or neutral about the development of fusion energy, with 32% compared to 24% in 2018.

Figure 12. *Acceptance of fusion energy (in %, total sample, n=19160)*

The public acceptance of fusion varied from 49% in Austria and Greece to 68% in the United Kingdom and Poland.

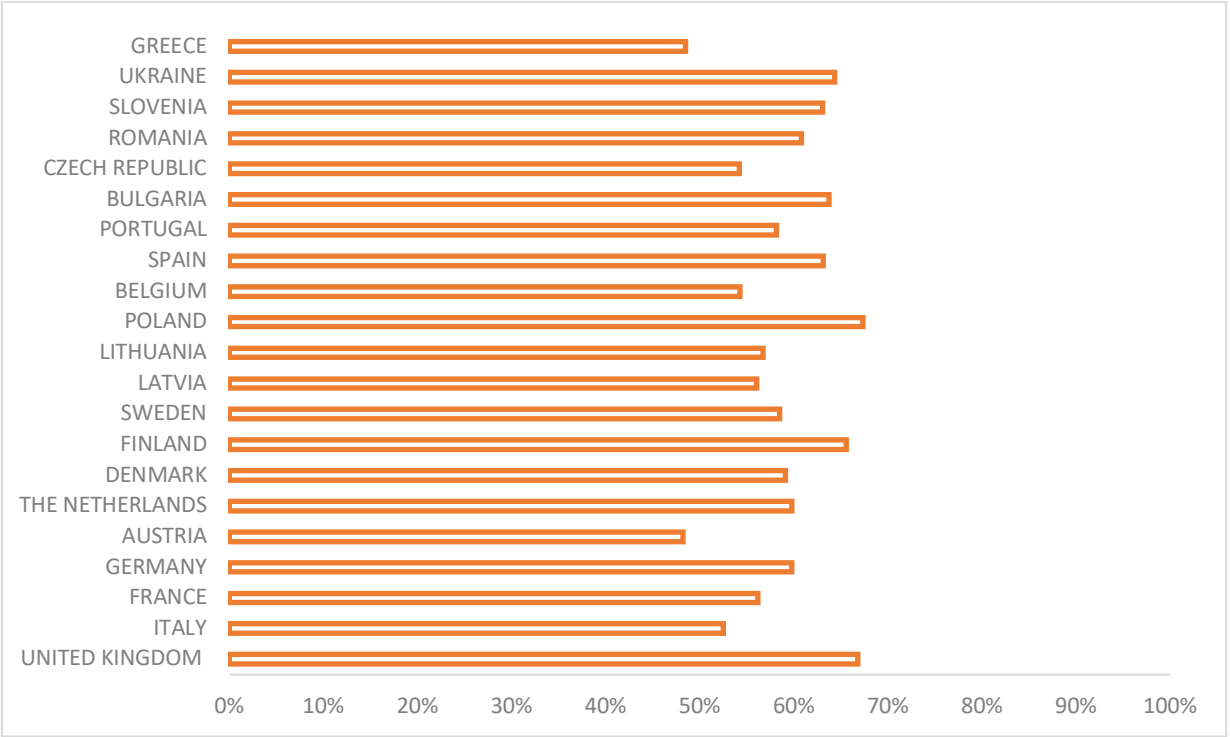

Figure 13. *Acceptance of fusion energy (per country, in % of respondents that consider fusion acceptable or totally acceptable)*

Support for expanding fusion energy was relatively high among the study population, with 54% of respondents in favour of expanding fusion energy in their own country. 31% of respondents were undecided about the expansion of fusion energy, and almost 14% were against it. These levels of support were similar to those found in the 2018 edition of the survey.

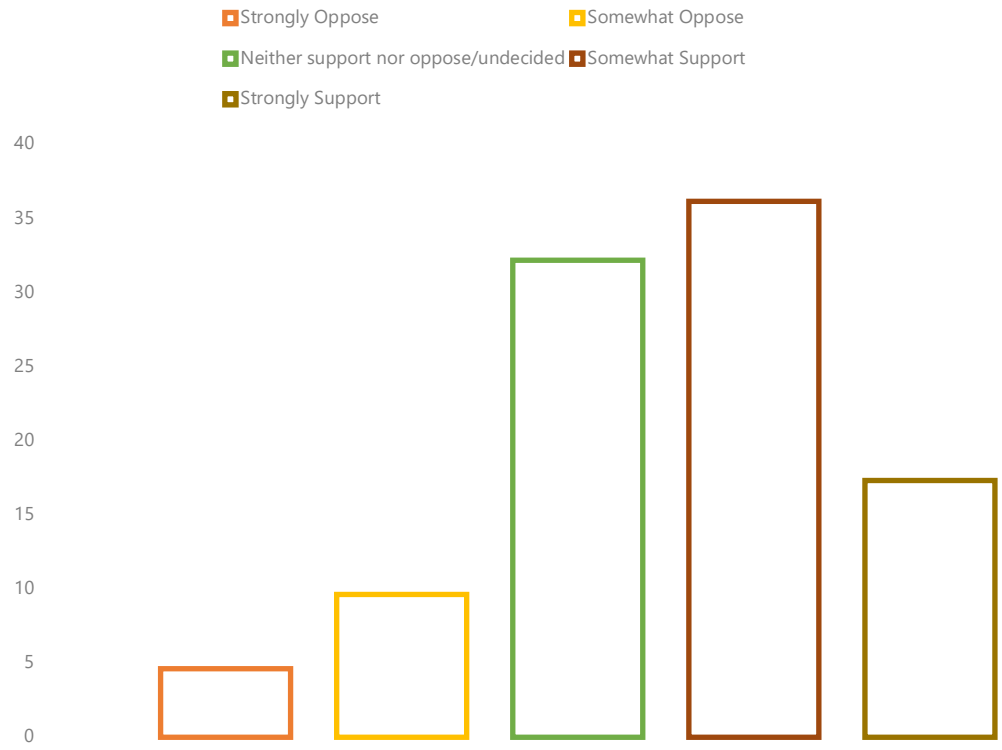

Figure 14. *To what extent do you support or oppose expanding fusion energy in your country? (in %, total sample, n=19160)*

