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Press Release

Knowledge about and evaluations of nuclear fusion – May 2019

- 17% of Czechs report having heard of nuclear fusion before.
- Higher awareness of nuclear fusion generally exists among men and college graduates.
- Most of those who heard of nuclear fusion evaluate it favourably as a potential option for generating power and are in favour of its further development as a source of energy in Europe.

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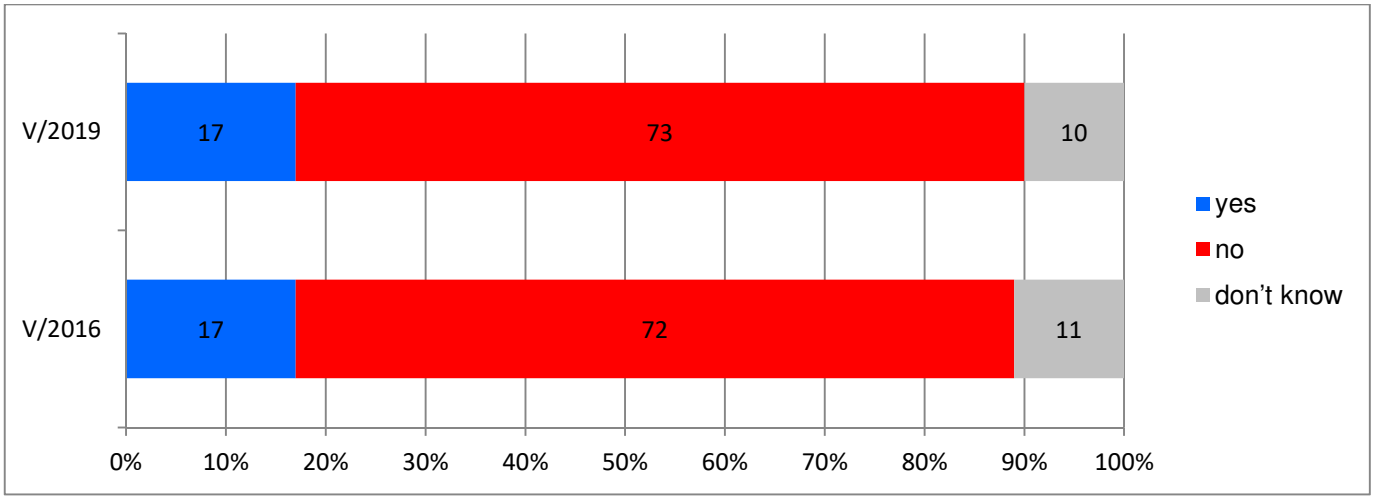
In the Our Society survey of May 2019, the annual battery of questions on energy issues was complemented with some special questions. Also included were questions on nuclear fusion as one of the potential energy sources that has long been in the focus of research by many countries and international groupings.[1] More specifically, the survey inquired whether people have ever heard of nuclear fusion and what, to what extent they feel familiar with the topic, how they perceive the pros and cons of nuclear fusion in terms of continuing or discontinuing research into it, whether they find nuclear fusion to be a good or rather bad option to produce energy, and whether they are in favour or against the development of fusion energy in Europe.

Graph 1: Ever heard of nuclear fusion[2] (%)



Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

The opening question of the battery inquired whether people had ever heard of nuclear fusion. 17% of the respondents reported they had, 73% said they had not, and 10% were not sure and picked the "don't know" option. This result is

[1] The series of questions used for measuring knowledge about and evaluations of nuclear fusion is a translation of English questions used in 2015 by the Belgian Nuclear Research Centre in its opinion poll on a sample of the Belgian population.
[2] Question wording: "So far I have asked you questions about nuclear energy which is created in current reactors by the process called nuclear fission. Now I would like to ask you some questions about a different source of energy, namely nuclear fusion or fusion energy. Have you ever heard of nuclear fusion? Yes, no."

practically identical with that of the May 2016 survey. In-depth analysis revealed that higher likelihood of reporting having heard of nuclear fusion exists among men (23%) than women (10%), among respondents aged 30–44 (22%), among college graduates (30%) and among highly qualified professionals or managers (31%).

