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## **Confrontation of fusion and other future energy technologies' representations in the public discourse – media analysis (Portugal and Spain)**

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#### **Confrontation of fusion and other future energy technologies' representations in the public discourse – media analysis (Portugal and Spain)**

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## Introduction

Nuclear fusion is considered by some as the most promising energy technology of the future, raising the hope for a fully accomplishment of our societies' growing demand for energy and concurrently for more sustainable and less costly energy supply systems. To some extent, nuclear fusion is conceived as a unique form of energy that is unrivalled in terms of power, efficiency, cleanliness and safety. However, for its critics, it is be very unlikely that nuclear fusion could deliver all that it promises in the forthcoming decades, moreover at this stage of development where it has yet to prove its commercial viability. Withal there are other emergent energy technologies that can be regarded as virtual solutions to the energy problem which may compete with nuclear fusion not only for political and economic support but also for broad public acceptance.

Social representations are key elements to assess the degree of public acceptance of these other emergent technologies, namely when compared with nuclear fusion with regard to the challenging possibilities of future energy scenarios. The analysis of news content can be a powerful method to achieve such an understanding, namely by identifying which topics, valuations and constructed views of energy related subjects are presented in the media and to what extent are they important in drawing comparisons between nuclear fusion and other emergent energy technologies.

The work described in this report is a follow-up of WP12-SER-ACIF-1, which conducted an analysis of news from German, Spanish and Portuguese journals, as well as of international press, regarding fusion, focusing in particular in the representation of fusion and fission before and after the Fukushima accident (Schmidt et al. 2012). Taking advantage of the database of news collected for WP12-SER-ACIF-1, we complement it with the collection of news regarding other emerging energy generating technologies, in order to compare media representations.

The emerging energy technologies selected for analysis are wave and tidal power, hydrogen, deep sea offshore wind power, energy applications of nanotechnology, biofuels from microalgae and IV generation nuclear fission. This work covered the news published in a selection of newspapers in Portugal and Spain between January 2007 and June 2013.

## Methodology

### a) Quantitative content analysis

#### *i. Method and analytical procedure*

Our study draws on a comparative analysis of media discourse about fusion and other emerging energy technologies in Portuguese and Spanish newspapers and encompasses coverage, thematic frames, valuations, risks or benefits associated with the various energy technologies. To begin with it was crucial to select a group of technologies that are currently at a similar stage of development and simultaneously have some relevance to each country's socioeconomic and political contexts. Our main list included: **off-shore wind power, energy-related applications of nanotechnology, hydrogen, wave power, tidal power and biofuels from microalgae**. Additionally and regarding the fact that Spain has nuclear energy and Portugal does not, we decided to include **IV nuclear generation** (IV Gen Reactors) as an extra subject only for the Spanish case analysis.

The study followed a quantitative content analysis of news with the aim of identifying the most frequent themes, valuations and propositions that ultimately shape media discourse about the selected energy technologies. Content analysis also enabled us to observe some connections between different features and topics of written news which added meaningful insights to our analysis

#### *ii. Sampling and sample description*

The sample was extracted from a collection of written news published on online editions of national mainstream and business newspapers between January 2007 and June 2013. We choose 2007 as starting date since it was the year of the beginning of the construction of the ITER research device (a milestone in nuclear fusion development) and June 2013 as a concluding date, thus completing a six and a half year period which seemed wide enough to gather a reasonable amount of articles. All section of newspapers (editorials, economic, political, scientific sections, etc.) and all forms of presentation (news in brief, opinion columns, interviews, reportage, etc.) were considered for the articles search and sampling.

The search words used for the data collection were:

- a) **Nuclear fusion**: "nuclear fusion"; fusion energy"
- b) **Off-shore wind power**: "off-shore wind power"; off-shore wind"
- c) **Hydrogen**: "hydrogen"
- d) **Wave power**: "wave power"

- e) **Tidal power:** “tidal power”
- f) **Energy-related applications of nanotechnology:** “nanotechnology”  
“nanomaterial”; “energy from nanotechnology”; “energy from  
nanomaterial”
- g) **Biofuels from microalgae:** “biofuels from microalgae”; “microalgae”
- h) **IV nuclear generation:** “IV nuclear generation”

After the collection of all articles we found that some energy technologies such as **off-shore wind power** or **wave power** account for one hundred or more articles each, while **biofuels from microalgae** or **energy-related applications of nanotechnology** account for less than thirty articles each. In order to produce a more balanced sample we decided to extract a subsample of the technologies more abundantly covered by selecting only the articles published in the first two weeks of each month.

**Table 1. Articles in Portuguese newspapers**

Newspapers	n	%
Público	137	44.1
Diário de Notícias	94	30.2
Jornal Económico (business newspaper)	80	25.7
Total	311	

The subsample for Portugal comprised 311 articles (Table 1), 44% of which were published by *Público*, considered the standard of quality for Portuguese daily newspapers, followed by *Diário de Notícias*, with 30% and *Jornal de Negócios*, with only 25% of the total records.

**Table 2. Articles in Spanish newspapers**

Newspapers	n	%
La Vanguardia	134	33,2
El Mundo	87	21,5
El País	73	18,1
Expansión (business newspaper)	51	12,6
ABC	40	9,9
La Razón	10	2,5
Público.es	9	2,2
Total	404	100

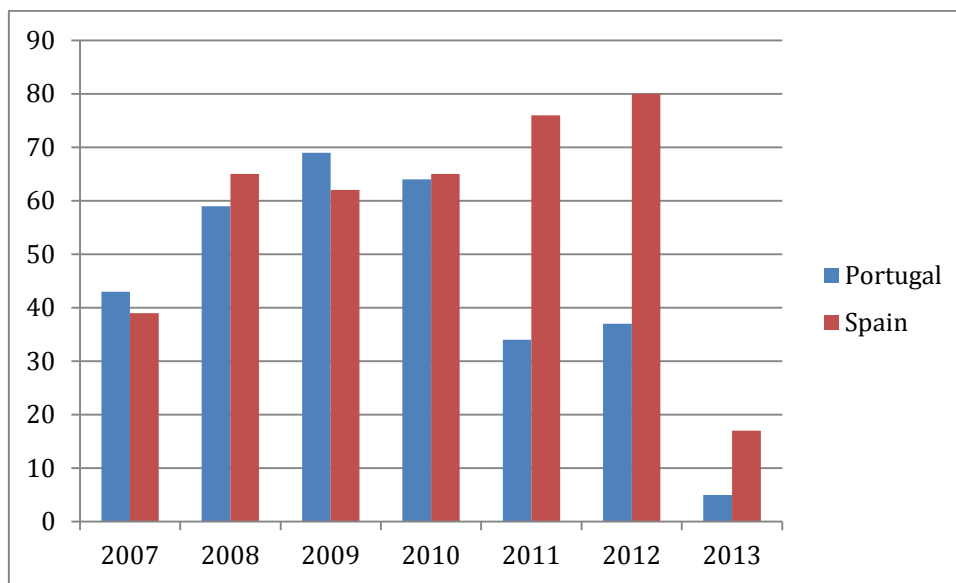
Of the 404 articles that comprise the Spanish subsample (Table 2), the top three highest values correspond to the articles published by three of the major general-interest daily newspapers in Spain: *ABC*, with 33%, *El Mundo*, with 21.5% and *El País*, with 18% of all records. These are far ahead from all the other newspapers especially from *Público.es* (a daily national) and *La Vanguardia* (a nationwide daily written in Catalan).

**Table 3. Articles by type of newspaper**

Newspapers	Portugal		Spain	
	n	%	n	%
Quality newspaper	231	74.3	353	87.4
Business newspaper	80	25.7	51	12.6
Total	311		404	

Quality dailies are overrepresented in both Portuguese and Spanish subsamples (74% of the total news in Portugal and 87% in Spain) and therefore we cannot relate the type of newspaper with the overall number of articles published (Table 3). In both countries only one business newspaper was selected for the study (*Jornal de Negócios* in Portugal and *Expansión* in Spain), with the purpose of having a different approach view about the subject of analysis.

**Figure 1 Articles by year of publication**



Portugal N= 311; Spain N=404

The distribution of news articles by year of publication (Figure 1) shows a continuous growing rate in Spain, whereas in Portugal, after the first few years of rise there is an abrupt descent that starts in 2011, a year in which, on one hand, news about the economic crisis took centre stage in Portuguese media and, on the other hand, the change of government slowed down the political and economic investment in renewable energies.

**Table 4. Articles by type of author**

	Portugal		Spain	
	n	%	n	%
Journalist	234	75.2	332	82,2
Agency	57	18.3	48	11,9
Other expert	11	3.5	2	0,5
Other	3	1.0	6	1.5
Scientific expert	3	1.0	13	3.2
Politician	1	0.3		
Representative of an interest group	1	0.3	3	0.7
Representative of NGO	1	0.3		
Total	311		404	



Journalists and agencies are the main authors of news with energy technologies related content (Table 4). National differences are almost irrelevant regarding these trends. The major national differences that can be described with regard to these data concerns the category “other expert”, which in Portugal account for 11 authors (3.5%) whereas in Spain accounts for only 2 authors (0.5%), and the category “Scientific expert”, which in Portugal accounts for 3 authors (1%) whereas in Spain accounts for 13 authors (3.2%). Overall, there are few experts writing about emergent energy technologies in both countries and even less representatives of organizations or politicians. Insights about this subject seem to emerge mainly from newspapers’ own agendas and priorities rather than from viewpoints of experts, individual and collective actors.

The majority of articles do not mention the background of the author both in Portugal and in Spain (Table 5). These articles are mainly undersigned by journalists and agencies which are rarely profiled in the newspapers. It is interesting to see that in either studied cases there are few articles undersigned by authors with high intellectual backgrounds (experts and scientists). There are some articles undersigned by authors from public science institutions (10 in Portugal and 11 in Spain), but they do not counterbalance for the dominant trend herein described. It is also noteworthy the few number of articles written by representatives from the industry sector and NGO.

**Table 5. Articles by background of author**

	Portugal		Spain	
	n	%	n	%
Background not named	294	94.5	384	95.0
Public science institution	10	3.2	13	3.2
Other industry	3	1	3	0.7
Civil service	2	0.6		
Alternative science institution	1	0.3		
NGO	1	0.3		
Private science institution			3	0.7
Electric utility			1	0.2
Total	311		404	

Content about emergent energy technologies is mostly presented in brief news both in Portuguese (79%) and Spanish newspapers (74%) (Table 6). There are some articles stating opinions or commentaries but they are underrepresented in either studied cases (8.7% in Portugal and 5.7% in Spain). However, in the Portuguese newspapers there is a greater focus given to business managers’ views

about this subject, as it is shown by the amount of interviews published (6.8%) when compared to that of Spanish newspapers (3%). In contrast, Spanish newspapers published much more reports or reportages (16.8%) in comparison to Portuguese (5.5%).

**Table 6. Articles by form of presentation**

	Portugal		Spain	
	n	%	n	%
News in brief	246	79.1	300	74.3
Commentary/opinion column	27	8.7	23	5.7
Interview	21	6.8	12	3.0
Report / reportage / feature	17	5.5	68	16.8
Portrait			1	0.2
Total	311		404	

### *iii. Coding procedure*

In order to classify all articles with common criteria and ensure the comparability of results, the coordinators' team outlined an encoding protocol after a pilot research and classification of 20 articles covering all technologies studied (for more detail see the codebook in Annex 1). Doubts and different interpretations in step-by-step encoding process were managed and clarified through discussions by email and meetings via Skype.

### *iv. Analysis procedure*

The data corpus was subjected to statistical analysis in SPSS (Statistical Package for the Social Sciences) which encompassed univariate analysis with frequency distribution of single variables and bivariate analysis with cross-tabulations and contingency tables. Bivariate analysis was aimed at identifying the relationship between independent and dependent variables such as the "technology mainly focused in the article" and "thematic frames". The data outputs were finally analyzed according to our main objectives: i) comparisons between the various emergent energy technologies with regard to the amount of articles published, degree of information, themes, valuations and statements or arguments presented

towards each technology; b) comparisons between Portuguese and Spanish most significant results.<sup>1</sup>

## **b) Qualitative content analysis**

### *v. Method*

Social representations about the different energy technologies could also be grasped by following a more in-depth analysis. With this objective in mind we employed a qualitative method based on a template with predefined codes (for more detail see the template in Annex 2).

### *vi. Sample*

The *data corpora* was based on a purposive sample. We selected one article about each technology within each country' sub-samples, thus analysing 15 articles in total. The guiding criteria for this selection were the length and depth of information (found mostly in as reportages and interviews). News in brief were therefore excluded. The number of articles selected corresponded to the number of technologies covered in each country. Thus, for the Portuguese analysis we collected seven articles while for the Spanish analysis we selected eight.

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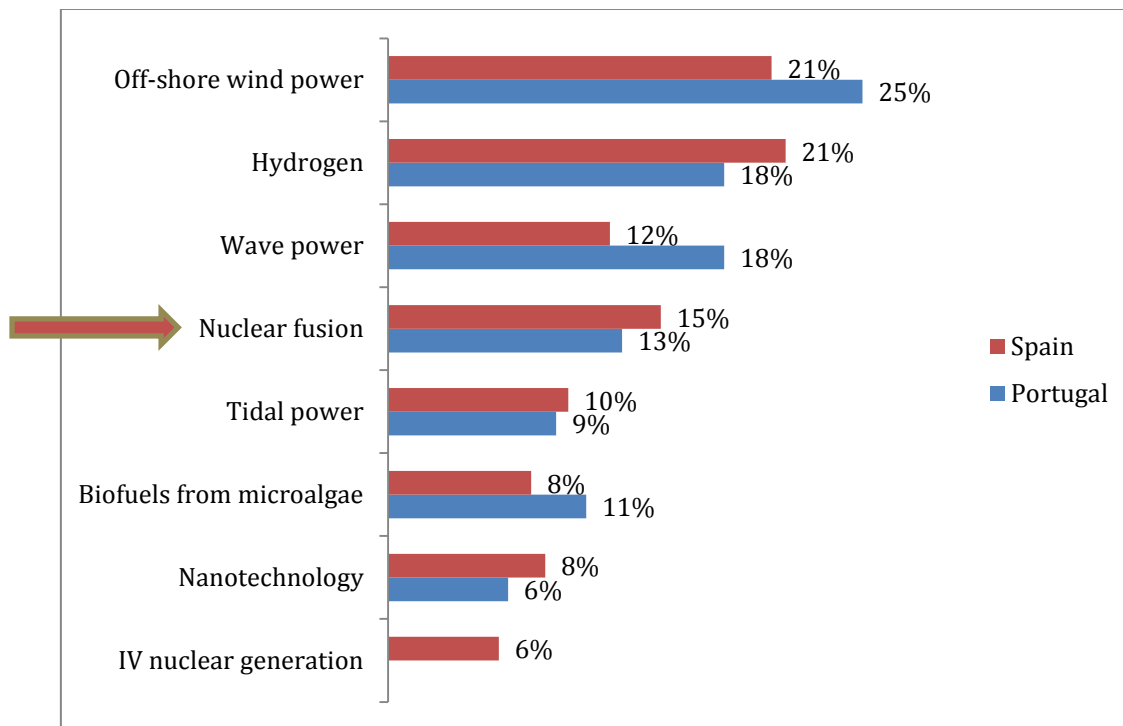
<sup>1</sup> Variables 17 to 23, pertaining to comparisons between technologies were not analysed because there were very few articles that dealt with these issues.