Support for expanding fusion at the national level varied from less than 40% in Austria and Latvia to over 60% in Poland, the United Kingdom, Finland, and Ukraine.

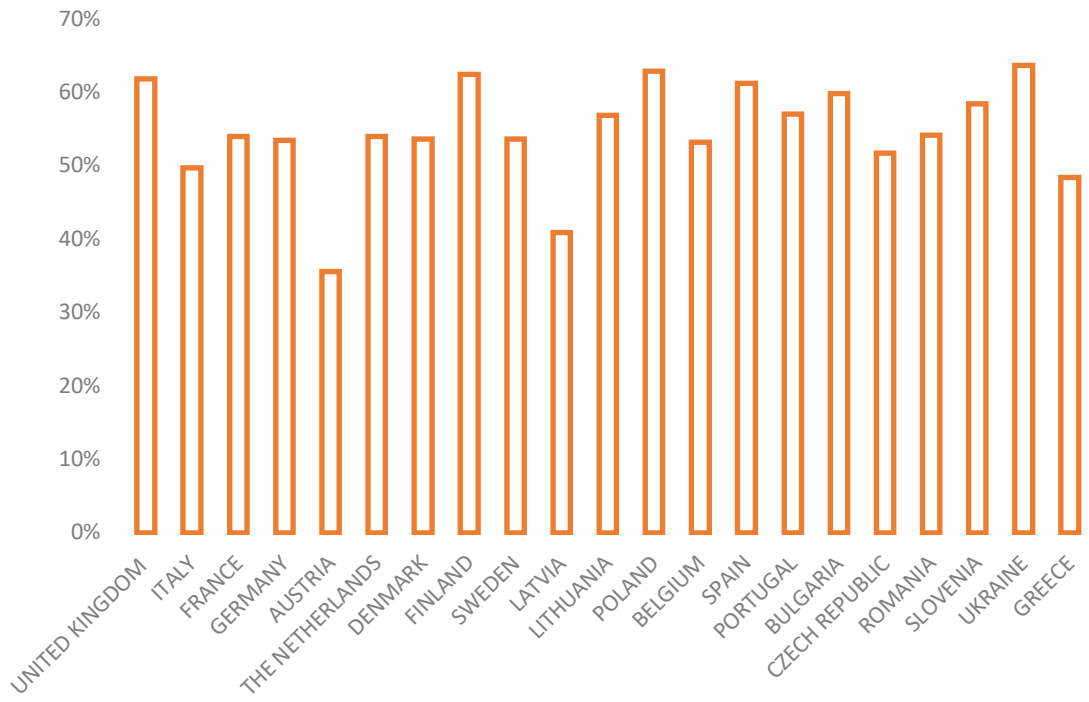

Figure 15. *Support for fusion energy (per country, in % of respondents that support or totally support expanding fusion energy in their country)*

Support for the expansion of fusion energy varied according to socio-demographics. Education and gender were moderately associated with support for fusion, while age was also significantly associated. Specifically, support was higher among men than women, older people than younger people, and those with college degrees compared to those without university education. There were no significant differences in support for fusion based on the size of the place of residence (see table below).

Variable	*Category*	*Support (mean, 1-5 scale)*
Sex	Male	3,70
	Female	3,34
Age	18-29	3,39
	30-39	3,45
	40-49	3,54
	50-64	3,58
	65 and above	3,66
Education	Did not graduate from high school	3,40
	High school graduate	3,44

	2-year college degree or Technical-vocational education	3,40
	4-year college degree or Postgraduate degree	3,82
Size of place of residence	A big city	3,53
	The suburbs or outskirts of a big city	3,53
	A town or a small city	3,52
	A country village	3,48
	A farm or home in the countryside	3,47

Table 4. *Overall evaluation of fusion according to socio-demographics (mean, n=19160)*

Investment preferences

Respondents were asked about their views on the development of fusion energy by governments or private companies. The chart below illustrates that 74% of respondents believe that both governments and private companies should be equally involved in the development of fusion energy. Only 20% of respondents believe that fusion energy should be mainly developed by governments, while 6% believe it should be mainly developed by private companies.