Those who reported having heard of nuclear fusion (N = 170) were asked an open-ended question (i.e. one without a pre-defined menu of answer options) that allowed the respondents to describe in their own words what specifically they had heard about nuclear fusion.[3] Table 1 presents a general overview of the results.

Table 1: What respondents have heard about nuclear fusion

	V/2016	V/2019
Process that occurs in the core of the sun and stars, energy source of stars	18%	19%
New, effective, practically inexhaustible energy source	14%	14%
Combination of atomic nuclei with energy release, two hydrogen nuclei fuse into a helium nucleus, etc.	14%	13%
Heard of the existence of nuclear fusion, learned about it at school, saw a movie about nuclear fusion, knows how it works in principle	13%	9%
Nuclear fission	7%	5%
Research is ongoing, a technological solution for use is being researched	10%	4%
Clean source of energy, no nuclear waste	-	4%
Power generated from solar radiation	2%	3%
Safe energy, safer than fission	2%	2%
Inability to launch it, attempts have failed thus far	-	2%
Other answers	10%	12%
Don't know, don't remember, can't say	10%	13%

Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 170 respondents aged 15 and over who had heard of nuclear fusion, face-to-face interviews.

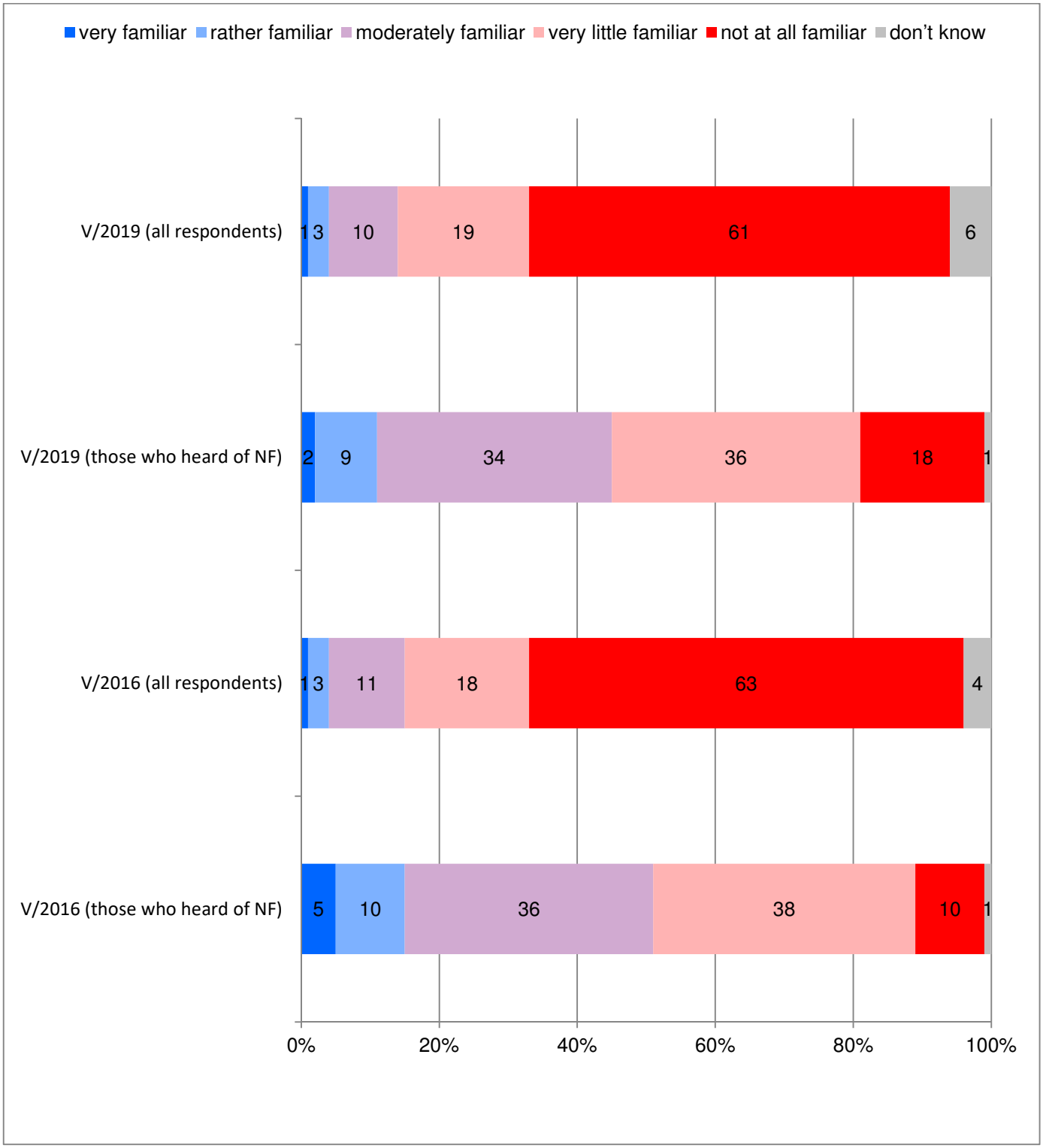
Among the more frequently occurring answers were ones that identified nuclear fusion as a process that occurs in the core of the sun and stars (19%), as a process in which atomic nuclei are combined, nuclei of heavier elements are produced and energy is released (13%), and as a new, effective or practically inexhaustible energy source (14%). General claims that the respondent had heard of the existence of nuclear fusion, learned about it at school, seen a motion picture or read an article about it, or knows what it entails, without further details, accounted for just under one-tenth of the answers. 4% of the respondents stated they had heard about fusion research, another 4% mentioned that it should be a clean source of energy that does not produce radioactive nuclear waste, 2% said that nuclear fusion would be safer than nuclear fission, and another 2% mentioned the failure of attempts to launch controlled nuclear fusion under Earth conditions thus far. In addition to substantially more-or-less correct statements about nuclear fusion, there were often apparently incorrect statements, primarily ones mentioning nuclear fission (5%) or power generation from solar radiation (3%). 13% of the respondents were unable to recall what specifically they had heard about nuclear fusion.