## Presentation of main results

### a) Quantitative analysis

The results for keyword research show that off-shore wind power and hydrogen are the technologies more frequently covered in Spanish newspaper (both representing 21% of the subsample) (Figure 2). Nuclear fusion accounts only for 15% of the sample, whereas IV nuclear generation account for only 6% of the total records. Off-shore wind power is also more extensively covered than any other technology in Portuguese newspapers, representing 25% of the subsample. Results for Hydrogen and Wave power are lower with equal percentages (18%) but still ranked above the remaining technologies including nuclear fusion (with only 13% of the total). Nanotechnology was the least covered topic in Portuguese newspapers.

**Figure 2 Articles by keyword (%)**

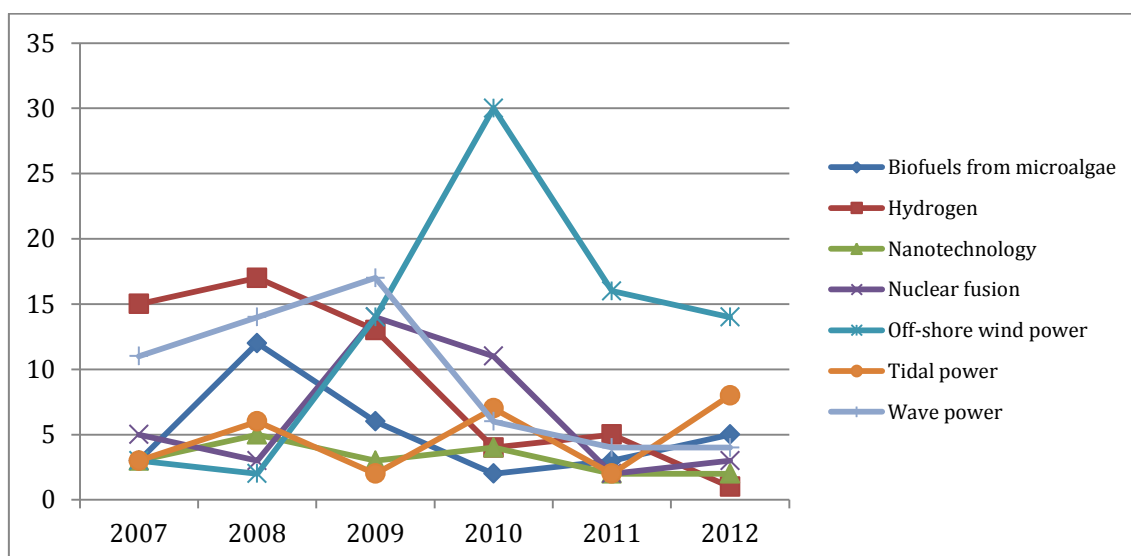


Portugal N= 311; Spain N= 404

Differences between the two countries are minor with regard to the majority of the technologies studied. The most significant disparities appear in the case of wave power (that has been being tested in Portugal for some years), which accounts for 18% of the articles whereas in Spain accounts for only 12%. Values for nuclear fusion display a slight difference with a higher proportion of news in the Spanish

case. IV nuclear generation is not subject to comparisons since it was only included in the Spanish subsample.

**Figure 3 Articles by keyword and year of publication in Portugal**

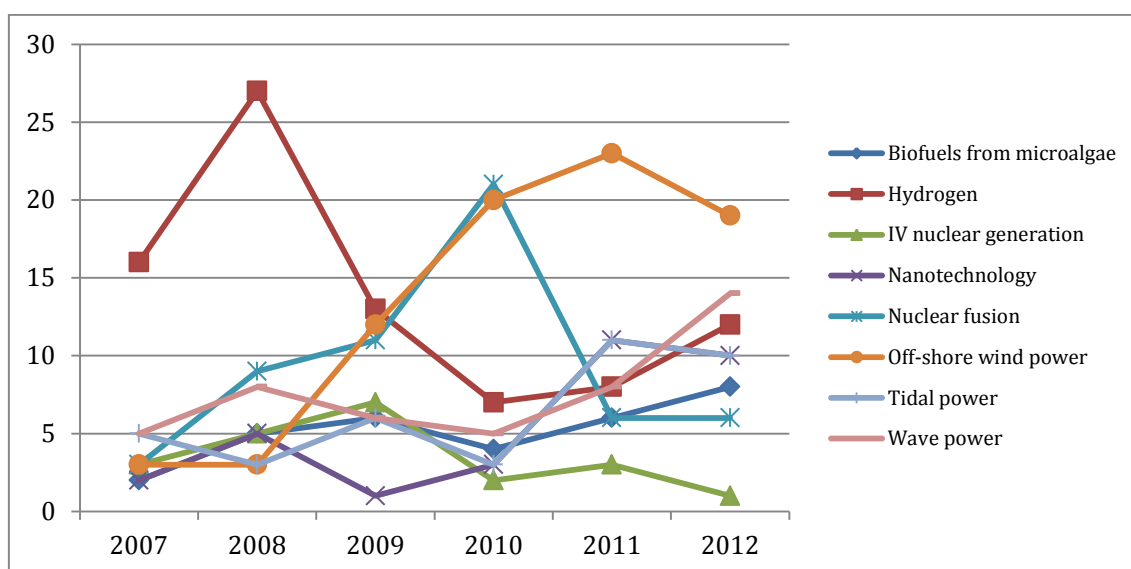


N=311

Regarding the distribution of articles per year and keyword in Portugal, some trends can be detected (Figure 3). Offshore wind power peaked in the news in 2010, when the main Portuguese electric company announced a project in the Portuguese coast, as well as investments in other countries in this form of energy. Wave power received more media coverage in 2009, mostly due to the beginning of an experimental project in Peniche. Hydrogen merited a greater number of articles in 2007 and 2008, in view of technological innovations announced by international car manufacturers, but almost disappeared in 2012. As for Nuclear fusion there was a peak in the number of articles in 2009 followed by a downward trend henceforth.

In Spain (Figure 4), hydrogen also peaked in 2008 and later in 2012 also as a result of international car manufactures innovations, but it was offshore wind power that received more media coverage in a later period, namely in 2011. The frequency of news on nuclear fusion was higher in 2010, the year of an important meeting of the board of directors of ITER, evolving with a relative visibility henceforth. Wave and tidal power have experienced a steady growth in media interest.

**Figure 4 Articles by keyword and year of publication in Spain**



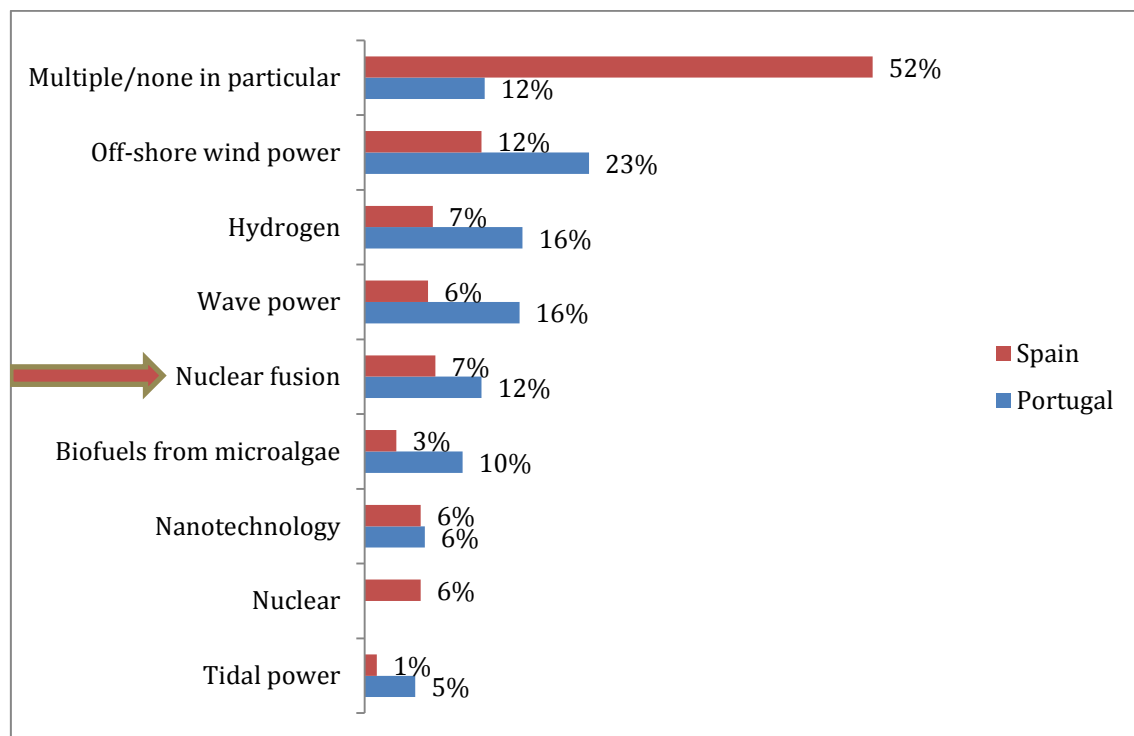
N=404

Regarding the main technology focused in news articles, an overwhelming proportion of articles in Spanish newspapers between 2007 and 2012 (52%) focus on multiple technologies (Figure 5). The second technology mainly focused is off-shore wind power but with a proportion significantly lower than the former. Biofuels from microalgae (3%) and tidal power (1%) are the least focused technologies. Nuclear fusion and Hydrogen show equal results (very close to those of wave power, nanotechnology and nuclear, the latter referring to IV nuclear generation).

Off-shore wind power is the technology mainly focused in Portuguese newspapers (in 23% of the articles) followed by hydrogen and wave power (both in 16%) and nuclear fusion (in 12%). Only 12% of Portuguese articles highlight multiple technologies, which contrasts significantly with the results from Spain.

The exception is tidal power. In fact, tidal power is more widely covered than nanotechnology and biofuels from microalgae both in Spain and Portugal (and IV nuclear generation in Spain), yet it is mainly focused in less articles than these other technologies. This is probably because the majority of articles written about tidal power also mention other sea energy related technologies such as offshore wind and wave power, to which it might be assigned a greater importance.

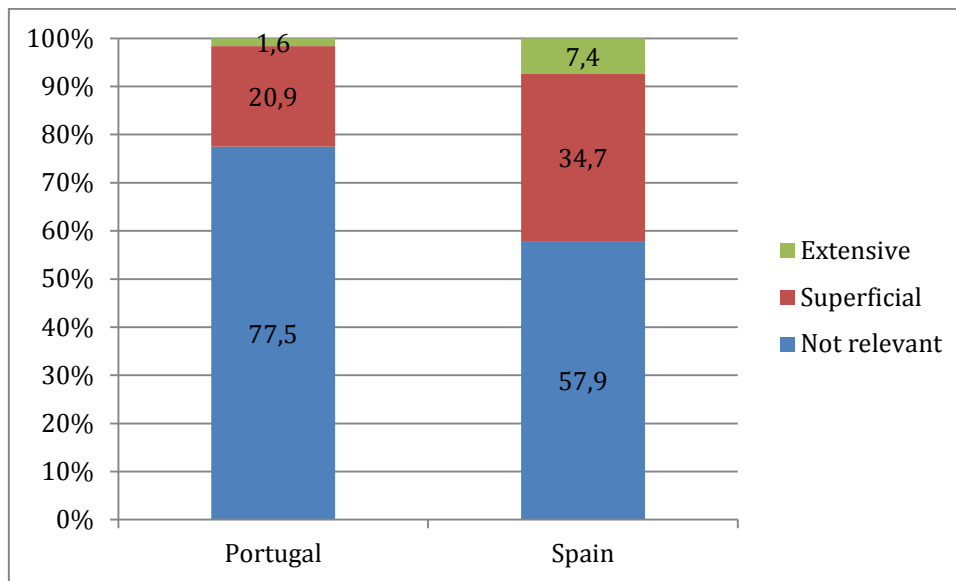
**Figure 5 Articles by main technology focused (%)**



Portugal N= 311; Spain N=404

Information provided about the various technologies is not relevant in the majority of the cases, especially in Portugal (Figure 6). In Spain there is a fairly proportion of articles that present superficial information when compared to Portugal, but not so much with regards to extensive information which is poorly disclosed in both countries.

**Figure 6 Articles by information provided (%)**



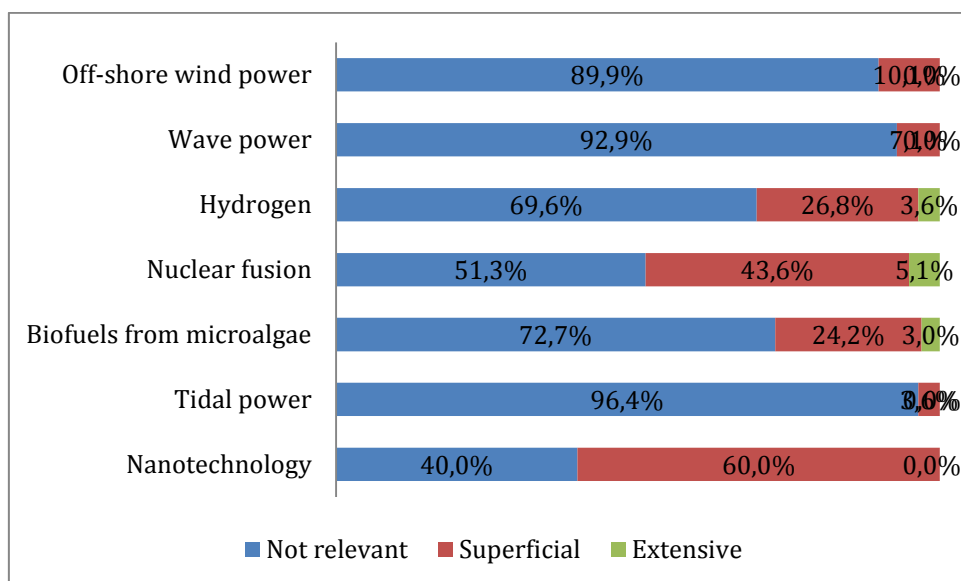
Portugal N= 311; Spain N=404

Non relevant information is presented mainly in articles addressing off-shore wind, wave and tidal power. Only the articles addressing nuclear fusion (5.1%), hydrogen (3.6%) and biofuels from microalgae (3.0%) disclose extensive content. In the case of nuclear fusion proportions are more balanced between non relevant (51.3%) and superficial information (43.6%), whereas in the case of nanotechnology there is a superior amount of articles with superficial information (60% against 40% with non-relevant information).