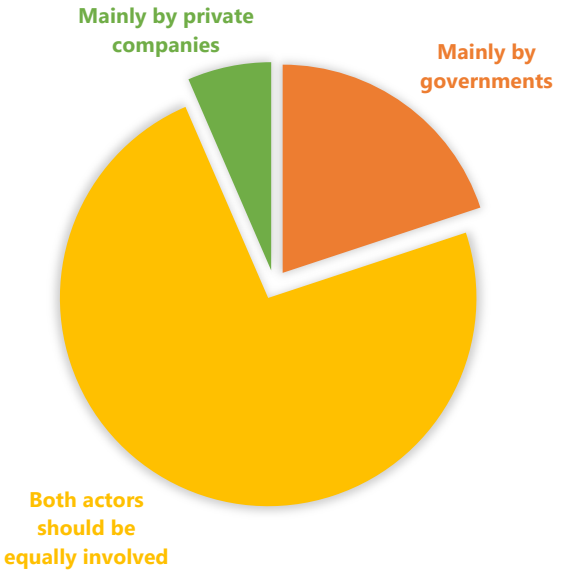

Figure 16. *To what extent do you think fusion energy should be developed by governments or by private companies? (in %, total sample, n=19160)*

In every country surveyed, the majority prefer equal involvement from both governments and private companies in fusion energy development. The percentages range from 67% in the Netherlands to 81% in Finland, indicating a strong overall preference for collaborative efforts. It is worth noting that all countries surveyed showed a strong preference for collaboration.

In some countries, a significant minority favours a government-led approach, with the strongest sentiment in the Netherlands (29%), Latvia, Slovenia and Greece (around 25%). The option for private companies taking the lead received the least amount of support in all countries, ranging from just 3% in Italy and Poland to 12% in Belgium.

Trust in information about fusion

Trust in information about fusion energy among the various actors differed significantly. Overall, the data shows a clear hierarchy of trust, with scientists and environmental NGOs at the top, traditional media in the middle, and social media at the bottom. Specifically, we found that:

Traditional newspapers: The trust is moderately distributed across all categories, with the majority of respondents indicating "some" trust, followed closely by "s lot." This suggests that while newspapers are trusted, there's significant scepticism as well.

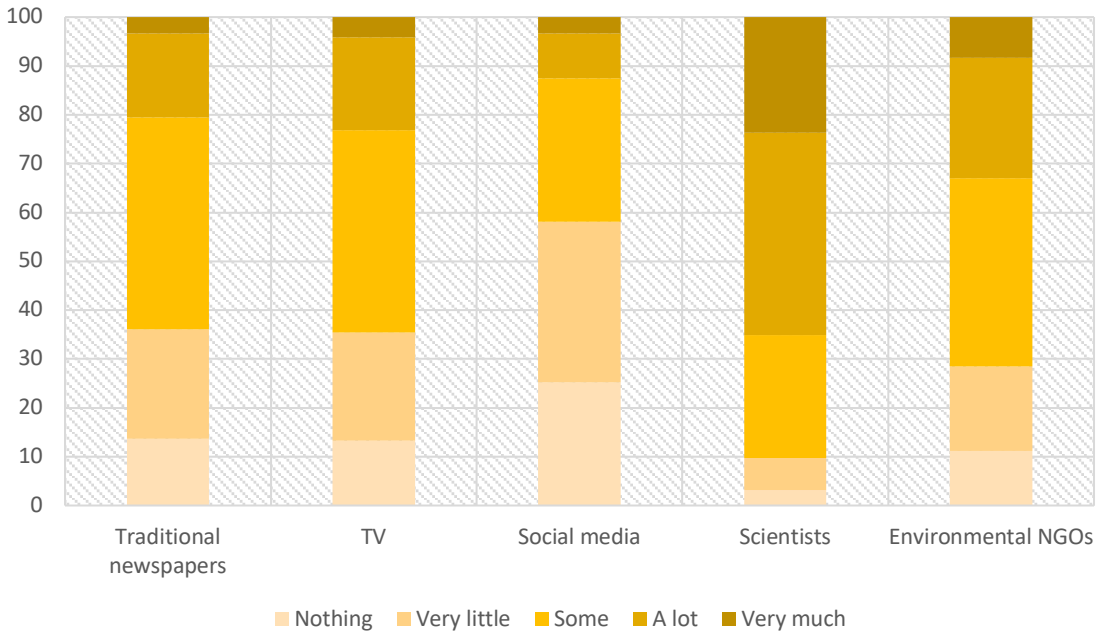

Figure 17. *Trust in information about fusion provided by various actors (average, total sample, n=19160)*

TV: The distribution of trust in TV is similar to that of traditional newspapers, but with slightly more respondents indicating "a lot" of trust. This might imply that TV is seen as a relatively reliable source of information about fusion.

Social media: Trust levels in social media are less favorable, with the majority of respondents indicating "very little" trust. This reflects a general skepticism about the reliability of social media for factual information on complex topics like fusion.

Scientists: Trust in scientists as a source of information on fusion is very high, with the majority of respondents indicating "very much" trust. This is followed by "a lot," showing that respondents regard scientists as the most credible source.

Environmental NGOs: Trust is also high for environmental NGOs, with "a lot" and "very much" being the most selected options. This indicates that these organizations are perceived as trustworthy and knowledgeable about fusion.

Effects of information on evaluation of fusion energy

At the beginning (time 1) and in the middle of the questionnaire (time 2, after reading information about fusion and reflecting on it), respondents were asked whether they supported or opposed the expansion of fusion energy in their country. The data shows that respondents reported a more positive attitude towards fusion energy after processing the information. Specifically, we found that:

Initially, a small proportion of respondents (11%) strongly opposed the expansion of fusion energy. After information and reflection, this group's size decreased further (5%), suggesting that learning more about fusion energy and reflecting on it reduced strong opposition.

The proportion of respondents who somewhat opposed fusion energy saw a slight decrease after information and reflection. This suggests that some respondents might have moved from moderate opposition to a more undecided or neutral position.