Since the question was answered by a relatively low percentage of the sample, no significant changes have been found in comparison with the year 2016. The most frequently mentioned categories in this year's survey were practically identical to 2016, although some answers occurred that had not been recorded in 2016. In contrast, the respondents in 2016 were somewhat more likely than current ones to mention fusion research (a difference of 6 percentage points).

The following survey question focused on the extent to which people feel familiar with the topic of nuclear fusion.[4]

[3] Question wording: "Can you describe in a few words what you have heard about nuclear fusion?"
[4] Question wording: "Nuclear fusion is the process that produces energy in the core of the sun and other stars. Scientists are trying to reproduce this process on Earth in order to find new and efficient energy sources. Currently, research on nuclear fusion is taking place in many countries, including the Czech Republic. How familiar do you feel with the topic of nuclear fusion? Not at all familiar, very little familiar, moderately familiar, rather familiar, very familiar?"

Graph 2: How familiar respondents feel with the topic of nuclear fusion (% of those who had heard of nuclear fusion, N = 176)



Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

The results shown in the graph indicate that one-seventh (14%) of Czechs aged 15 and over feel at least "moderately familiar" with the topic of nuclear fusion, including 1% who are "very", 3% "rather" and 10% "moderately" familiar. Another 19% feel only "very little" familiar and a majority of approximately three-fifths (61%) report being "not at all" familiar with the topic of nuclear fusion. More than two-fifths (45%) of those who reported having heard of nuclear fusion (N = 170) felt they were familiar with the topic of nuclear fusion, including 2% who were "very", 9% "rather" and 34% "moderately familiar". Another more than one-third of this group of respondents (36%) felt they were "very little" familiar with the topic, and 18% of Czechs who had heard of nuclear fusion do not at all feel familiar with the topic. Compared to the year 2016, the situation in this regard has not changed significantly, although those who had heard of nuclear fusion are more likely (by 8 percentage points) to be not at all familiar with the topic of nuclear fusion.