Articles with non relevant information are those that do not mention the scientific or engineering processes behind the development of a specific technology or only present minor and unsystematic aspects of these processes. These articles primarily address other subjects such as energy policy, legislation, budgetary issues, business and market transactions. Articles with superficial information present more detailed but still unsystematic aspects about the scientific development of a specific technology. Articles with extensive information provide detailed and systematic facts and figures about the scientific and engineering processes behind the development of a specific technology.



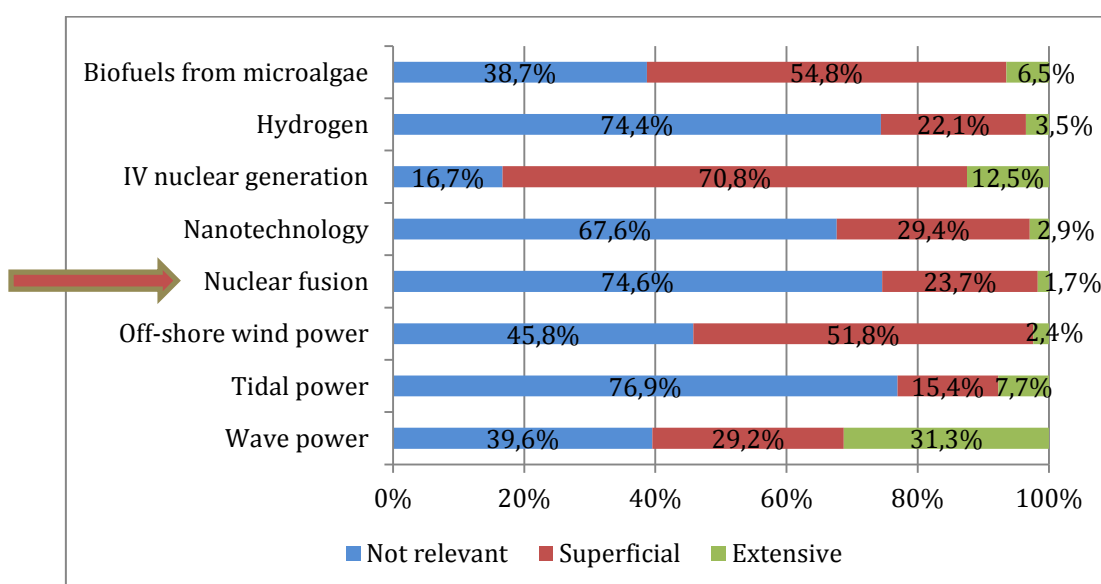
**Figure 7 Articles by keyword and information provided in Portugal (%)**



N=311

In Spanish newspapers the higher proportion of articles with non-relevant content are also those that address off-shore wind, wave and tidal power. A reasonable proportion of articles about hydrogen (40%), nuclear fusion (40%) and biofuels from microalgae (20%) display extensive information, whilst those that address nanotechnology display mainly superficial information.

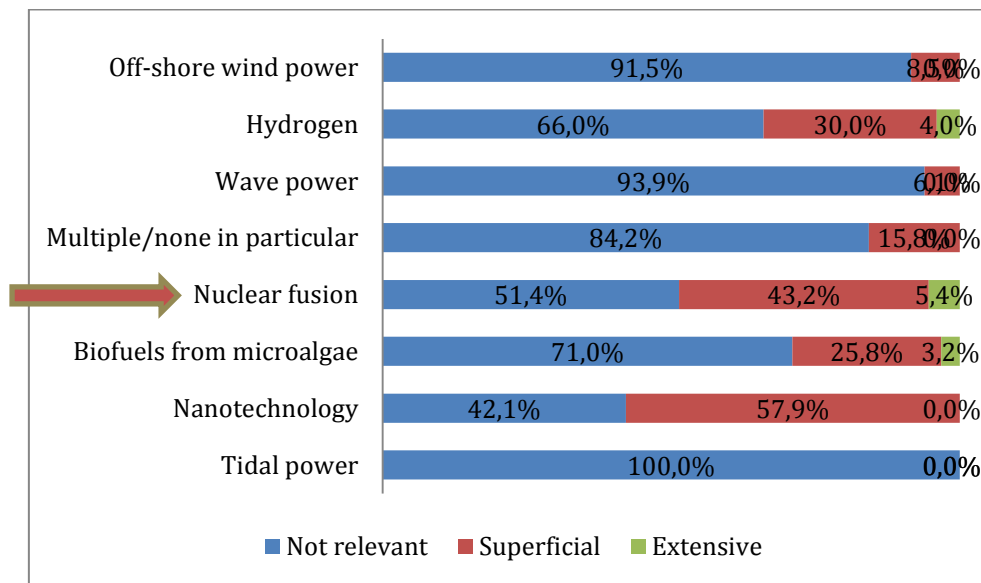
**Figure 8 Articles by keyword and information provided in Spain (%)**



N=404

The type of information provided does not differ much from the previous account when analysing the results by technology mainly focused in Portuguese newspapers. Non relevant information is predominant even in articles that address multiple technologies. In all other cases the results nearly overlap those described in Figure 4, with the exception of tidal power which is reported exclusively with non-relevant information whenever it is the technology mainly focused.

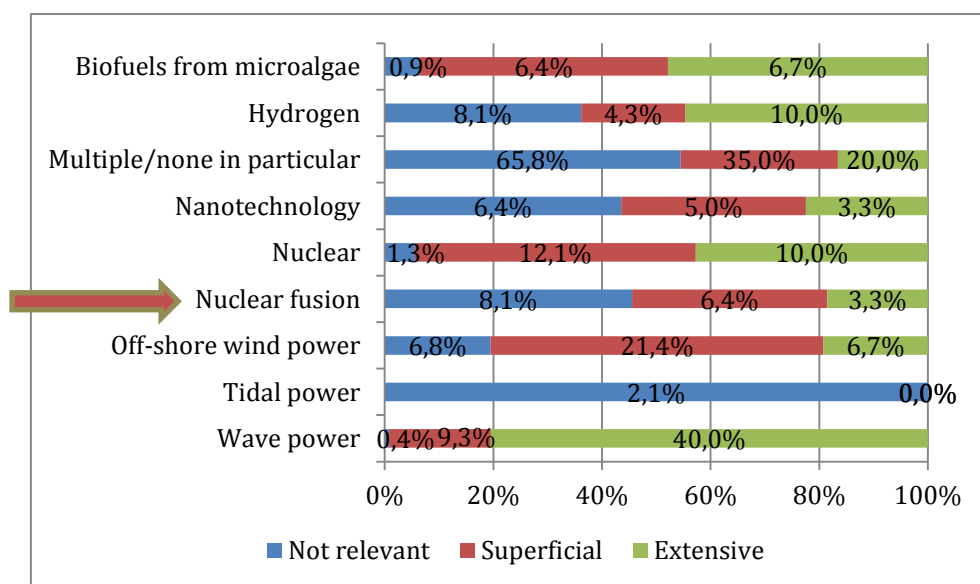
**Figure 9 Articles by main technology focused and information provided in Portugal (%)**



N=311

Results from Spain are also very similar when comparing the information provided by keyword to that of technology mainly focused. Like the Portuguese, Spanish newspapers display non relevant content in most articles focusing on multiple technologies, but the proportion of those that present superficial information is greater in Spain than in Portugal. In Spain and also similarly to Portugal, news focusing mainly on Tidal power present exclusively non relevant information.

**Figure 10 Articles by main technology focused and information provided in Spain (%)**

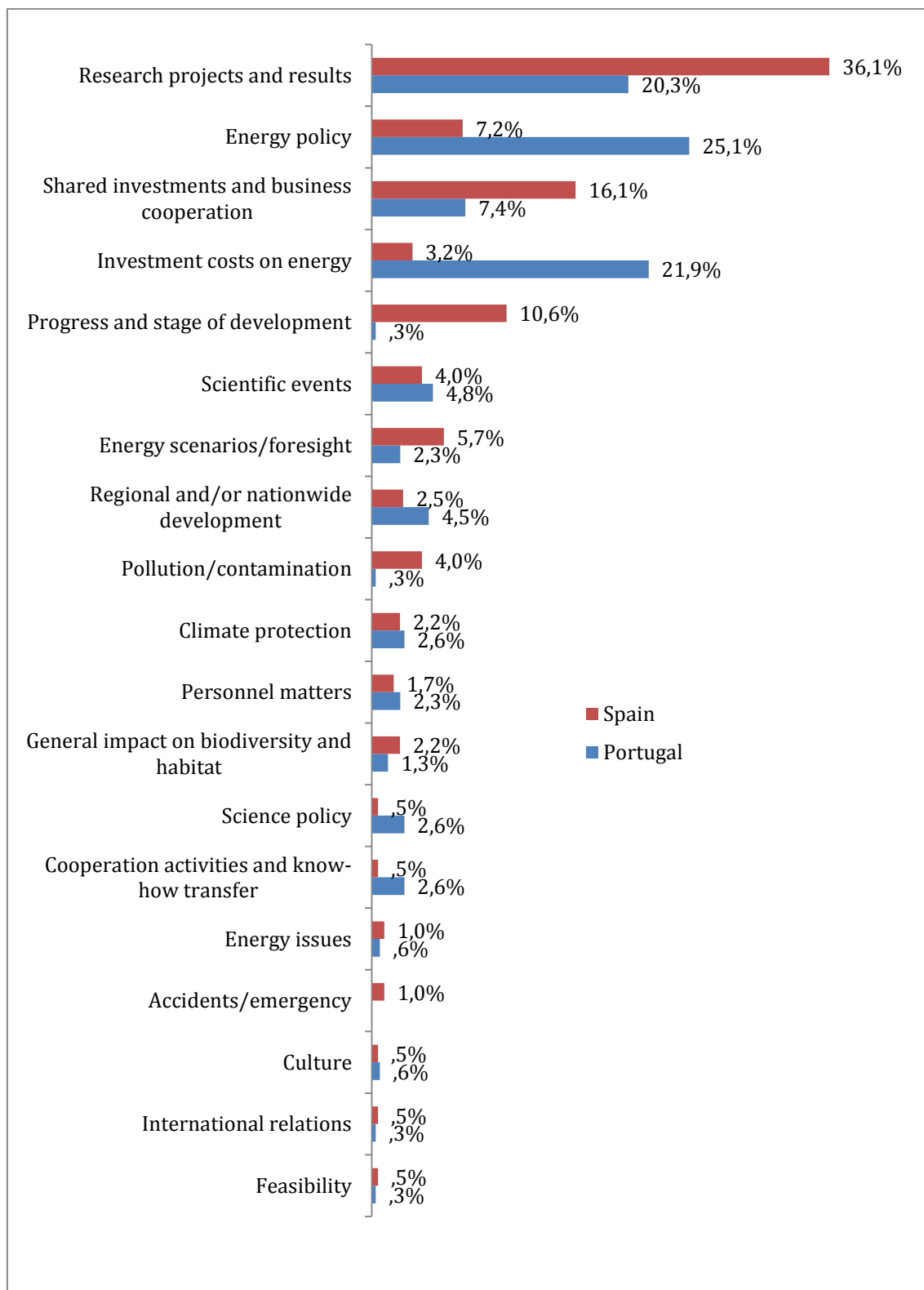


N=404

Regarding the themes addressed in the news articles, the larger proportion of articles from Spanish newspapers focus primarily on “research projects and results” (36%) (Figure 11). “Shared investments and business cooperation”, which is linked to the economic dimension, is the second most frequent theme (16%) but with a difference of 20% in comparison to the aforementioned. There is also a fairly number of articles focusing on the state of the art of emerging energy technologies as it is seen by the proportion of articles associated with “progress and stage of development” (11%). Policy related themes are mostly linked to “energy policy” (7%) and much less to “regional or national development” (3%). Only a few percentage of articles address environmental or safety related themes (the most frequently covered is “pollution or contamination” with only 4% of the total news) as well as “climate protection” (2%). Culture related issues (such as consumption patterns, lifestyles and attitudes) are discarded in the primary thematic frame.

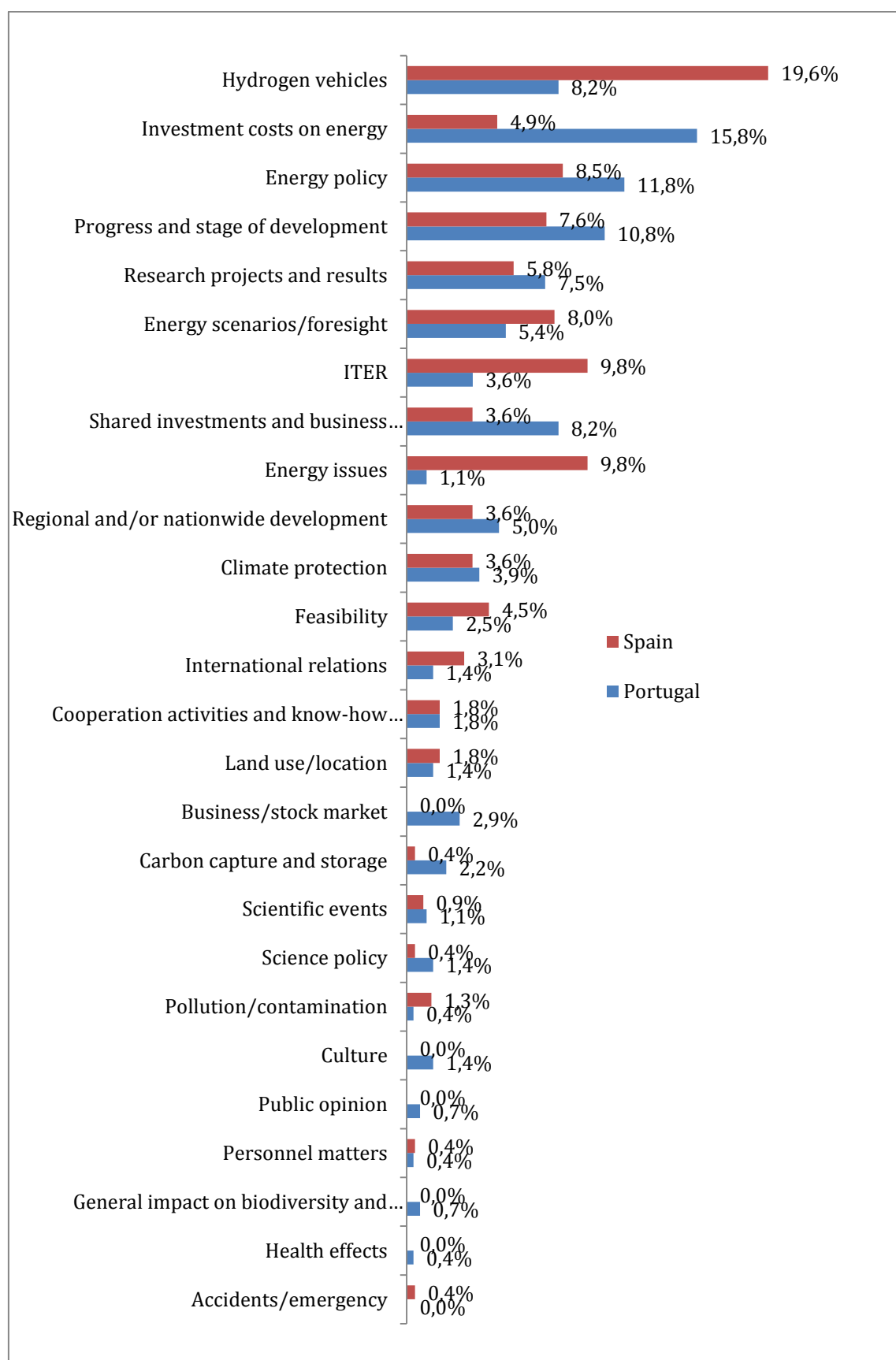
Portuguese newspapers address predominantly energy policy related content with 25% of the total news. “Investment costs on energy” is the second most focused theme with 22% of the total news, whereas “research projects and results” is the third with 22%. Contrary to their Spanish counterparts, Portuguese newspapers tend to focus on a wider range of thematic dimensions such as policy, energy economy, and science, but here again environment and safety as well as culture or climate protection related subjects are underrepresented.