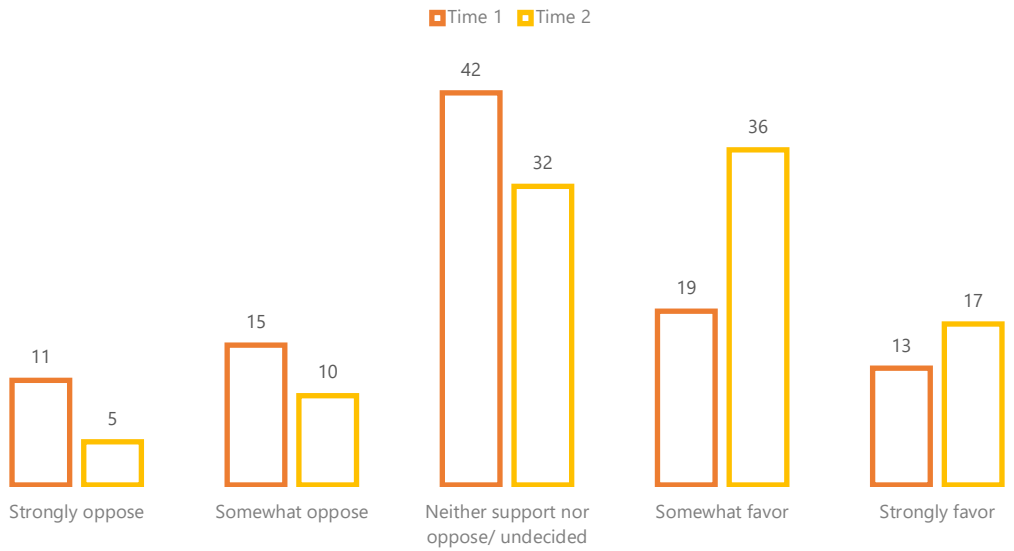

Figure 18. *Changes in support for expanding fusion energy before and after the information (average, total sample, n=19160)*

The most significant change is observed in the neutral/undecided category, which saw a marked decrease (from 42% to 32%). This indicates that the information and reflection period helped many respondents form a clearer opinion on the issue.

There was a noticeable shift towards somewhat favoring fusion energy after respondents received information and reflected on it (from 19% to 36%). This category saw the largest increase, suggesting that the information provided shifted opinions positively, but not necessarily strong enough to generate strong support.

The number of respondents who strongly favour fusion energy increased slightly after information and reflection. This increase is less pronounced than in the somewhat favor category, indicating

that while positive information about fusion energy can increase support, it may not be sufficient to create a deeply held conviction for many.

Effect of the type of information

The table below presents the effects of different information on respondents' attitudes, acceptance, and support for fusion energy. Each row represents a different frame: information on consequences, climate change frame, innovation frame, socio-economic benefits frame, and global cooperation frame. The values represent mean scores on a survey scale for each frame.

	Frame				
	Information on consequences	Climate change	Innovation	Socio-economic benefits	Global cooperation
Attitude (% support)	43	46	44	45	44
Acceptance	3,62	3,59	3,56	3,54	3,55
Support	3,56	3,56	3,45	3,45	3,47

Table 5. *Differences in attitude, acceptance and support according to message frame condition (n=19160)*

The data for the total sample shows:

- Attitude: Overall attitude towards fusion is quite similar across all frames. Respondents in the climate change frame showed a more positive attitude relative to participants reading the information on the consequences of fusion (46 vs 43%). This difference was statistically significant but very weak. This suggests that the various frames have a similar level of influence on respondents' general attitudes towards fusion energy.
- Acceptance: The highest score is seen with the information on consequences frame (3.62), suggesting that providing information about the consequences of fusion energy leads to the highest level of acceptance. The climate change frame (3.59) also scores high, indicating that framing fusion energy in the context of climate change is almost as effective in gaining acceptance. The innovation, socio-economic benefits, and global cooperation frames are very close in their influence on acceptance, with scores ranging from 3.54 to 3.56.
- Support: Similar to acceptance, the information on consequences frame yields the highest level of support (3.56). The climate change frame also results in a high level of support (3.56). Scores for support drop slightly for the innovation and socio-economic benefits frames (both at 3.45).

The effect of each framing varies among countries.

Final classification of countries

The scatter plot below shows the relationship between the average level of acceptance and the average level of support for the expansion of fusion energy across various countries. As expected, given that acceptance can be considered a precursor to support, there is a positive correlation between acceptance and support. Countries tend to cluster in the middle range of both acceptance and support, with few outliers.

Countries like the United Kingdom, Finland, and Poland exhibit both high acceptance and support levels, placing them in the top right quadrant of the plot. This suggests a more positive public opinion towards fusion energy and its expansion in these countries.