In-depth analysis demonstrated that men and college graduates were significantly more likely to report familiarity with the topic of nuclear fusion.

Table 2: Ranking of reasons for continuing fusion research[5] (%)

	1	2	3	4	mean, V/2019	mean, V/2016
Nuclear fusion will provide a nearly unlimited source of energy.	35	24	19	22	2.27	2.08
Nuclear fusion is climate friendly because it does not produce greenhouse gasses.	24	28	29	19	2.43	2.47
Nuclear fusion does not produce highly radioactive waste or very limited quantities.	22	25	26	27	2.58	2.53
Nuclear fusion is completely safe because major accidents are not possible.	19	23	26	32	2.72	2.80

Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

Table 2a: Ranking of reasons for continuing fusion research (% of those who had heard of nuclear fusion, N = 170)

	1	2	3	4	mean, V/2019	mean, V/2016
Nuclear fusion will provide a nearly unlimited source of energy.	43	24	20	13	2.02	1.96
Nuclear fusion is climate friendly because it does not produce greenhouse gasses.	24	32	28	16	2.36	2.35
Nuclear fusion does not produce highly radioactive waste or very limited quantities.	20	24	29	27	2.64	2.73
Nuclear fusion is completely safe because major accidents are not possible.	13	20	23	44	2.98	2.79

Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 170 respondents aged 15 and over who had heard of nuclear fusion, face-to-face interviews.

[5] Question wording: "What follows is a list of advantages of nuclear fusion. In your opinion, to what extent are these advantages important to justify the continuation of research on nuclear fusion? Please rank them from the most important to the least important. The most important one ranks 1st and the least important one ranks 4th. (a) Nuclear fusion will provide a nearly unlimited source of energy. (b) Nuclear fusion does not produce highly radioactive waste or very limited quantities. (c) Nuclear fusion is climate friendly because it does not produce greenhouse gasses. (d) Nuclear fusion is completely safe because major accidents are not possible."

Table 3: Ranking of reasons for stopping fusion research[6] (%)

	1	2	3	4	mean, V/2019	mean, V/2016
Nuclear fusion takes too long to develop into a power generation technology so it cannot solve the current problems with energy sources.	31	24	24	21	2.36	2.23
Nuclear fusion involves the use of radioactive materials.	31	18	22	29	2.48	2.51
The money used for nuclear fusion research should be rather spent on the development of renewable energy sources.	20	28	27	25	2.56	2.63
Nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process.	18	30	27	25	2.60	2.59

Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

Table 3a: Ranking of reasons for stopping fusion research (% of those who had heard of nuclear fusion, N = 170)

	1	2	3	4	mean, V/2019	mean, V/2016
Nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process.	31	30	26	13	2.20	2.42
Nuclear fusion takes too long to develop into a power generation technology so it cannot solve the current problems with energy sources.	32	31	16	21	2.26	2.22
Nuclear fusion involves the use of radioactive materials.	23	18	32	27	2.64	2.52
The money used for nuclear fusion research should be rather spent on the development of renewable energy sources.	14	21	26	39	2.89	2.85

Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 170 respondents aged 15 and over who had heard of nuclear fusion, face-to-face interviews.

The following two questions in the battery presented the respondents with four potential advantages and four potential disadvantages of nuclear fusion and fusion research as a potential source for power generation. The respondents were asked to rank by importance the advantages of, or reasons for continuing, fusion research, and to produce a similar ranking of the disadvantages of, or reasons for stopping, this line of research. Tables 2 and 3 show the percentages of respondents assigning the different rankings to each statement, and the mean score of each statement.