**Figure 11 Articles by primary theme (%)**



Portugal N= 311; Spain N=404

**Figure 12 Articles by secondary theme (%)**

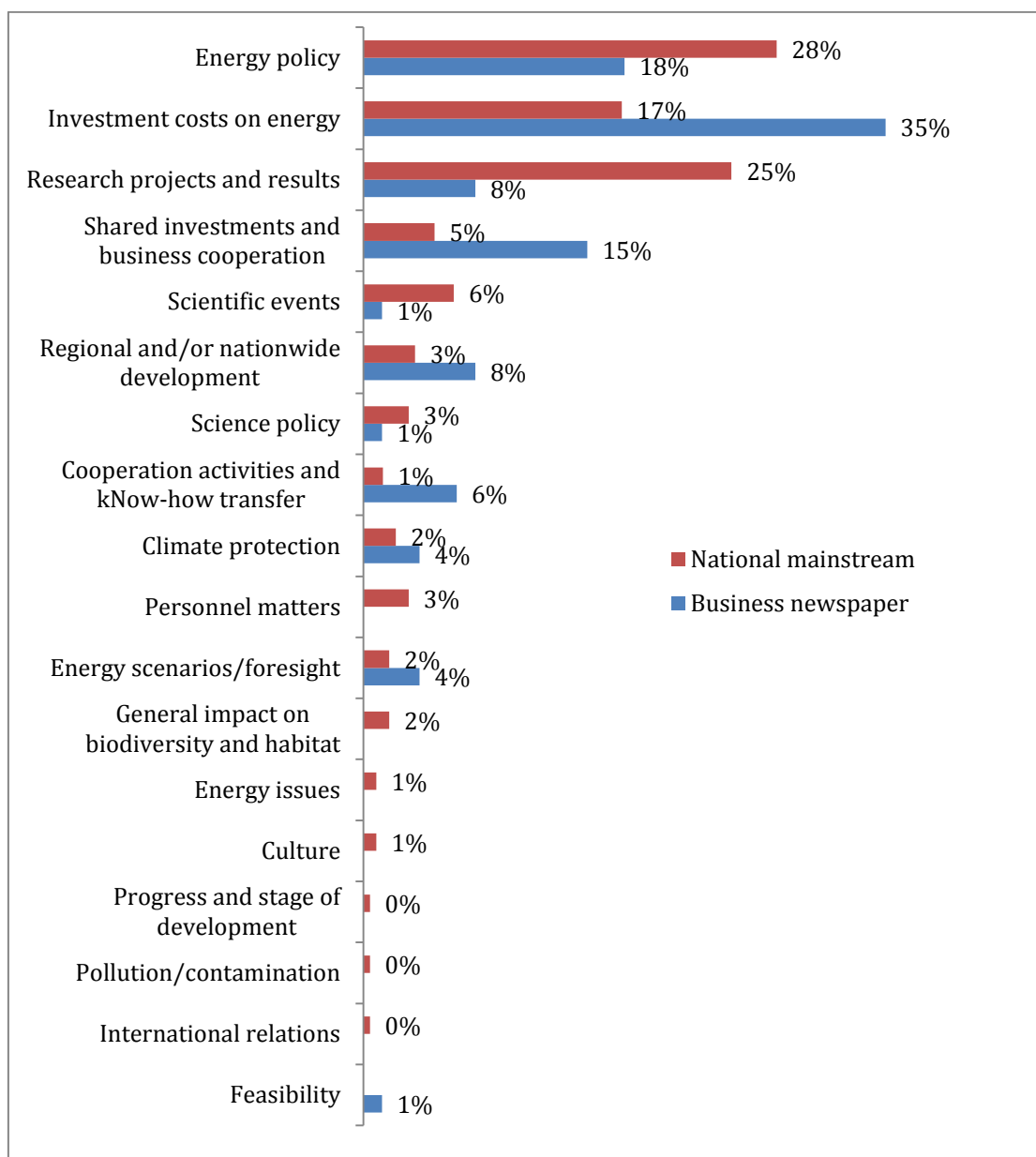


Portugal N= 279; Spain N=225

In terms of secondary themes (Figure 12), results from Spain show that “Hydrogen vehicles” is the most frequent secondary theme, present in 20% of the subsample. Spanish newspapers also address with a rather relevant proportion content related to ITER research device (10% of the total). “Energy issues” (such as energy justice, legislation and social equity) also have a relative importance as secondary themes, contrary to those that relate to environment and safety (pollution, accidents, health effects score near or below 1%) or economy (“business and stock markets”, 1%; “shared investments and business cooperation”, 2%).

In Portugal the most predominant secondary theme is “investment costs on energy”, with 16% of the total news, followed by “progress and stage of development”, with 11%. Portuguese newspapers address the emergent energy technologies in a more balanced way than its Spanish counterparts: as we can observe, the proportions of articles that address other themes are equitably distributed between “energy policy”, “shared investments and business cooperation” or “research projects and results”, all ranging up to 8% of the total news. Portuguese (and Spanish) newspapers also address “climate protection” as a secondary theme, although in a small proportion of articles (4%).

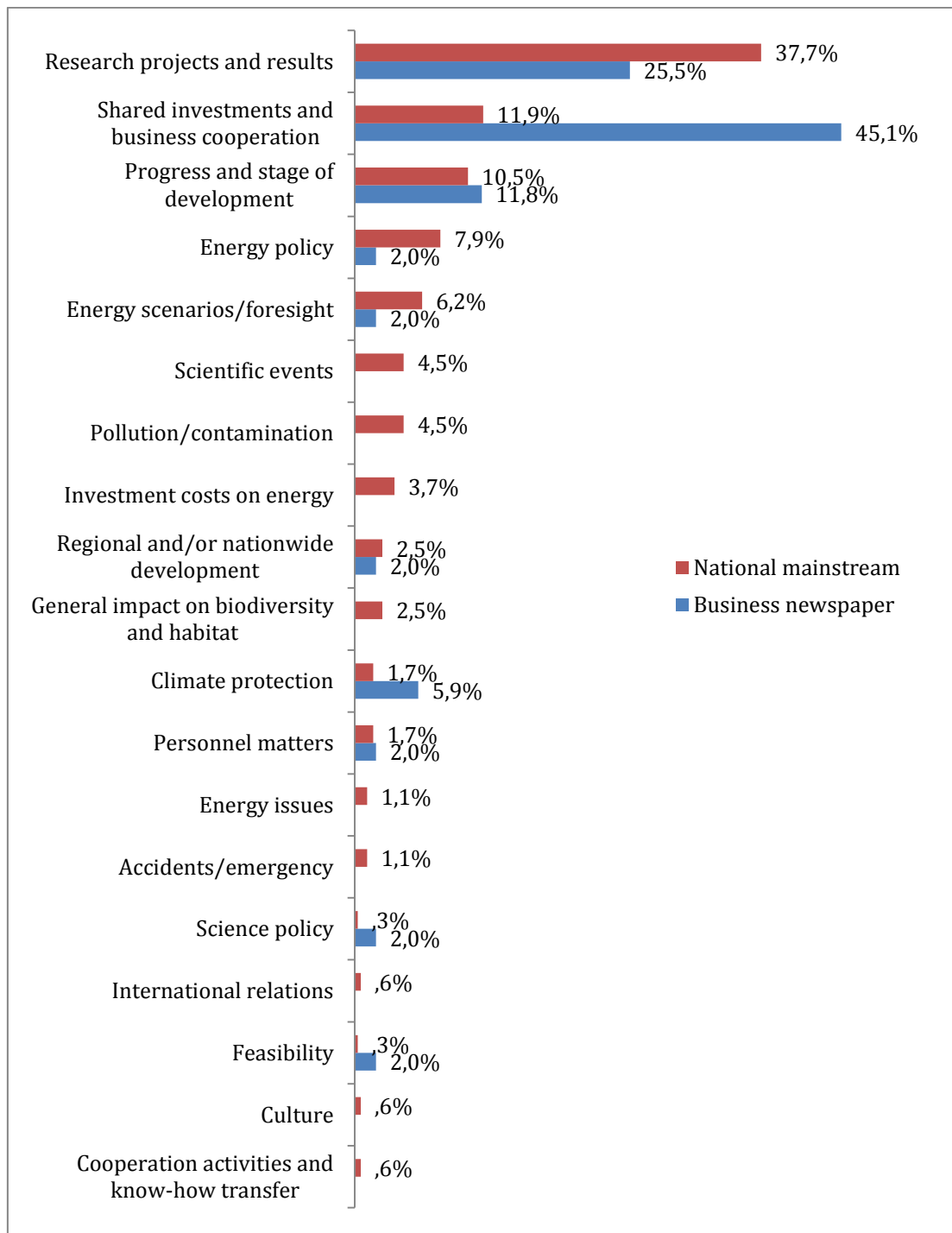
**Figure 14 Articles by primary theme and type of newspaper in Portugal (%)**



N= 301

Regarding the primary theme of the articles by type of newspaper in Portugal (Figure 14), national mainstream papers tend to cover a wide range of issues, but energy policy and scientific content (results of research projects) are more frequent. Business newspapers give more prominence to investment costs in energy, followed by energy policy and by shared investments and business cooperation. This can be explained by a growing concern with energy prices in Portugal, often associated with the rents paid to electric companies as a result of feed-in-tariffs and also the economic crisis.

**Figure 15 Articles by primary theme and type of newspaper in Spain (%)**



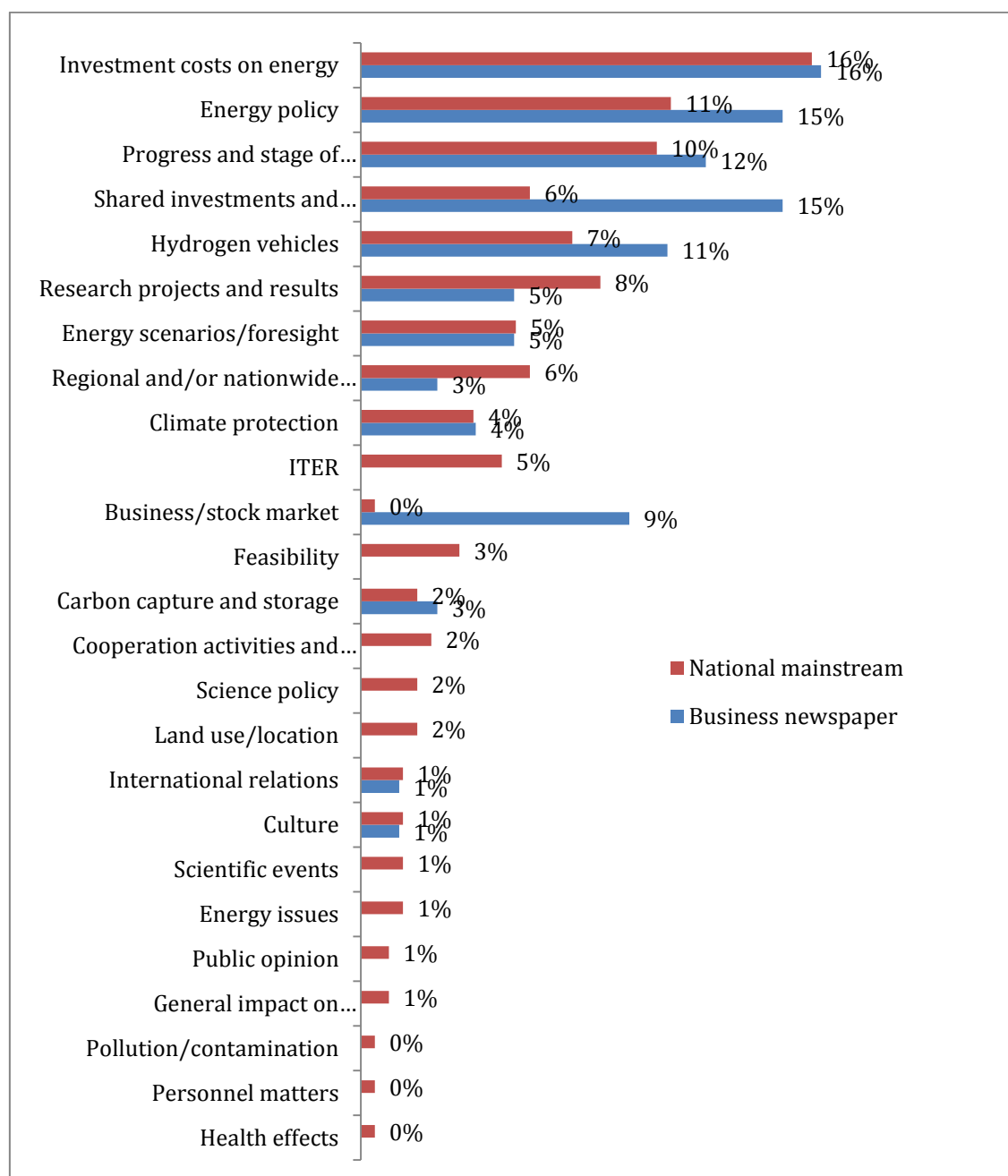
N=404

In Spain, a slightly different picture emerges (Figure 15): even though the dispersion over different themes is also high, over one third of articles on fusion published in national mainstream newspapers concern research results. Almost



half of the articles published in business newspapers focus on shared investments and business cooperation, followed by research projects and results.