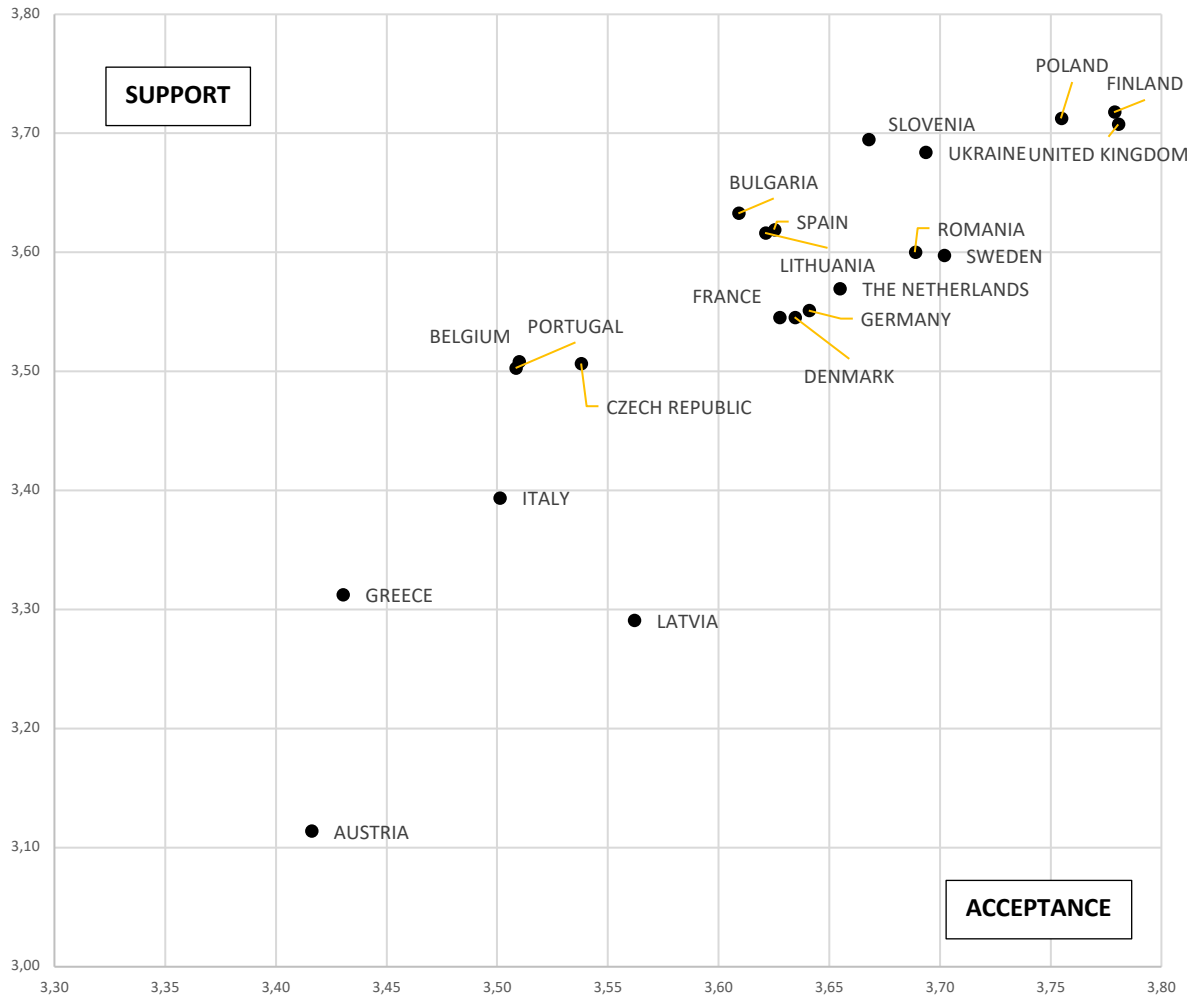

Figure 19. *Comparative analysis of country acceptance and support*

(average, total sample, n=19160)

Most countries, including Spain, France, Germany, the Netherlands, and Romania, are grouped closely together, indicating a moderate to high average acceptance and support level for fusion energy. This cluster represents a consensus among these countries' respondents.

Austria shows the lowest levels of both acceptance and support, placing it at the bottom left of the plot. Latvia stands out with a lower level of acceptance compared to its level of support,

indicating that while the concept of fusion energy might not be widely accepted, the support for its expansion is relatively higher among those who do accept it. Greece, while having a moderate level of acceptance, shows one of the lowest levels of support for expanding fusion energy. This might indicate scepticism or concerns about the implementation or impact of fusion energy despite understanding and accepting its concept.

Summary and conclusion

Awareness of Fusion Energy

- Compared to renewable energy sources, the general public has lower familiarity with fusion energy.
- 72% of respondents know very little or nothing about fusion energy.

Initial Attitudes and Evaluation

- Before learning about fusion, respondents mostly expressed either neutral or undecided sentiments.
- After receiving information about fusion, respondents indicated a generally positive evaluation of fusion energy.

Feelings and Beliefs Associated with Fusion Energy

- Respondents reported largely neutral to positive feelings toward fusion, showing levels of interest and optimism.
- Fusion energy is perceived as having beneficial environmental and socioeconomic impacts.
- Nearly half of the respondents express a positive view on fusion in these dimensions.
- The perceived safety on public health was the one with the highest perceived negativity.

Consequences of Developing Fusion Energy

- While unsure about costs, respondents acknowledge the benefits of fusion. This includes a positive environmental impact and applications beyond electricity.
- The success of fusion is viewed with some uncertainty. Despite this, fusion's potential benefits strongly influence overall positive evaluation.

Attitude, Acceptance, and Support

- Most respondents exhibit either a supportive or neutral stance towards fusion, favouring continued research and prioritization alongside other energy sources.
- Acceptance for developing fusion energy is high overall, though a substantial group remains undecided.
- Support for expanding fusion in participants' countries is also strong, though a fraction express opposition.
- Sociodemographic factors influence support. Support leans higher among older individuals, men, and those with higher education.

Investment Preferences and Trust in Information

- Respondents overwhelmingly favor a collaborative approach between governments and the private sector in developing fusion energy.
- Scientists and environmental NGOs are highly trusted sources for information about fusion.
- Traditional media enjoys moderate trust, while social media is mostly distrusted.