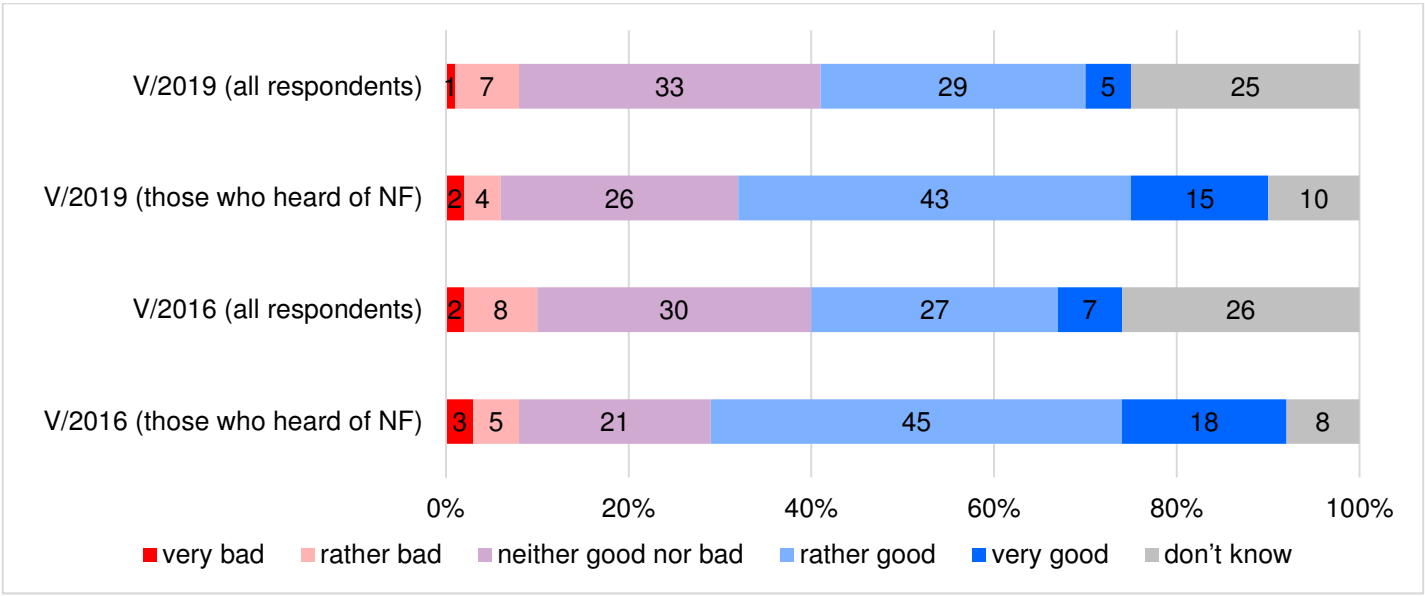
As for advantages, the leading statement, with a mean score of 2.27, is that nuclear fusion represents a nearly unlimited source of energy: more than one-third (35%) of the respondents ranked the statement first in importance. The second position was taken by the statement that nuclear fusion is climate friendly because it does not produce greenhouse gasses (mean score of 2.43). The third and four positions, with a narrow margin between them, were taken by the statements that nuclear fusion produces practically no radioactive waste (mean score of 2.58) and that nuclear fusion is completely safe (mean score of 2.72), respectively. Table 2a reveals that the ranking of advantages among those who had heard of nuclear fusion is the same, only with somewhat more pronounced margins, and the ranking did not change since the survey three years ago, in May 2016.

[6] Question wording: "What follows is a list of disadvantages of nuclear fusion. In your opinion, to what extent are these disadvantages important to stop the research on nuclear fusion? Please rank them from the most important to the least important. The most important one ranks 1st and the least important one ranks 4th. (e) Nuclear fusion involves the use of radioactive materials. (f) Nuclear fusion takes too long to develop into a power generation technology so it cannot solve the current problems with energy sources. (g) The money used for nuclear fusion research should be rather spent on the development of renewable energy sources. (h) Nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process."