**Figure 16 Articles by secondary theme and type of newspaper in Portugal (%)**

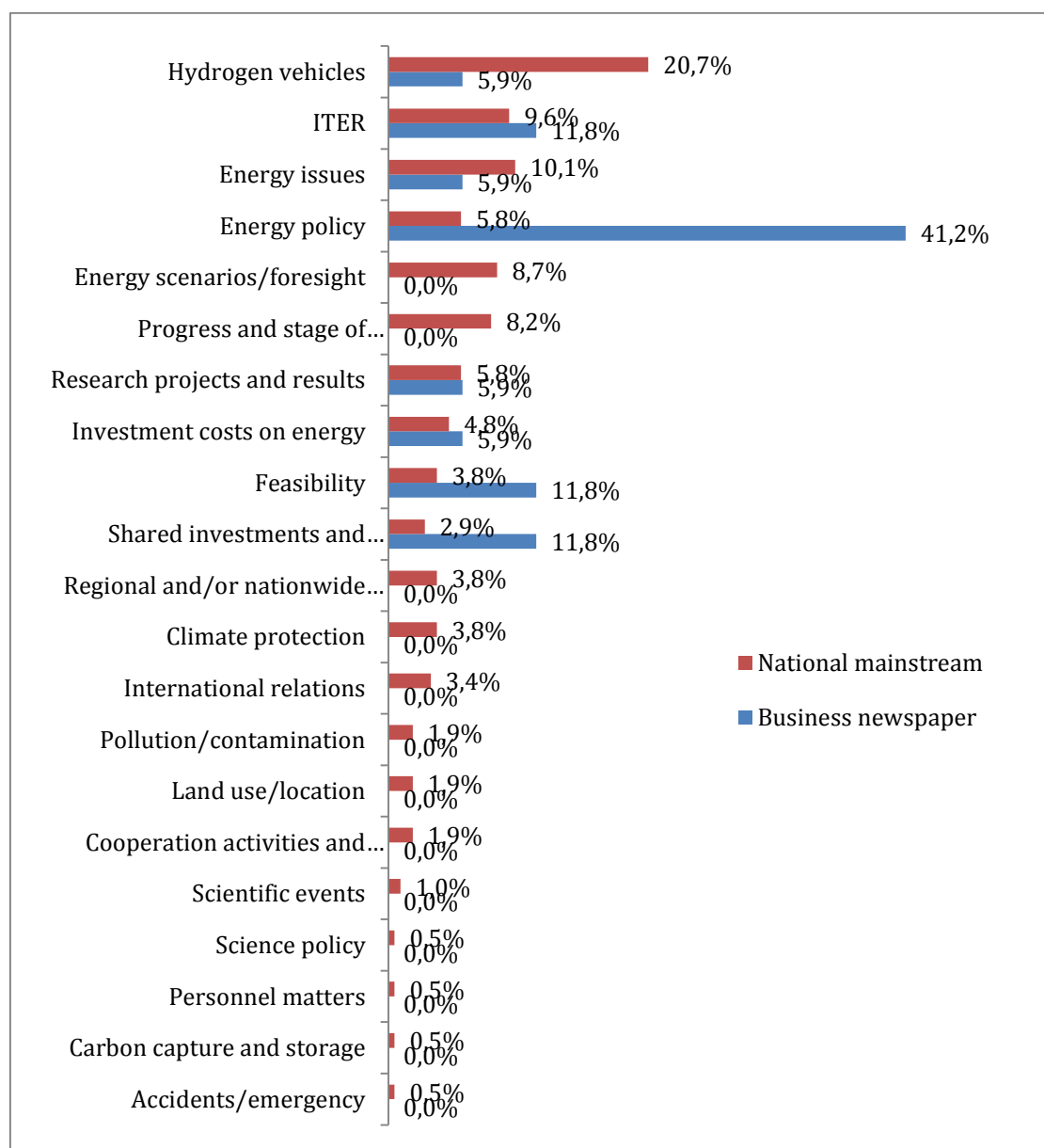


N= 279

In terms of secondary themes of the articles in Portuguese newspapers (Figure 16), the differences between types of newspapers remain at the level of dispersal

in national mainstream and concentration in business newspapers. However, investment costs are the most frequent category in both types, followed by energy policy and shared investments in business newspapers.

**Figure 17 Articles by secondary theme and type of newspaper in Spain (%)**



N=225

The secondary theme in news articles of Spanish business newspapers is concentrated in energy policy and the feasibility of new technologies (Figure 17), whereas mainstream newspapers articles are scattered in many different issues, though “hydrogen vehicles” is the most frequent.

**Table 7 Articles by primary theme and main technology focused in Portugal (%)**

	Multiple/none in particular	Off-shore wind power	Hydrogen	Wave power	Nuclear fusion	Biofuels from microalgae	Nano technology	Tidal power
Energy policy	39.5	28.2	20.0	44.9	8.1	6.5	10.5	25.0
Investment costs on energy	18.4	29.6	28.0	26.5	2.7	32.3	5.3	6.3
Research projects and results	7.9	4.2	28.0	14.3	35.1	45.2	42.1	6.3
Shared investments and business cooperation	2.6	28.2		2.0		3.2		
Scientific events			14.0	2.0	2.7		21.1	12.5
Regional and/or nationwide development	15.8	4.2	2.0	2.0				18.8
Climate protection		1.4	2.0	4.1	5.4		5.3	6.3
Cooperation activities and know-how transfer		1.4	2.0		8.1	3.2	10.5	
Science policy	5.3				13.5		5.3	
Energy scenarios/foresight	7.9		2.0	2.0				12.5
Personnel matters	2.6				16.2			
General impact on biodiversity and habitat				2.0		9.7		
Culture					2.7			6.3
Energy issues		1.4	2.0					
Feasibility		1.4						
International relations					2.7			
Pollution/contamination								6.3
Progress and stage of development					2.7			

N=311

**Table 8 Articles by primary theme and main technology focused in Spain (%)**

	Multiple/none in particular	Off-shore wind power	Hydrogen	Nuclear fusion	Wave power	Nuclear	Nanotechnology	Biofuels from microalgae	Tidal power
Research projects and results	25.8	22.9	50.0	82.8	57.7	21.7	52.2	84.6	
Shared investments and business cooperation	14.8	33.3	7.1		23.1	8.7	17.4	7.7	60.0
Progress and stage of development	6.2	18.8	10.7			52.2	21.7	7.7	
Energy policy	10.5	4.2	3.6		11.5		4.3		
Energy scenarios/foresight	10.0			3.4	3.8				
Pollution/contamination	4.3		25.0						
Scientific events	6.7					4.3	4.3		
Investment costs on energy	3.8	6.3		3.4					20.0
Regional and/or nationwide development	3.8		3.6			4.3			
Climate protection	3.3	2.1				4.3			
General impact on biodiversity and habitat	1.0	12.5							20.0
Personnel matters	2.9			3.4					
Accidents/emergency	1.0			6.9					
Energy issues	1.4				3.8				
Cooperation activities and know-how transfer	1.0								
Culture	1.0								
Feasibility	.5					4.3			
International relations	1.0								
Science policy	1.0								

N=404

**Table 9 Articles by secondary theme and main technology focused in Portugal (%)**

	Multiple/none in particular	Off-shore wind power	Hydrogen	Wave power	Nuclear fusion	Biofuels from microalgae	Nano technology	Tidal power
Investment costs on energy	19.4	26.7	8.2	29.3		11.1	5.3	6.7
Energy policy	19.4	16.7	4.1	17.1	6.3		5.3	26.7
Progress and stage of development	2.8	13.3	10.2	7.3	9.4	7.4	36.8	6.7
Hydrogen vehicles	5.6		42.9					
Shared investments and business cooperation	2.8	13.3	2.0	9.8	9.4	14.8	5.3	6.7
Research projects and results	8.3	1.7	6.1	2.4	9.4	18.5	26.3	
Energy scenarios/foresight	11.1	8.3	6.1	2.4		3.7	5.3	
Regional and/or nationwide development	8.3	3.3	4.1	9.8	3.1			13.3
Climate protection	8.3	1.7	2.0	4.9	3.1	11.1		
ITER					31.3			
Business/stock market		8.3	2.0	4.9				
Feasibility		1.7			9.4	11.1		
Carbon capture and storage		3.3	2.0			3.7	5.3	6.7
Cooperation activities and know-how transfer	2.8					7.4	10.5	
Culture					6.3			13.3
International relations	2.8			4.9	3.1			
Land use/location				7.3		3.7		
Science policy	2.8		4.1		3.1			
Energy issues		1.7	2.0		3.1			
Scientific events	5.6				3.1			
General impact on biodiversity and habitat						7.4		
Public opinion								13.3
Health effects								6.7

Personnel matters			2.0					
Pollution/contamination			2.0					

N=279

**Table 10 Articles by secondary theme and main technology focused in Spain (%)**

	Multiple/ none in particular	Off-shore wind power	Hydrogen	Nuclear fusion	Wave power	Nuclear	Nano technology	Biofuels from microalgae	Tidal power
Hydrogen vehicles	21.1		87.5						
Energy issues	8.3				65.0				
ITER	2.8			70.4					
Energy policy	12.8	14.3			10.0	4.8			
Energy scenarios/foresight	11.0			3.7		23.8			
Progress and stage of development	7.3	35.7				14.3	16.7		
Research projects and results	4.6			3.7	15.0		50.0	33.3	
Investment costs on energy	4.6		4.2			14.3		33.3	100.0
Feasibility	1.8	7.1		3.7		19.0	16.7	33.3	
Climate protection	6.4		4.2						
Regional and/or nationwide development	4.6			3.7	5.0	4.8			
Shared investments and business cooperation	1.8	14.3			5.0	14.3			
International relations	4.6			7.4					
Cooperation activities and know-how transfer	1.8					4.8	16.7		
Land use/location	0.9	21.4							
Pollution/contamination	2.8			3.7					
Scientific events	0.9			3.7					
Accidents/emergency		7.1							
Carbon capture and storage			4.2						
Personnel matters	0.9								
Science policy	0.9								

N=225

Regarding the primary theme by type of energy focused on the news articles in Portugal (Table 7), a few aspects can be highlighted. Articles focused on off-shore wind power tend to give more relevance to economic (investment costs, shared investments) and policy issues. Hydrogen is mainly associated with research projects and with investment costs. Almost half the articles on wave power focus on energy policy. Articles on biofuels from microalgae also have mainly a scientific nature, though investment costs represent a third of primary themes. Nanotechnology articles also are focused on science. Articles on tidal power are characterized by a wide diversity of themes: energy policy, regional development, energy scenarios, and scientific events. Regarding nuclear fusion over a third of the articles concern research projects and results, followed by personnel matters and science policy. In comparison to other technologies, nuclear fusion is the one that more frequently raises the concept of future scenarios in news coverage, but it is also the one that is less often linked to investment costs, placing fusion in a realm still too far from the state of affairs in what concerns new solutions for energy production.

Spanish newspapers highlight different themes for each technology (Table 8). Scientific aspects (research projects) are clearly dominant in articles on nuclear fusion and biofuels from microalgae, but also reach over half the sample on wave power and nanotechnology. Off-shore wind power is associated with shared investments and research projects. Half the articles on hydrogen concern research and a fourth of the articles mention pollution or contamination. Articles on nuclear energy underline the progress and stage of development. Articles on tidal power mention more frequently shared investments.

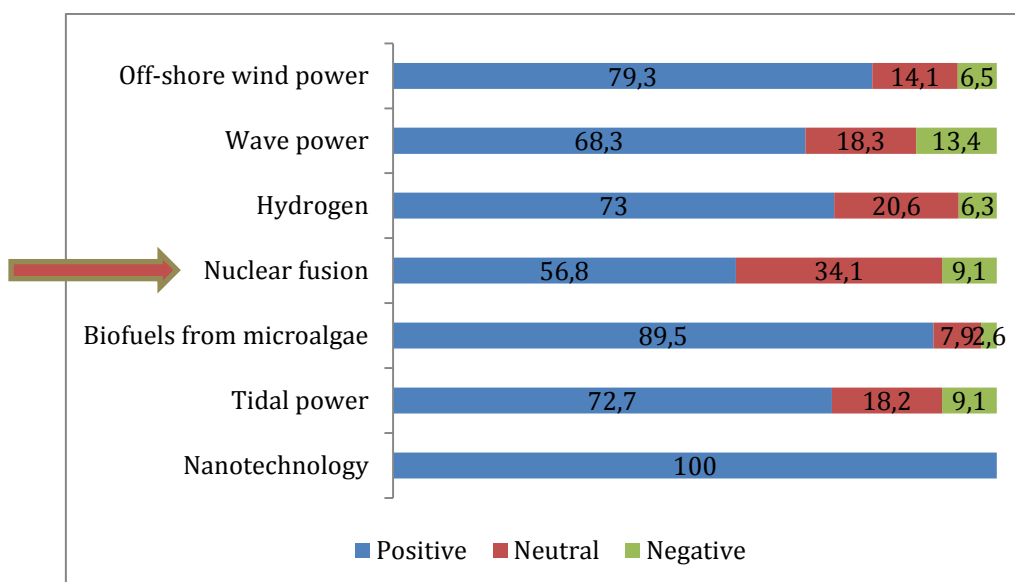
In what regards secondary themes in Portuguese newspapers (Table 9), investment costs are again the dominant feature in articles on off shore wind power and wave power. Articles on hydrogen vehicles represent almost half the articles on this form of energy. A third of articles on fusion mention ITER as its secondary theme. Articles on biofuels from microalgae have a quite diversified range of secondary themes, but research projects and shared investments are the most frequent. Nanotechnology articles are dominated by scientific issues: research projects and stage of development. Energy policy is the most frequent secondary theme of articles on tidal power.

In Spanish newspapers (Table 10), over two thirds of articles on fusion focus on ITER as a secondary theme. Fusion is also the only technology mentioned with regard to international relations. Off-shore wind power articles concern more frequently the progress and stage of development of the technology, as well as issues of location. Articles on hydrogen almost solely address the theme of vehicles (see Flynn et al 2010 and Budde et al 2012 for an appraisal of public perceptions regarding hydrogen vehicles). Energy issues are dominant in wave power articles. Nuclear energy articles pay more attention to energy scenarios and foresight. Half



the articles on nanotechnology concern research projects. Articles on biofuels from microalgae cover feasibility, research and investment issues. There is just one article on tidal power whose secondary theme is investment costs.