Effects of Information about Fusion

- After provided information, there was a noticeable shift away from opposition to fusion and a growth in moderate support.

- While various ways of framing the information (climate change etc.) show slightly different impact, the information and reflection led to a generally more positive stance.

Country-Specific Findings

- The UK, Finland, and Poland showed the highest levels of both acceptance and support.
- Most countries are clustered in the moderate-to-high range of acceptance and support for fusion energy.
- Austria presents the lowest levels of both acceptance and support.

Conclusion

This report highlights low to moderate public awareness and understanding of fusion energy in Europe. Although initial attitudes are neutral, providing factual information positively impacts perception. The majority of respondents across Europe see fusion as a good, acceptable, and potentially viable energy source with strong environmental and societal benefits. While concerns about safety, cost, and feasibility persist, a willingness to explore fusion energy is evident. Respondents prefer a collaborative approach between the public and private sectors, placing high trust in scientists and environmental NGOs as key information sources. Notably, public acceptance and support vary across countries, with some demonstrating higher enthusiasm than others. As fusion technology matures, targeted public engagement strategies aligned with national contexts will be crucial in fostering informed decision-making about fusion's role in Europe's energy future.

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Annex 1. Questionnaire

SCREENING SECTION

ASK THIS SECTION TO ALL UNLESS OTHERWISE STATED

SHOW INTRO ON A SEPARATE PAGE

Hi there!

We're conducting a survey to get your views on an experimental energy source that could bring important changes to the energy sector in the future. The survey should take about 10 minutes to complete.

We'll start by giving you some information about the technology, and then we'll ask you a few questions about your impressions. We just want to know your honest thoughts, based on what you currently know.

Your participation is important because it will help us to make better decisions about the future development of this technology.

Thanks for your time!

S1. You are... **(SC)**

1. Male
2. Female
3. Other

SEE QUOTA FILE TO SET UP HARD QUOTAS

S2. How old are you? **(OPEN, NUMERIC – ALLOWED RANGE 0 TO 99)**

PLEASE CLOSE IF AGE IS BELOW 18

RECODE AS PER BELOW

1. 18-29
2. 30-39
3. 40-49
4. 50-64
5. 65 and above

SEE QUOTA FILE TO SET UP SOFT QUOTAS

GEO. Where do you live? **(SC)**

EDU. What is the highest level of education that you have completed? **(SC)**

1. Did not graduate from high school
2. High school graduate
3. 2-year college degree or Technical-vocational education
4. 4-year college degree or Postgraduate degree

SEE QUOTA FILE TO SET UP SOFT QUOTAS

SECTION 1

SHOW INTRO ON A SEPARATE PAGE

To start, we would like to know your point of view on some energy-related issues.

Problem perception_energy trilemma → TITLE, DO NOT SHOW

Q1. Thinking about the electricity generation and supply in your country, to what extent are you concerned about... **(GRID SC PER ROW – RANDOMIZE ITEMS)**

SHOW AS ROWS

1. the **reliability** of how electricity is generated and supplied
2. the **environmental impact** of how electricity is generated and supplied
3. the **cost and affordability** of how electricity is generated and supplied
4. the **safety** (in terms of potential accidents and hazardous emissions or wastes) associated with the generation and supply of electricity

SHOW AS COLUMNS

C1. Not at all concerned
C2. Slightly concerned
C3. Somewhat concerned
C4. Quite concerned
C5. Very concerned

Familiarity with energy options → TITLE, DO NOT SHOW

Q2. How would you describe your level of familiarity with the following electricity generation and supply options? **(GRID SC PER ROW – RANDOMIZE ITEMS)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind farms
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Nothing, I have never heard of it
C2. Nothing, I only know the name
C3. Very little
C4. A moderate amount
C5. A lot

Initial attitude towards energy technologies → TITLE, DO NOT SHOW

Q3. To what extent would you support or oppose expanding the following energy technologies in your country? **(GRID SC PER ROW – RANDOMIZE ITEMS – KEEP THE SAME RANDOMIZATION AS Q2)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind farms
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Strongly oppose
C2. Somewhat oppose
C3. Neither support nor oppose/ undecided
C4. Somewhat favor
C5. Strongly favor

SECTION 2

ASK THIS SECTION TO ALL UNLESS OTHERWISE STATED

SHOW INTRO ON A SEPARATE PAGE

Now we would like you to read carefully the following information about an experimental energy source that might be relevant for energy policy in the future and ask you about what features you like and dislike in this technology.

SHOW INTRO ON A SEPARATE PAGE

Fusion energy

The world's **energy needs** are growing, and governments and companies need to find ways to meet them while also reducing our emissions and fighting climate change. One promising low-carbon energy source is **fusion energy or nuclear fusion**.

Fusion energy is the process that powers the sun, and it works by fusing two smaller atoms together to create a larger atom. This process releases a tremendous amount of energy, which can be used to generate electricity. A **future nuclear fusion power plant** would be similar in size to today's coal, gas, or nuclear plants, but they would produce electricity with no greenhouse gasses and very little radioactive waste.

Fusion energy is still in its **early stages of development** and scientists and engineers around the world are working to make it a practical source of energy. While we have achieved net energy gain from fusion reactions, there are still many challenges that need to be overcome before fusion power plants can be a reality.