The ranking of disadvantages by importance, as shown in Table 3, appears much less differentiated than that of advantages. The first rank was relatively more often assigned to the statement that nuclear fusion will take too long to develop into a power generation technology, which is why nuclear fusion cannot solve the current problems with energy sources, along with the statement that nuclear fusion involves the use of radioactive materials. Both statements were ranked first by 31% of the respondents, although the mean score for the first item was considerably lower than that for the second item (2.36 versus 2.48) because it was more often ranked second and, conversely, it was less often ranked as the least important reason. The third position, by mean score, was taken by the statement that the money used for nuclear fusion research should be rather spent on the development of renewable energy sources (2.56). Finally, the fourth position, with an inconsiderable and statistically non-significant margin, was taken by the statement that nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process (mean score of 2.60).

In contrast to the advantages, the answers of those who reported having heard of nuclear fusion presented in Table 3a provide a rather different picture with a different ranking by importance of disadvantages, as possible reasons to stop funding fusion research. The first position, although with a close and statistically non-significant margin, was taken by the item that nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process (mean score of 2.20), followed by the item that nuclear fusion will take too long to develop into a power generation technology so it cannot solve the current problems with energy sources (mean score of 2.26). Both remaining reasons obtained much lower priorities among the respondents who had heard of nuclear fusion, whereas the statement that the money used for nuclear fusion research should be rather spent on the development of renewable energy sources ranked clearly last, with a mean score of 2.89. The information in Tables 3 and 3a also reveals that the ranking of disadvantages changed since 2016. This occurred both in the general population, where the items ranking third and fourth switched positions (although the difference had been little and the shift was not statistically significant), and especially in the better-informed part of the public, where the item that nuclear fusion facilities will require large amounts of energy themselves to maintain the fusion process (which ranks last in the general population) shifted considerably higher, from the second position with a considerable margin in 2016 to the first position with a close margin now.

Graph 3: Evaluations of nuclear fusion as an option to produce energy[7] (%)