**Figure 18 Valuation by type of technology in Portugal (%)**

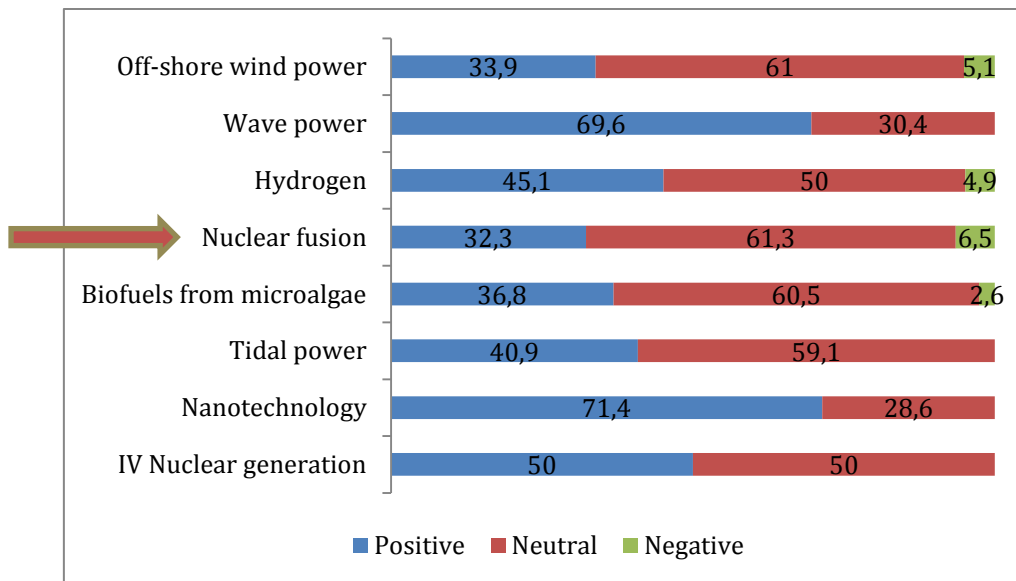


N=311

Articles on emerging energy technologies in Portuguese newspapers are of a largely positive nature (Figure 18). Positive valuations are more frequent in the case of nanotechnology, biofuels from microalgae and off-shore wind power. The proportion of articles with a negative stance is slightly higher in what regards wave power, which is due to the controversies raised by some projects. A third of articles on nuclear fusion (which is the energy technology with a lower rate of positive articles) are neutral. This is in line with the generally positive coverage that is given to scientific issues in Portuguese newspapers (Mendes 2002; Schmidt 2008; Ramos and Carvalho 2008).

By comparison, articles in Spanish newspapers tend to be more nuanced (Figure 19). The majority of technologies receive a neutral coverage, in particular fusion, biofuels from microalgae and off-shore wind power. Articles on nanotechnology and wave power are more frequently positive. Negative positions are a minority, but they can be found in articles concerning fusion, off-shore wind power and hydrogen.

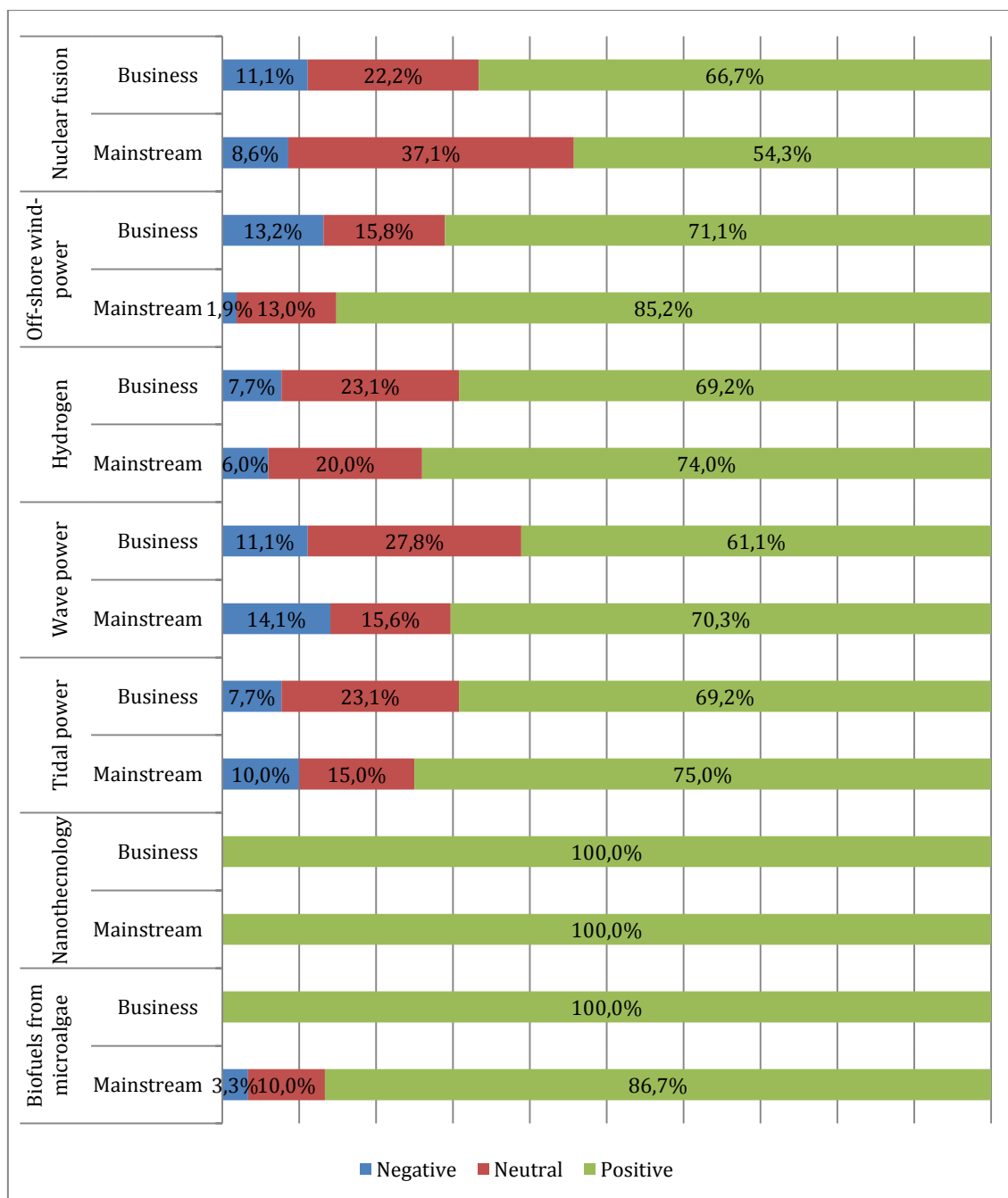
**Figure 19 Valuation by type of technology in Spain (%)**



N=404

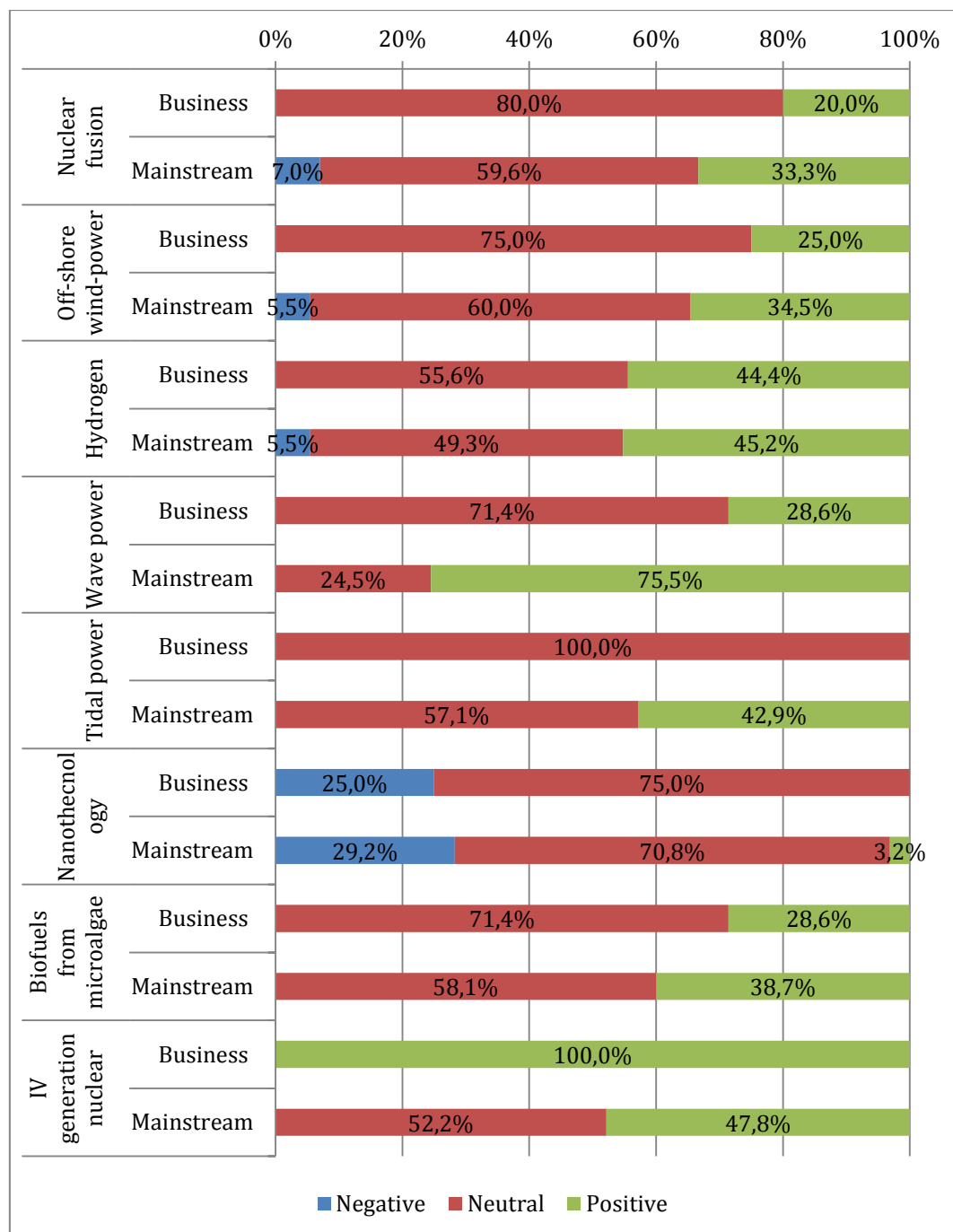
Analysing the valuation by type of newspaper and type of energy technology, a few tendencies can be detected. In Portugal (Figure 20), even though positive valuations are clearly dominant, business newspapers tend to present a more positive image of fusion energy and biofuels from microalgae and a more critical stance regarding off-shore wind power. In Spain (Figure 21) opt mainly for a neutral stance regarding most technologies (the values for IV generation nuclear energy pertain to a single article, therefore are not significant), whereas mainstream national newspapers present a more positive view of nuclear fusion, marine technologies (wave power, off-shore wind energy, tidal power) and biofuels from microalgae.

**Figure 20 Valuation by type of technology and type of newspaper in Portugal (%)**



N=311

**Figure 21 Valuation by type of technology and type of newspaper in Spain (%)**



N=404

The following tables list the more common positive and negative statements for each energy technology in Portuguese and Spanish newspapers.

**Table 11 Positive statements for each technology in Portugal (%)**

	Off-shore wind power	Wave power	Hydrogen	Nuclear fusion	Biofuels from microalgae	Tidal power	Nanotechnology
No/low environmental impact (clean, general)	19.6	53.7	34.9	34.1	63.2	42.4	50.0
Benefits for the economy (investments, jobs)	45.7	31.7	27.0	11.4	23.7	42.4	45.0
Climate neutrality (no CO2 emissions)	16.3	15.9	39.7	15.9	50.0	30.3	5.0
There are successful projects	29.3	14.6	23.8	9.1	31.6	9.1	45.0
Alternative to energy technologies based on fossil fuels	8.7	13.4	36.5	25.0	44.7	33.3	5.0
Abundant or unlimited resources	13.0	19.5	6.3	13.6	23.7	18.2	
Part of mixed energy supply portfolio	15.2	11.0	4.8	15.9	15.8	42.4	
It will be ready/it will produce energy in the near future	20.7	11.0	14.3	0.0	15.8		25.0
Promotes international collaboration	15.2	7.3	3.2	11.4	5.3	6.1	25.0
Answer to growing energy demand	15.2	3.7	7.9	11.4	7.9	12.1	5.0
Good for energy security (no dependency on foreign energy)	12.0	7.3	12.7	4.5	2.6	18.2	
Unlimited production of energy	7.6	2.4	12.7	34.1			
Cost-effectiveness of energy production	9.8	1.2	14.3	6.8	18.4		
Alternative for nuclear fission	4.3	6.1	3.2	18.2		9.1	
Enhances power and/or efficiency of energy technologies							85.0
Alternative to crop-biofuel					36.8		
Captures CO2 from the atmosphere					21.1		

N=311

**Table 12 Positive statements for each technology in Spain (%)**

	Off-shore wind power	Hydrogen	Nuclear fusion	Wave power	Biofuels from microalgae	Tidal power	Nano technology	IV Nuclear Generation
Benefits for the economy (investments, jobs)	55.9	18.3	4.8	43.1	7.5	24.4	32.1	4.2
There are successful projects	26.5	28.0	3.2	41.4	5.0	8.9	10.7	12.5
Climate neutrality (no CO2 emissions)	5.9	47.6	8.1	6.9	22.5	11.1	3.6	16.7
Alternative to energy technologies based on fossil fuels	2.0	41.5	8.1	8.6	22.5	8.9	0.0	0.0
Part of mixed energy supply portfolio	7.8	24.4	6.5	19.0	2.5	17.8	0.0	16.7
It will be ready/it will produce energy in the near future	9.8	8.5	1.6	37.9	0.0	4.4	0.0	8.3
No/low environmental impact (clean, general)	4.9	0.0	17.7	19.0	15.0	4.4	0.0	25.0
Abundant or unlimited resources	7.8	1.2	11.3	20.7	12.5	6.7	3.6	4.2
Unlimited production of energy	2.9		17.7	27.6		8.9	0.0	0.0
Promotes international collaboration	8.8	6.1	9.7	10.3		2.2	0.0	0.0
Alternative for nuclear fission	4.9		17.7	3.4		8.9	0.0	12.5
Good for energy security (no dependency on foreign energy)	3.9	1.2	6.5	6.9		8.9	3.6	8.3
Cost-effectiveness of energy production	2.9	1.2	3.2	3.4	7.5		25.0	8.3
Answer to growing energy demand	2.9		1.6	1.7		2.2	0.0	4.2
Generates more power/efficient								25.0
No visual impact				3.4		2.2		
It's a predictable and constant energy						4.4		
Less toxic waste than nuclear (3rd generation)								8.3

N=404

**Table 13 Negative statements for each technology in Portugal**

	Off-shore wind power	Wave power	Hydrogen	Nuclear fusion	Biofuels from microalgae	Tidal power	Nano technology
Technology not ready (not proven)	16.3	12.2	15.9	36.4	5.3	18.2	
High costs of investment	12.0		12.7	15.9	2.6	3.0	
Government support needed (dependent on subsidies)	5.4	9.8	11.1	11.4		9.1	
High risk investment	6.5	2.4	1.6			3.0	
Too far in the future	2.2			13.6			
Bureaucratic hurdles	3.3	2.4	1.6			3.0	
Consumes more energy than it produces (energy penalty)				13.6			
There are better options to tackle energy problems	1.1	2.4	1.6			6.1	
Conflicts with other activities/land use	1.1	3.7			2.6		
Uncertain public acceptance		1.2	3.2		5.3		
Adverse natural conditions	2.2	1.2				3.0	
Form of nuclear energy				6.8			
Not a real solution to climate change		1.2	1.6				
Not clean (dangerous by-products)			1.6				