Fusion energy has the **potential to be a major source of clean energy in the future**. With continued research and development, we may one day be able to harness the power of fusion to meet our energy needs without harming the planet.

DP ATTENTION!
DIVIDE THE SAMPLE IN 5 GROUPS AS PER BELOW:

1. 50% of participants do not see any frame and go to Q4
2. 12,5% see frame 1
3. 12,5% see frame 2
4. 12,5% see frame 3
5. 12,5% see frame 4

SHOW FRAME ON A SEPARATE PAGE

GROUP 1 - No frame: no text
GROUP 2 - Frame 1 (climate change) – show → Fusion energy offers a clean and sustainable source of power without emitting greenhouse gasses. By harnessing the same process that powers the sun, we can combat climate change and create a brighter future for generations to come.
GROUP 3 - Frame 2 (innovation) – show → Fusion energy is a cutting-edge technology that could lead to other innovations in the fields of energy, materials science, and medicine.

GROUP 4 - Frame 3 (socio-economic benefits) – show → Fusion energy could create a significant number of jobs in the construction, operation, and maintenance of fusion reactors. As a potential driver of job creation and economic growth, fusion holds exciting prospects.
GROUP 5 - Frame 4 (global cooperation) – show → Fusion energy is more than just science; it's a bridge that connects nations. Scientists from around the world are teaming up to unlock its potential for peaceful purposes. By studying fusion, you're not only advancing our knowledge but also fostering cooperation and unity on a global scale.

Attitude t1 → TITLE, DO NOT SHOW
Q4. Initially, how would you rate fusion energy as a potential energy option? **(SC)**

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

ASK TO GROUP 2 TO 5
Affect → TITLE, DO NOT SHOW
Q5. To what extent does fusion energy evoke the following feelings in you, if at all? **(SC PER ROW, 1 TO 5 SLIDER WITH THE WORDS ON THE LEFT ON TOP OF NUMBER 1 AND THE WORDS ON THE RIGHT ON TOP OF NUMBER 5 – RANDOMIZE ITEMS)**

1. Worry---Tranquility
2. Aversion---Enthusiasm
3. Disinterest---Interest
4. Pessimism---Optimism

ASK TO GROUP 2 TO 5
Perceived costs, risks and benefits (perceived effects) → TITLE, DO NOT SHOW
Q6. What are your expectations with respect to this technology? I belief that it would… **(SC PER ROW, 1 TO 5 SLIDER WITH THE TEXT ON THE LEFT ON TOP OF NUMBER 1 AND THE TEXT ON THE RIGHT ON TOP OF NUMBER 5+ DON'T KNOW OPTION – RANDOMIZE ITEMS)**

1. Cost too much to develop --- Have acceptable costs (in terms of the investments in research, development and demonstration)
2. Have a very negative --- Very positive effect on the environment (thinking about potential impacts on land, the atmosphere, water, etc.)
3. Be very dangerous --- Very safe for human health
4. Be technologically not feasible --- Feasible
5. Have very negative --- Very positive socio-economic effects

SHOW INTRO ON A SEPARATE PAGE TO GROUP 1
Fusion energy on a large scale will probably not be possible to implement before 2040. 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:

ASK TO GROUP 1
Evaluation of consequences → TITLE, DO NOT SHOW
Q7. Do you consider this consequence as…? **CAROUSEL – RANDOMIZE ITEMS**

SHOW AS ITEMS

1. **The success of fusion energy is uncertain.** Scientists and researchers have been working on fusion for several decades, and substantial investments are being made in fusion research worldwide. While new achievements in recent years provide encouraging signs of progress, we cannot guarantee that fusion energy will work with certainty

2. **Fusion energy does not produce long-lived radioactive waste like nuclear fission** (current nuclear power plants)**.** It can induce radioactivity in reactor materials due to high-energy neutrons. However, this generated radioactivity is relatively short-lived compared to fission-generated waste. Fusion reactor designs and materials aim to minimize radioactivity and handle any waste safely.

3. **Fusion energy has the potential to contribute significantly to climate change mitigation**. Unlike fossil fuels, fusion reactions release energy without producing greenhouse gas emissions or air pollutants. If successfully developed, fusion could replace high-carbon energy sources and reduce emissions

4. **Building technology to harness fusion power will take many years**. The timeline for commercial fusion energy is still uncertain. Some companies believe that fusion energy could be available by the early 2030s. Other companies and scientists are more cautious and believe that fusion energy will not be available until the early 2040s.

5. **Fusion power uses abundantly available resource**s. The fuel for a fusion power station would be a mixture of deuterium and tritium, which can be obtained from seawater and lithium found in the Earth's crust.

6. **Investing in fusion energy research and development does come with substantial costs.** Fusion is a complex and challenging field of study, requiring significant financial resources for experiments and facilities. The construction of fusion reactors and the necessary infrastructure can be expensive endeavors.

7. **Nuclear fusion has potential applications beyond electricity production**. It could be used for advanced space propulsion, hydrogen production, desalination of seawater, and materials and isotope production. However, these applications require further research and technological advancements for practical implementation.