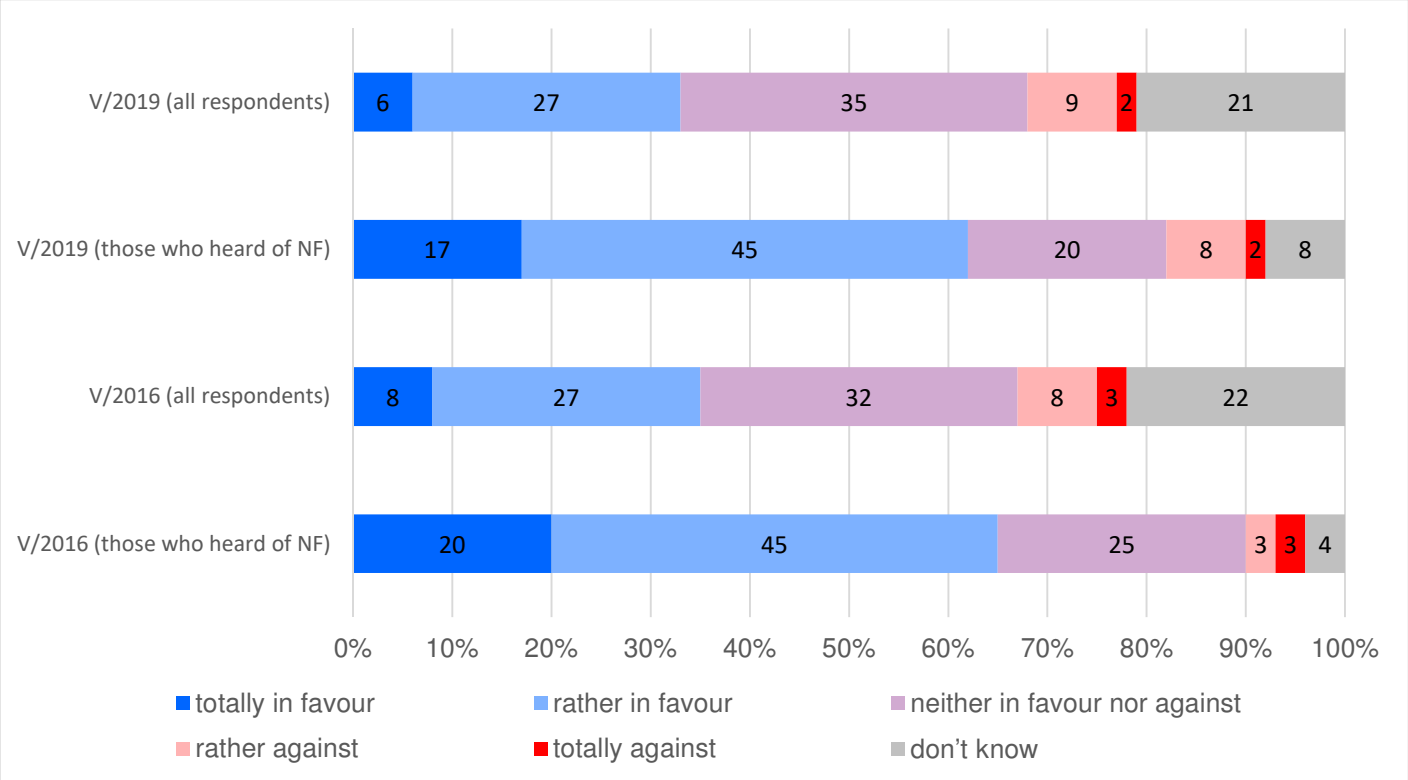


Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

[7] Question wording: "In conclusion, if you consider the arguments in favour and against, do you think nuclear fusion is a bad or a good option to produce energy? Very bad, rather bad, neither good nor bad, rather good, very good?"

Graph 3 presents the results of evaluations of nuclear fusion as an option to produce energy. It is apparent that positive evaluations prevail relatively clearly over negative ones, both in the general population and especially among the respondents who had heard of nuclear fusion before. More specifically, more than one-third (34%) of people consider nuclear fusion a good option to produce energy, including 5% who view it as "very good" and 29% who view it as "rather good". Nuclear fusion is viewed as a good option to produce energy by almost three-fifths (58%) of the respondents who have ever heard of nuclear fusion before, including 15% who view it as a "very good" and 43% who view it as a "rather good" option. In contrast, only 8% of the entire sample referred to nuclear fusion as a bad option to produce energy, including 7% who viewed it as "rather bad" and 1% who viewed it as "very bad"; negative views were only expressed by 6% of the respondents who had heard of nuclear fusion before. Nuclear fusion was perceived indifferently, as "neither good nor bad" an option to produce energy, by one-third (33%) of the entire sample and about one-fourth (26%) of respondents who had heard of nuclear fusion before. One-fourth of the entire sample and one-tenth of respondents who had heard of nuclear fusion before were unable to answer the question specifically and picked the "don't know" option. A time comparison between the results of the current survey and those recorded in May 2016 does not exhibit any statistically significant shifts in the general population and, given the limited number of respondents who had ever heard of nuclear fusion, no shift could be demonstrated among them either.

Graph 4: Attitudes to the development of fusion energy in Europe[8] (%)



Source: Public Opinion Research Centre, Institute of Sociology CAS (CVVM SOÚ AV ČR, v.v.i.), Our Society (*Naše společnost*), May 4–14, 2019, 1026 respondents aged 15 and over, face-to-face interviews.

