

A content and thematic analysis of the presentation of nuclear fusion on the Internet

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Executive Summary for EUROFUSION

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Background and objectives

Fusion energy is clearly an issue where online environments have the potential to increase public knowledge levels by providing easier access to information. Web-based content is also likely to play a role in audiences' attitudes about nuclear fusion developments. In recent years, the European nuclear fusion research and development community has become more aware of the need to take seriously societal awareness of its activities.

Among the various public information and dissemination activities, public bodies such as the European Commission, the ITER Organization and the US Department of Energy have created specific web pages about nuclear fusion and related projects. The Internet has also become a useful medium for other actors to discuss the potential benefits and risks of fusion power. But scientific communities might not be aware of this content.

The objective of this study was to examine the nature of the web-based information about fusion energy.

- First, given the limited research on the content of web documents about fusion energy, we sought to describe the structural characteristics of the web sites.
- Second, we explored how the technology is portrayed on the Internet by examining the nature of the content of the web documents providing information about fusion energy. We specifically examined three questions:
 - How do the web documents link fusion energy to nuclear fission technologies?
 - What types of ideas are employed in the presentation of fusion energy in the web documents?
 - What are the main benefits and costs associated to fusion power on the web-based content?

Method

We implemented a quantitative and qualitative content analysis with a sample of web documents about nuclear fusion including web pages, blogs and online documents in Spanish, Portuguese and English. We selected these three languages based on the capabilities of the research team. We used Google Search¹ engine during a one-day period in March 2013 to draw the sample for the study (consistent with other authors' recommendations for sampling Internet-based content).

We initiated Google searches for fusion energy with three key phrases: "fusion energy", "nuclear fusion" and "nuclear fusion advantages and disadvantages" in English and "fusión nuclear", "energía de fusión" and "fusión nuclear ventajas y desventajas" in Spanish, "Fusão nuclear", "energia de Fusão" and "Fusão nuclear, vantagens e desvantagens" in Portuguese.

For each search, the first 50 results were collected. We included various sets of data: Web pages (from official and non-official Web sites), blog entries, articles in online magazines and online documents. We discarded scientific papers and Ph.D. thesis. The search procedure resulted in a final sample of 139 web documents in the Spanish-language sample, 106 in the Portuguese sample and 147 in the English-language sample (Table 1). The list of the web documents included in the study is available from the author.

Google search	Spanish-language	English- language	Portuguese-language
“Fusion energy”	50	47	41
“Nuclear fusion”	48	50	37
“Nuclear fusion” advantages and drawbacks	41	50	28
Total	139	147	106

We developed a content analysis protocol for gathering basic quantitative data on various dimensions of the online documents: its structural characteristics, the nature of the content, the risks and benefits associated with fusion power and the general position on fusion (assessed by the researcher).

The coding protocol was based on the protocol developed in a previous EFDA-SERF task.

Two researchers independently assessed the content of a small subsample of web documents using the content analysis sheet.

Summary of findings

- The web-based information about nuclear fusion is produced by a variety of actors (mainly the media, associations and educational organizations, private users and scientific and official organizations). The production of information about fusion it is not “monopolized” by any single actor. The media and education sites contribute more than any other actor to the information about fusion power on the Internet, but scientific organizations, private users and official agencies also contribute to the presentation of nuclear fusion on the Web. The majority of the web documents about nuclear fusion in English are web pages. In Spanish, news articles and blog entries are more frequent.
- Nuclear fusion is generally introduced as a solution to energy problems (mainly the growing energy demand and climate change) and as a scientific and technological challenge. The first argument states that the global society will face important energy problems, so new energy technologies (such as nuclear fusion) need to be developed. The second argument introduces nuclear fusion as one of the most relevant scientific problems being investigated. Web information about fusion generally introduces two main ideas to describe nuclear fusion to the general public: the process in the Sun and

the opposite process of fission. Both ideas transmit a positive image of nuclear fusion. Fusion is clearly opposed to nuclear fission. The main message developed in the web documents states that nuclear fusion has many advantages over current fission technologies. The main advantages discussed are safety, the environmental impacts and the energy density of both technologies.

- The majority of web documents provide a positive view of nuclear fusion. Five out of ten web documents are positive about nuclear fusion, three are neutral and only one is ambivalent or negative. Ambivalent documents, containing positive and negative feelings about nuclear fusion, represented almost 10% of the total sample. Web documents clearly negative about nuclear fusion were hardly found. An analysis of the valuation towards nuclear fusion by type of author found that web documents from official sources had the highest rate of positive valuations (92%), followed by companies (77%) and scientific organizations (70%). Generally, positive web documents discussed nuclear fusion in terms of its potential benefits for society and provided messages such as: “fusion energy is the key solution to world energy problems” or “fusion energy has substantial benefits, namely, that is clean, safe and reliable and it is worthwhile to research it”. Neutral documents discussed nuclear fusion as a scientific and technological issue. These web documents do mentioned very few potential benefits and drawbacks of fusion energy, do not discussed the viability of fusion energy in negative terms, do not provided an energy policy context for discussing fusion and do not stated the advantages of nuclear fusion over other energy sources. Ambivalent web documents outlined the potential benefits of fusion energy (eg. Inexhaustible source of clean energy) but also provided a negative or skeptic view about the feasibility or viability of fusion. Finally, negative documents emphasized the risks and costs of fusion and reject the potential benefits of fusion.
 - The feasibility of fusion energy is widely discussed in the web documents, but not necessarily in negative terms. We found the existence of an optimistic view regarding the viability of nuclear fusion, mainly based on three ideas: nuclear fusion has already been achieved; controlled nuclear fusion reactions are achievable but at a high cost; and fusion energy has made important progress in the last years. This view coexists with a negative view on fusion’s viability that emphasizes that “it is highly unlikely that fusion reactor technology will be available in the future”.
 - Web-based information about fusion energy emphasizes the benefits of nuclear fusion. We registered an average of 2.7 benefits per document, as opposed to 0.6 negative statements per document. The most frequently mentioned benefits of nuclear fusion were the existence of unlimited resources for fusion power, the low environmental impact of fusion reactions and safety. The most frequently mentioned risks/drawbacks of fusion were the lack of feasibility, the negative energy balance and the high costs of investment.
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Conclusions

The information about fusion in the web is not controlled by any single actors.

Web pages from Wikipedia, the media, official agencies and research organizations are in the first positions in Google searches about fusion energy, so they are more likely to influence the views of the general public.

But the information about nuclear fusion that a potential interested user can reach on the Internet is varied and includes news articles about recent fusion developments, educational material, blog entries introducing fusion, videos, detailed reports, etc.

Almost half of the web documents found in our Google searches for nuclear fusion provided relevant and detailed information about fusion. Only a minority of web pages found in our searches were completely not relevant (mainly related to nuclear fusion conferences or journal advertisements).

Web-based information about nuclear fusion is generally positive and emphasizes the potential role of fusion power in the global solution to energy problems.