N=311

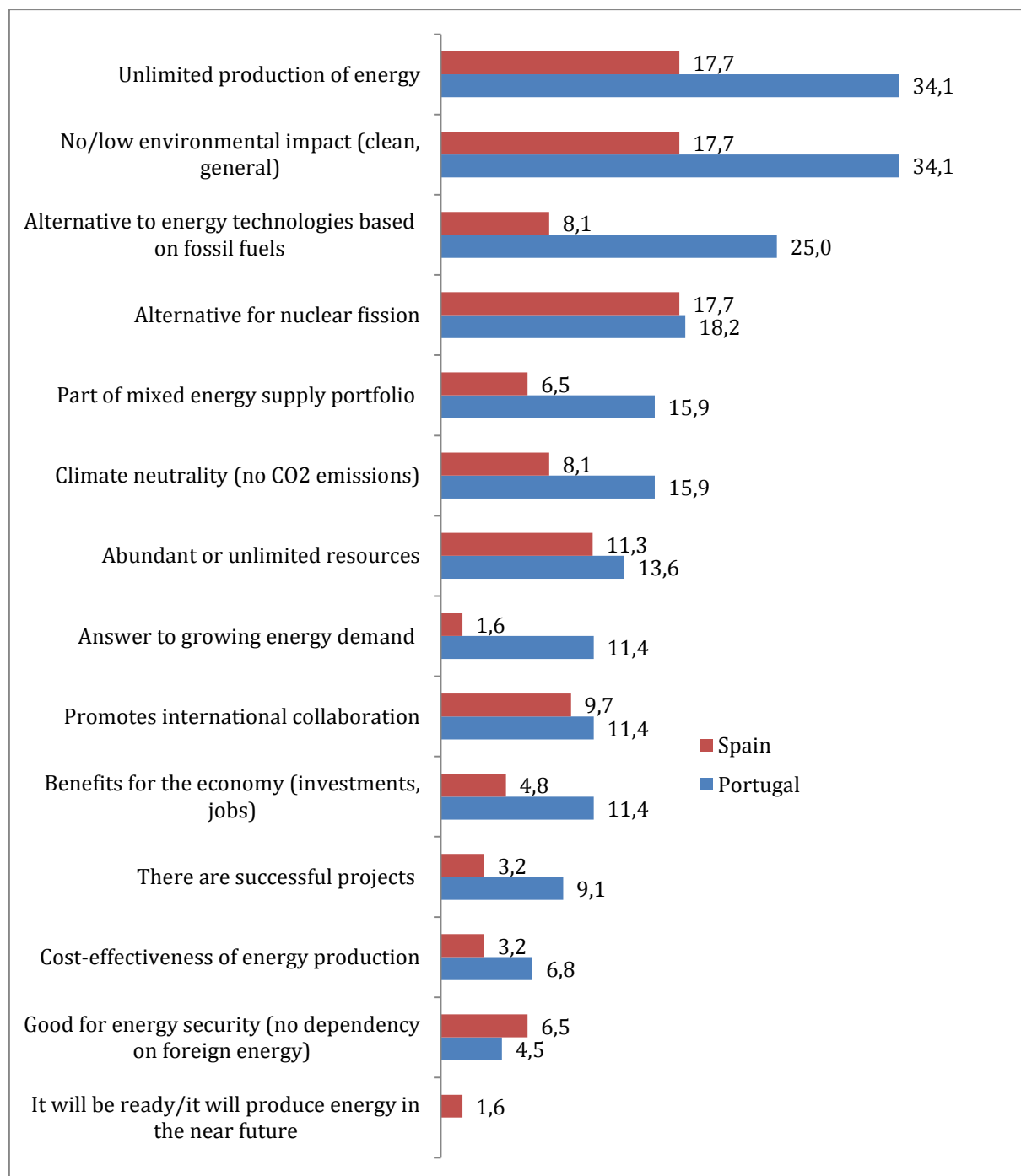
**Table 14 Negative statements for each technology in Spain (%)**

	Off-shore wind power	Wave power	Hydrogen	Nuclear fusion	Biofuels from microalgae	Tidal power	Nano technology	IV Nuclear Generation
Technology not ready (not proven)	5.9	12.1	25.6	11.3	5.0	6.7		
High costs of investment	10.8	6.9	14.6	16.1	10.0			4.2
Government support needed (dependent on subsidies)	10.8	6.9	2.4	1.6	0.0	4.4		4.2
Conflicts with other activities/land use	14.7	3.4		3.2	2.5			
Uncertain public acceptance	10.8	1.7		1.6				16.7
Too far in the future				9.7	5.0	2.2		16.7
Risks to the environment	7.8	1.7				4.4		
Consumes more energy than it produces (energy penalty)		1.7	1.2	1.6	5.0			
There are better options to tackle energy problems			3.7	1.6		2.2		
Threat for investments in mainstream renewable				4.8				4.2
Not clean (dangerous by-products)			1.2					
Based on non-renewable resources			1.2					
Not a real solution to climate change				1.6				
Form of nuclear energy								4.2
Not viable in Spain						2.2		4.2

N=404

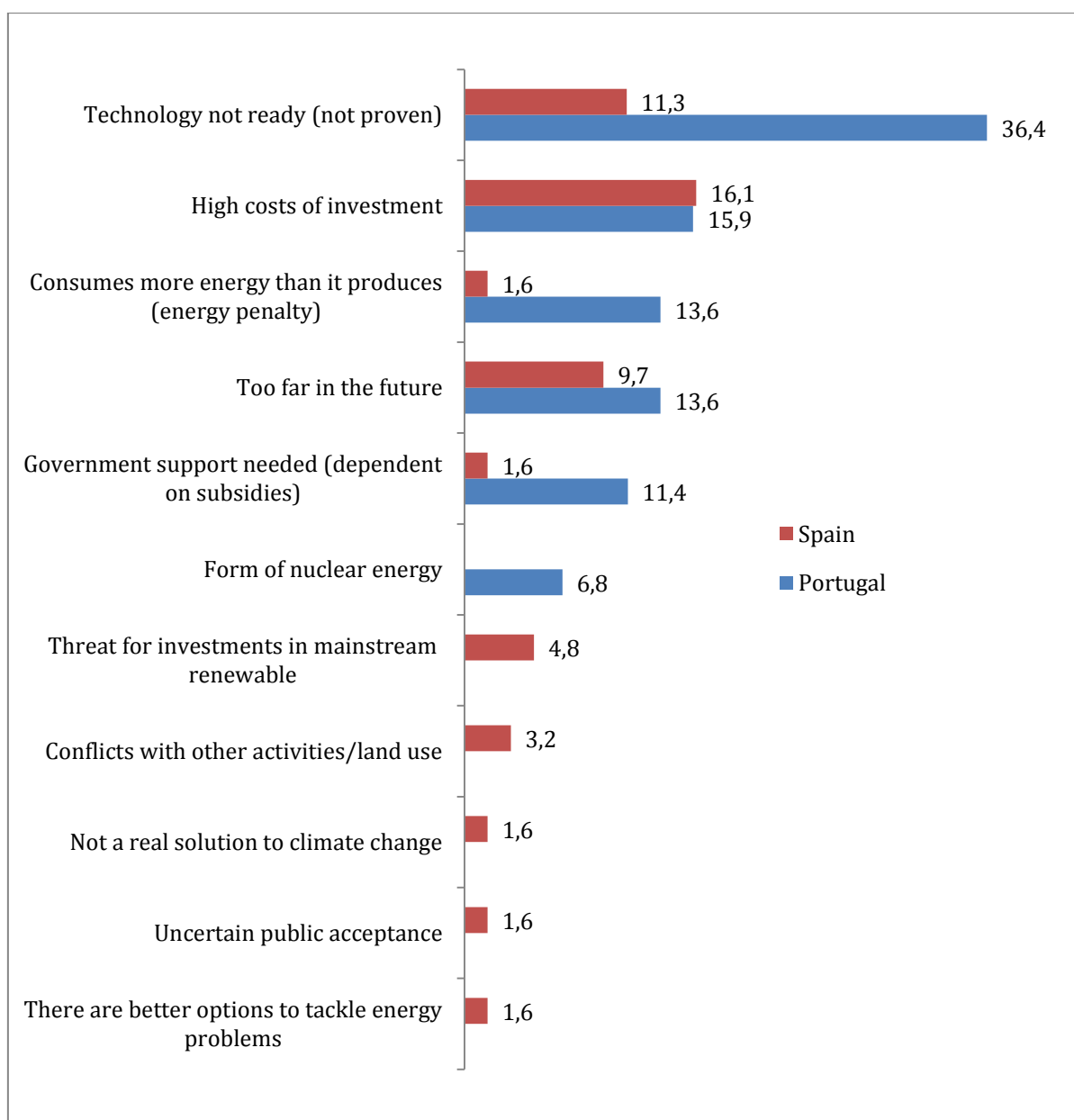


**Figure 22 Positive statements regarding nuclear fusion in Portugal and Spain (%)**



N= 44 and 62

**Figure 23 Negative statements regarding nuclear fusion in Portugal and Spain (%)**



N= 44 and 62

In Portuguese newspapers (Table 11), off-shore wind power is more often associated with benefits for the economy. Wave power is commended for its low environmental impact. Articles on hydrogen mention more frequently its climate neutrality, low environmental impact and role in replacing fossil fuels (especially due to its use in motor vehicles). Biofuels from microalgae are usually associated with low environmental impact and climate neutrality. Articles on tidal power refer to its low environmental impact, economic benefits and its role in the energy mix. Nanotechnology articles highlight its capacity for enhancing power or

efficiency of other energy technologies. Nuclear fusion is characterised in the Portuguese news by three main advantages: its low environmental impact; the unlimited production of energy; and also as an alternative to energy technologies based on fossil fuels.

In Spanish newspapers (Table 12), benefits for the economy come on top for off-shore wind power, wave power, tidal power and nanotechnology. Climate neutrality is the most frequently mentioned positive aspect of hydrogen, followed by its role in replacing fossil fuels. Biofuels from microalgae are commended for their climate neutrality and as an alternative to fossil fuels. IV generation nuclear power is valued for its low environmental impact and efficiency.

Nuclear fusion in Spanish news is mostly associated with low environmental impact, unlimited production of energy and replacement of fission energy.

Negative statements on emerging energy technologies in Portuguese newspapers (Table 13) fall mainly into three categories: the technology is not ready or not proven (more frequent concerning fusion and off-shore wind power), the investment cost is high (especially in offshore wind power and hydrogen) and it needs government support (in particular wave power and hydrogen). No negative statements were found regarding nanotechnology.

In Spanish newspapers (Table 14), negative statements on off-shore wind power mostly concern conflicts with other activities or land uses. The unproven state of the technology is more frequently mentioned with regard to wave power, tidal power and hydrogen. Nuclear fusion and biofuels from microalgae are criticised mostly for the high costs of investment. IV generation nuclear power is considered to be too far in the future and to garner uncertain public acceptance. Again, no negative statements were found regarding nanotechnology.

Comparing the two countries in terms of the positive valuation of nuclear fusion (Figure 22), in Portugal more favourable arguments are used in news articles and the role of fusion as unlimited, clean and an alternative to fossil fuels is more often highlighted. Spanish news articles are in general less optimistic (even if they highlight unlimited production, low environmental impact and alternative for nuclear fission). With regard to negative statements (Figure 23), a wider range of arguments against fusion are used in Spain (mainly high costs, not proven, too far), whereas criticism in Portuguese articles tends to focus on the unproven nature of this technology.

## **b) Qualitative analysis**

As stated in the methodology section, we have selected one article concerning each emerging energy technology from Spanish and Portuguese newspapers for a qualitative in-depth analysis, totalling 15 articles. This analysis covers the context of the articles, the description of the technology, the positive or negative (or neutral) evaluation performed, the links that are established with other emerging energy technologies, with renewable energies and with conventional energy sources, the feasibility and stage of development, the benefits and costs.

### **i) Biofuels from microalgae**

Regarding biofuels from microalgae, we selected the Portuguese article with the title «*Automobiles powered by algae*», published in Público on 2008-02-14, and the Spanish article with the title «*A company from Alicante generates the world's first bio-oil from algae*», published in ABC, on 2007-11-23.

### **Context**

In the Portuguese article, biofuels from microalgae are presented in the context of advanced research developed by Instituto Nacional de Engenharia, Tecnologia e Inovação (INETI), a laboratory dedicated to research on engineering and new technologies. As environmental concerns related to energy production and consumption increase, there is also a growing interest in Portugal for green fuels, whether extracted from microalgae or other sources. The scaling of oil prices besides environmental concerns is an additional argument towards the endorsement of biofuels. The article herein analysed was written in 2008, a time when the Portuguese government was encouraging investment in alternative energy technologies, aiming at supplying the country with at least 10% of biofuels in 2010.

*«At a time when environmental concerns are high, Portugal also joined the rush for biofuels, planning to have ten percent of green fuels in 2010. A good part of this percentage may be literally green. So says the National Institute of Engineering, Technology and Innovation (INETI), one of the largest research centres in the field of renewable energies in Portugal studying microalgae as a way to substitute diesel».*

The Spanish article herein analysed reports a major breakthrough in microalgae research as a result of the collaboration between a biofuel company and a public institution.

*«The company Alicante Biofuel Systems (BFS), in collaboration with the University of Alicante (UA), has created an energy conversion system that enables sustainable mass production of the first bio-oil in the world».*

## **Description**

According to the Portuguese article, research on microalgae covers more than its energy related potentialities. In this specific field of research, it still has to compete with other biotechnologies that are currently at a higher stage of development (mainly Crop-biofuels extracted from sunflower and wheat). Biofuels from microalgae are portrayed as a future energy technology that carries no environmental risks. Microalgae cultivation may also be a good solution for fuel companies in the sense that they can attain biomass for fuel production at a low cost.

*«Algae, which are only now beginning to emerge from the field of research, compete with other oil plants that are already rooted in market for many years and have a large cultivation area. "There are sunflower crops of 24 thousand hectares, while algae have no more than around 120 acres."»*

*«"Having the obligation to produce biofuel (...) the oil companies have many advantages in getting their own raw materials. They can also profit from this"».*

In the Spanish article, the technology employed takes advantage of the natural process of photosynthesis occurring within a controlled environment.

*«The new system is based on the intensive culture of marine algae that absorb CO<sub>2</sub> and convert it into a biomass from which biofuel is obtained».*

## **Evaluation**

In the Portuguese article, biofuels from microalgae are very positively evaluated. It is basically considered as a new hope for a cleaner car industry.

*«"In the field of biofuels, algae seem to emerge as the least controversial option, since they have almost no disadvantages"».*

In the Spanish article, biofuels from microalgae are mostly valued for their twofold environmental protection: CO<sub>2</sub> reduction and non-pollutant emissions.

*«This fuel (...) reduces [carbon dioxide emissions] (...) it also generates no sulphur dioxide or other harmful by-products».*

## **Relation to mainstream renewable technologies**

According to the Portuguese article, whereas crop-biofuels have negative impacts on land use and food market, microalgae cultivation is less costly and efficient than the above mentioned and does not interfere with land use for food plants nor with food prices.