Graph 4 shows respondents' answers to the question on their attitudes to the development of nuclear fusion as an energy source in Europe. Here, the results often overlap with their previous evaluations of fusion energy, as demonstrated by a high level of correlation between answers to both items.[9] One-third (33%) of the entire sample and more than three-fifths (62%) of the respondents who had heard of nuclear fusion before were in favour of the development of nuclear fusion as an energy source in Europe, including 6% of the entire sample who were "totally in

[8] Question wording: "To what extent are you in favour and against the development of fusion energy in Europe? Totally in favour, rather in favour, neither in favour nor against, rather against, totally against?"
[9] The Spearman rank-order correlation coefficient equals –0.659.

favour” and 27% who were “rather in favour”; among the respondents who had heard of nuclear fusion before, 17% were “totally in favour” and 45% “rather in favour”. Only 11% of the entire sample and 10% of the respondents who had heard of nuclear fusion before were against, including 9% and 8%, respectively, who were “rather against” and 2% who were “totally against”. More than one-third (35%) of the entire sample and one-fifth (20%) of those who had heard of nuclear fusion before were indifferent on the question, picking the “neither in favour nor against” option, with about one-fifth (21%) of the entire sample and under one-tenth (8%) of those who had heard of nuclear fusion before picking “don’t know”. No significant shift since 2016 was recorded for this question either.

Technical parameters of the survey

Survey:	*Our Society, v19-05*
Survey by:	*Public Opinion Research Centre, Institute of Sociology, Czech Academy of Sciences*
Project:	*Our Society – Continuous Public Opinion Research Project of the Public Opinion Research Centre, Institute of Sociology, Czech Academy of Sciences*
Survey dates:	*4 –14 May 2019*
Sampling method:	*Quota sampling*
Quotas:	*Region (NUTS 3 Regions), size of place of residence, sex, age, education*
Data source for quota sampling:	*Czech Statistical Office*
Representativeness:	*Population of the Czech Republic aged 15+*
Number of respondents:	*1026*
Number of interviewers:	*217*
Data collection method:	*Face-to-face interviews conducted by interviewers with respondents – mixed CAPI and PAPI methods*
Research instrument:	*Standardised questionnaire*
Questions:	*FUS.1, FUS.2, FUS.3, FUS.4, FUS.5, FUS.6, FUS.7*
Release no.:	*oe190916en*
Published on:	*16 September 2019*
Prepared by:	*Jan Červenka, Martin Ďurďovič*

Glossary of terms:

A quota sample replicates the structure of the basic population of the study (in this case the population of the Czech Republic aged 15+) by setting quotas for different parameters. In other words, a quota sample is based on the same proportion of persons with the selected characteristics. We used data from the Czech Statistical Office to create the quotas. In our surveys, quotas are set for sex, age, education, region, and community size. The sample is thus selected so that the percentage of men and women in the sample, for instance, corresponds to the share of men and women in each region of the CR. Similarly, the sample reflects the corresponding shares of the population in individual regions in the CR, citizens in different age groups, people with different levels of educational attainment, and people in different sizes of communities.

A representative sample is a sample of the total population whose characteristics can be validly inferred to apply as the characteristics of the population overall. In our case, this means that respondents were selected with a view to generalising the collected data as applicable to the population of the Czech Republic aged 15 and over.

The Public Opinion Research Centre (CVVM) is a research department of the Institute of Sociology, Czech Academy of Sciences. It dates back to 1946, when the Czechoslovak Institute for Public Opinion Research began operating as part of the Ministry of Information. The current CVVM emerged in 2001 when its predecessor (IVVM) was transferred from the Czech Statistical Office to the Institute of Sociology. Its incorporation within an academic institution provides a guarantee of high professional standards and quality, and as part of an academic environment, the CVVM is required to fulfil criteria that ensure it meets the highest professional standards. The CVVM's work is centred on the Czech Society research project, under which it examines public opinion by conducting ten surveys annually on a representative sample of the population over the age of 15, with approximately 1000 respondents participating in each survey. The questionnaire's omnibus format makes it possible to cover a wide array of topics. Political, economic, and other general social topics are regularly covered by the survey. The surveys include both repeat questions, whereby it is possible to observe phenomena over time, and new topics that reflect current events. The long-term and continuous nature of this public opinion survey project is unique in the Czech Republic.

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