SHOW AS SCALE

1. Very negative
2. Negative
3. Not important
4. Positive
5. Very positive

ASK TO GROUP 1

Q7b. Are there other potential consequences of developing fusion that are you concerned about? **OPEN, TEXT – SHOW A LARGE BOX - OPTIONAL**

ASK TO GROUP 1

Global evaluation t2 → TITLE, DO NOT SHOW

Q8. Considering your previous evaluation of the consequences of developing fusion energy, how would you rate fusion energy as a potential energy option? **(SC)**

1. Very Poor
2. Poor
3. Neutral
4. Good
5. Very Good

Global attitude (categorical) → **TITLE, DO NOT SHOW**

Q9. Which of the following statements best expresses your views on fusion energy? **(SC)**

1. Fusion power might be an important source of electricity in the future, and interested countries should fund research on fusion
2. Fusion might or might not be a viable source of electricity. We should keep research on fusion energy but prioritize other sources of energy.
3. Fusion power is unnecessary. We should reduce or cancel the nuclear fusion program and invest in other energy sources or alternative programs

Acceptance → **TITLE, DO NOT SHOW**

Q10. Fusion research and development is ongoing in Europe and other countries around the world. Some of the key organizations involved in this work include EUROfusion, ITER (the International Thermonuclear Experimental Reactor), as well as many national laboratories and some private companies.
Fusion energy is a promising but challenging energy source. Critics raise concerns about the technical challenges, cost, and safety of fusion energy, and argue that we should be focusing on developing other, more promising energy technologies. But scientists believe that fusion has the potential to be a clean, safe, and abundant source of energy and the best long-term solution to our energy needs.

Overall, do you consider the development of fusion energy for the purpose of electricity generation in Europe to be…? **(SC)**

1. Totally unacceptable
2. Unacceptable
3. Neither acceptable nor unacceptable/undecided
4. Acceptable
5. Totally acceptable

ASK IF Q10 = 1 OR 2

Q10b. Why is this? **OPEN, TEXT – SHOW A LARGE BOX**

Support → **TITLE, DO NOT SHOW**

Q11. To what extent do you support or oppose expanding fusion energy in your country? **(SC)**

1. Strongly Oppose
2. Somewhat Oppose
3. Neither support nor oppose/undecided
4. Somewhat Support
5. Strongly Support

ASK IF Q11 = 3 OR 4 OR 5

Q12. To what extent do you think fusion energy should be developed by governments or by private companies? **(SC)**

1. Mainly by governments
2. Both actors should be equally involved
3. Mainly by private companies

Trust in information → **TITLE, DO NOT SHOW**

Q13. How much do you trust the following information sources about fusion? **(GRID SC PER ROW)**

SHOW AS ROWS

1. Traditional newspapers
2. TV
3. Social media
4. Scientists

5. Environmental NGOs

SHOW AS COLUMNS

C1. Nothing
C2. Very little
C3. Some
C4. A lot
C5. Very much

SECTION 3

ASK THIS SECTION TO ALL UNLESS OTHERWISE STATED

SHOW INTRO ON A SEPARATE PAGE

Finally, we would like you to rate the various options to generate electricity in various dimensions.

Evaluation of energy options → TITLE, DO NOT SHOW

Q14. How harmful or harmless to the environment do you think each of the following power sources is? **(GRID SC PER ROW – RANDOMIZE ITEMS – KEEP THE SAME RANDOMIZATION AS Q2)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind power
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Very harmful
C2. Rather harmful
C3. Neutral
C4. Rather harmless
C5. Completely harmless

Q15. How positive do you consider the contribution of each of the energy sources to the reliable and consistent supply of energy and to meet the needs of a country? **(GRID SC PER ROW – RANDOMIZE ITEMS – KEEP THE SAME RANDOMIZATION AS Q2)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind power
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Very negative
C2. Rather negative

C3. Neutral
C4. Rather positive
C5. Completely positive

Q16. How safe (in terms of potential accidents and hazardous emissions or wastes) do you think it is to produce electricity with each of the energy options? **(GRID SC PER ROW – RANDOMIZE ITEMS – KEEP THE SAME RANDOMIZATION AS Q2)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind power
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Very dangerous
C2. Rather dangerous
C3. Neutral
C4. Rather safe
C5. Completely safe

Q17. How costly or cheap do you think it is to produce electricity with each of the energy options? **(GRID SC PER ROW – RANDOMIZE ITEMS – KEEP THE SAME RANDOMIZATION AS Q2)**

SHOW AS ROWS

1. Gas power plants
2. Solar plants
3. Residential/commercial solar panels
4. Wind power
5. Hydroelectricity
6. Nuclear power (nuclear fission)
7. Fusion energy (nuclear fusion)

SHOW AS COLUMNS

C1. Very costly
C2. Rather costly
C3. Not costly neither cheap
C4. Rather cheap
C5. Very cheap

FINAL DEMOGRAPHICS

ASK THIS SECTION TO ALL UNLESS OTHERWISE STATED

SHOW INTRO ON A SEPARATE PAGE

To conclude, we would like to ask you some questions about yourself.

D1. How would you describe the area where you live? **(SC)**

1. A big city
2. The suburbs or outskirts of a big city
3. A town or a small city
4. A country village
5. A farm or home in the countryside
6. Don't Know

D2. Do you have any of the following installations at home? **(GRID SC PER ROW)**

SHOW AS ROWS

1. PV panels
2. Solar thermal energy
3. Heat pumps

SHOW AS COLUMNS

C1. Yes
C2. No

D3. How would you describe your household's current income? **(SC)**

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

SHOW END TEXT ON A SEPARATE SCREEN

Many thanks for your time!

This questionnaire is part of the project Socio-Economic Research on Fusion (SES), funded by EUROfusion. For more information on the project, you can visit:

https://collaborators.euro-fusion.org/socio-economic-studies/

Please click on the ">>" button to submit your answers.