*«The rising prices in other raw materials make them [algae] a good deal - this week wheat prices reached its maximum ever».*

*«[microalgae] “do not compete with agricultural crops for human consumption and therefore do not make the price of food to rise”».*

## **Relation to conventional energy systems**

In the Spanish article, biofuels are portrayed as a product that retains the dynamic power of conventional fuels but not its shortcomings. Apparently, these shortcomings are mentioned with regard to the environmental impacts of fossil fuels.

*«It is a new source of energy, similar to oil, that “retains all its products and advantages but not its disadvantages”, said the company spokesman».*

## **Feasibility**

The Portuguese article highlights the fact that biofuels from microalgae are based on abundant and fast growing plants. They are viable without many costs of investment or any other sort of obstacles.

*«“[microalgae] grow very fast and can be harvested every day (unlike other crops, which are dependent on seasonality)”».*

## **Current stage of development**

According to the Portuguese article, research on biofuels from microalgae is highly advanced at this stage. It is now possible to apply all research findings and technique to vehicles in a nearby future.

*«“The institute is now at the stage of technology transfer to companies (...) cars being moved by algae power in the streets of Portugal is our hope.”».*

The Spanish article underlines the importance of the particular research project mentioned due to its industrial scope and pioneering status.

*« (...) massive and sustainable production of the world's first bio-oil»*

## **Benefits**

The Portuguese article mentions that there are many benefits in microalgae research and development besides those that relate directly with energy. The main advantages of biofuels from microalgae are related to environmental protection. In this particular case, microalgae have a double function: they are a powerful source for green fuels and consume CO<sub>2</sub> from the atmosphere.

*«"Algae are the largest consumers of CO<sub>2</sub>. In the refineries, which are major polluters, it makes all sense that CO<sub>2</sub> is harnessed to grow algae"».*

According to the Spanish article, the major benefit of the use of a fuel system based on microalgae is its contribution to climate change mitigation, namely by the process of CO<sub>2</sub> capture and CO<sub>2</sub> reuse. The automobile industry is the most obvious commercial target.

*«The device (...) could capture about eight or nine kilos of CO<sub>2</sub> per year. "It seems little, but with a single square meter we could immobilize the entire CO<sub>2</sub> shooting from a car within a distance of 360 kilometres"».*

*«This system can help mitigate the effects of climate change (...) it does not release CO<sub>2</sub> into the atmosphere, on the contrary, reuses it"».*

## **Costs**

The Portuguese article also mentions costs. Although there is an abundant supply of algae, only few amounts can be used for energy purposes. Microalgae are also easily transformed in biofuel, albeit there is still a high cost associated with this process.

*«"(...) microalgae cultivation is easy and cheap but turning them into fuel still costs much money"».*

## **ii) Hydrogen**

Regarding hydrogen, we selected the Portuguese article with the title *«GM invests in hydrogen and looks beyond the crisis»*, published in Público on 2008-12-06, and the Spanish article with the title *«Ciemat opens a pilot facility to produce hydrogen from solar energy»*, published in El Mundo, on 2008-04-08.

## Context

The Portuguese article states that at the beginning of the financial crises a new hope for hydrogen vehicles emerges from the efforts of a major company (General Motors, builder of HydroGen4). Discussions about its usage and future commercialization in Europe are tightly linked to official support and approval (by the EU Commission) and to private investments.

*«[GM] built over 10 [vehicles] and sent them to Europe, where they were adapted to meet the technical specifications of the European Union (EU), especially with regard to safety».*

The Spanish article focuses on hydrogen cells. It is not an energy source but instead a generator for other energy sources. This is the case of the hydrogen power plant focused in this article, which is based on solar power. The plant was built on the foundations of a previous electric power station sited in Almería.

*«The Centre for Energy and Environmental Research (CIEMAT) has inaugurated an experimental hydrogen power plant based on solar energy.»*

## Description

In the Portuguese article, hydrogen vehicles are described as a pioneering technology that need to be urgently supported and commercialized in order to guarantee climate protection.

*«The automobile industry estimates that the current global park 900 million vehicles will reach 1100 million in 2020, an increase which becomes urgent mobility solutions that cause fewer emissions».*

In the Spanish article, the new hydrogen power plant is described as a turning point in energy generation particularly when compared with the previous electric power facility.

*«The Hydrosol II project multiplies by 10 the power of the previous reactor that has been operating (...) since 2002. The new hydrogen generator has a magnitude of 100 thermal kW and produces continuously three kilograms of hydrogen per hour.»*

## Evaluation

In the Portuguese article, hydrogen fuel cells are much appraised especially because of the abundance of hydrogen as key element for its production.



*«The current production of hydrogen for industrial purposes is 50 million tons per year».*

The Spanish article mentions automobiles as copious sources of pollution in our societies. They are also the main commercial target for hydrogen fuel, as it is emphasized in the article.

*«Technologies that split water to get hydrogen as a future fuel for electric vehicles are considered priorities.»*

### **Relation to conventional energy systems**

According to the Portuguese article, one of the major advantages of hydrogen is that it can be as powerful and efficient as petrol and diesel.

*«[hydrogen available is] enough to fuel 300 million fuel cell cars, and the outstanding amounts are now comparable with those of petrol and diesel».*

### **Relation to mainstream renewable technologies**

The core of the Spanish article is indeed the link between hydrogen synthesis and solar power. This is the only renewable energy mentioned in the article.

*"(...) hydrogen generation using solar energy"*

### **Feasibility**

In the Spanish article, feasibility does not seem to be an issue for concern with regard to this method of attaining hydrogen fuel. The way that the article presents the easiness underlying all the process is quite evident.

*«(...) Hydrosol produces hydrogen at very low temperatures, of the order of 800 degrees Celsius, which operates continuously using only solar energy»*

*«(...) conventional ways of producing hydrogen require high energy consumption»*

### **Current stage of development**

The Portuguese article states that at this moment there are only prototypes available for evaluation especially in terms of efficiency and safety. Nevertheless,

there is a growing confidence that hydrogen vehicles can progressively substitute for diesel ones.

*«The real adventure HydroGen4 started a year ago in the U.S., where the builder put into circulation 100 prototypes in the hands of 30 families for a period of three months, a total of 3400 drivers».*

The Spanish article states that all the developments that have been done in this field of research and particularly within the context of this project are ready to emerge out of the scientific confines toward the industrial and commercial spheres.

*«The continuance of the research aims to take the leap for technologic transfer to industrial and business network, using only renewable energy.»*

## **Benefits**

According to the Portuguese article, the main benefit of using hydrogen in fuel cells is that it is simultaneously abundant and a clean source of fuel. Hydrogen vehicles can contribute largely for EU mitigation targets set for 2020.

*«[hydrogen] is the most abundant substance on the planet, it can help to significantly reduce emissions of carbon dioxide and its production from renewable electricity can contribute to achieving the EU 2020 [mitigation] targets».*

The Spanish article presents an additional argument in favour of the project herein focused and, overall, of hydrogen fuel: its climate neutrality.

*«(...) what is being tested is (...) a sustainable fuel, since its production only uses the sun's energy, which is 100% renewable and free of [GHG] emissions.»*

## **Costs**

The Portuguese article claims that although it can provide energy at a low cost in the nearby future, hydrogen fuel cells are still dependent on large amounts of money. Costs and problems of production are also related to cooperation between public and private interests.

*«Studies in this area indicate that it will take a decade to build a supply chain, requiring "close cooperation between industry and governments." For the European case, the necessary investments [predicted for] 2015 and 2030 accounted for EUR 50 billion (...) ».*

### iii) Nanotechnology

Regarding nanotechnology, we selected the Portuguese article with the title «*FotOrg - The "low-cost" reached the photovoltaic*», published in Jornal de Negócios, on 2011-01-27, and the Spanish article with the title «*Nanoscience and nanotechnology to achieve alternative energy*», published in El Mundo, on 2011-11-28.

#### Context

Energy applications of Nanotechnology are hardly addressed as singular issue in Portuguese news. It is rather usual to present several applications of nanotechnology and nanomaterials as a whole subject. This article relates nanotechnology research and technical breakthroughs with improvements in solar panels technology.

*«These are low cost solar cells that can be embedded in almost everything the imagination allows. In FotOrg, innovation has joined hands with creativity».*

The Spanish article addresses the relationship between the major environmental concerns that arise from our societies' predominant energy model and the possibility to change the present state of affairs with the use of new technologies. The article is an interview with Fernando Briones, a research professor at the Institute of Microelectronics of Madrid (IMM-CSIC).

*« (...) there are several scientific studies which show that the use of fossil fuels as the main energy source causes serious environmental damages such as pollution and climate change. Our society needs to change urgently the energy model.»*

#### Description

According to the Portuguese article, solar nanocells are considered the state of the art in this field of research. They were produced for the first time a few years ago, but are only now being improved so that can be applicable to solar panels in a way that can boost energy produced by this method.

*«This type of solar cells, "third generation", is already known in university laboratories for about eight years. What FotOrg did was introduce new ideas for their manufacture and optimization».*

In the Spanish article, the role ascribed to nanotechnology in this alternative scenario is to engage with other technologies such as the ones linked to solar power, in order to provide highest levels of energy.

*«Nanotechnology can improve the performance of materials used in photovoltaic solar devices»*

## **Evaluation**

In the Portuguese article, nanocells technology is positively evaluated mainly because of its efficiency, flexibility and small size, making it a very comfortable and aesthetic method of generating energy.

*«"This type of PV is virtually 100% flexible, without loss of efficiency. It can be applied to almost anything that our imagination is capable of conceiving"».*

In the Spanish article, the design, abundance and low-cost of materials are the most positively evaluated features of the application of nanotechnology to solar power systems.

*«"Photovoltaic solar cells will combine (...) capture and conversion of solar photons into electrical energy with a smart design, using abundant and low-cost materials"».*

## **Relation to mainstream renewable technologies**

According to the Portuguese article, when applied to solar energy systems such as photovoltaic, nanotechnology proves to be highly efficient.

*«The advantage of these PV's is the competitiveness of the relationship between efficiency and cost».*

The Spanish article states that nanotechnology applications to energy technologies are several, but the scope of the article is precisely the relationship between nanotechnology and solar power systems. This linkage is perceived as a game changer for solar power itself.

*«Nanotechnology can improve the performance of photovoltaic materials used in solar devices. In the forthcoming years, nanoscience and nanotechnology can play a key role in facilitating this unavoidable conversion».*

## **Relation to conventional energy systems**

The main question addressed in the Spanish article concerns the possibility to shift from an energy model based on fossil fuels to a more sustainable one. Solar power is presented as the most complete answer to this question, whereas nanotechnology is highly estimated for its role in the development of solar power systems.

*[nanotechnology may offer] « (...) a great contribution to the development of a new energy model based on more rational generation, storage, and distribution of energy. Essentially, by its linkage to the use of solar energy, the most ubiquitous source of energy and the most sustainable and clean that we have ».*

## **Feasibility**

The Portuguese article affirms that photovoltaic systems are technically and commercially viable under certain conditions. The development of this new technology is also achieved in scientific cooperation activities that involve private and public institutions.

*«The best endurance timeline has already been achieved, about one year, which is manifestly unfeasible from a commercial point of view. But there already two major developments: at UA, the knowledge of the physical phenomena of electrical charge transport / morphology allowed to devise a new strategy; in CeNTI and Nanolayer a protective barrier was develop to increase the durability of photovoltaic systems».*

Feasibility assessments in the Spanish article are mainly related to nanocells design and in particular to its small dimensions. Ultimately, by achieving this level of precision the conditions are set to guarantee economic viability.

*«[nanocells] “small dimensions also mean a significant reduction in costs of installation, monitoring systems, maintenance and optical concentration that ultimately define the economic viability of any energy option”».*

## **Current stage of development**

According to the Portuguese article, technically, these applications of nanotechnology to photovoltaic are already at a final stage of development. The next step toward commercialization is mainly dependent on investments.

*«The onset of the company is dependent on the results of the pilot phase, which will begin in the second half next year. Now they want to purchase large*

*equipment for pilot production. “According to the suppliers, the equipment will be installed and operational by the end of the first half of 2011”».*

Regarding the Spanish article, despite the advance stage of investigation and technologic development already achieved, nanotechnology applications to energy systems are still dependent on a variety of aspects that do not relate directly to science. The main question here presented is that without political and economic support, nanotechnology is more likely to remain encircled within the boundaries of science.

*«“The basic technologies are already well advanced but its overall scale implementation now depends primarily on economic, social and political factors quite extraneous to science and technology”».*

## **Benefits**

Besides other benefits already mentioned in the Portuguese article, nanotechnology applications to energy are also appreciated for its small scale dimension, flexibility and productivity.

*«They are about ten thousand times thinner than a human hair, the manufacture is simple and can be done in large production systems ».*

The main benefit of nanotechnology in the Spanish article, besides its contribution to a more sustainable energy model, is identified within the relationship between technologic development and cost reduction. In fact, there is a high level of optimism with regard to the commercialization of nanotechnology applications to solar power, part of it based on an economic oriented view of technology itself.

*« (...) “the large-scale development of the market allows a substantial reduction in costs while increasing performance, this option may soon be very effective for industrial generation connected to the grid, particularly in desert areas with strong direct sunlight (...)”».*

## **Costs**

The Portuguese article claims that solar Nanocells may be produced at a very low cost with a small loss of efficiency in comparison to other photovoltaic techniques.

*«In fact, the efficiency is around 5%, four times less than the best photovoltaic monocrystalline silicon [solar panels actually being used] (...), but the cost is ten times smaller”».*

#### **iv) Nuclear fusion**

Regarding nuclear fusion, we selected the Portuguese article with the title «*Nuclear Pros and Cons*», an interview with Carlos Varandas, published in *Diário de Notícias*, on 2013-12-09, and the Spanish article with the title «*Leading scientists are appealing for the relinquishment of the nuclear fusion reactor*», published in *La Vanguardia*, on 2010-08-26.

#### **Context**

In the Portuguese article, it is said that nuclear fusion is often compared with nuclear fission in terms of safety, environmental impact, feasibility, costs and efficiency, which somewhat corresponds to a divide between those that argue in favour of one against the other. Notwithstanding, there are some who advocate for nuclear energy as a core source of energy, regardless the method to achieve it, highlighting at the same time that both have advantages and disadvantages which might be differently managed in order to satisfy our societies' energy demand. This is the case of Carlos Varandas, a reputed expert in nuclear research who has been for the past years the President of the Institute of Plasmas and Nuclear Fusion and a member of the Scientific and Technical Committee of the Euratom.

*«(Fusion) It's a cheap and almost inexhaustible source of near twenty per cent of the electricity consumed in the world. Nevertheless, nuclear energy still gathers enemies everywhere and the fact is that Portugal will not have a nuclear power plant in the forthcoming years. For Carlos Varandas, scientist and president of the Institute of Plasmas and Nuclear Fusion, this is unavoidably the energy of the future».*

According to the Spanish article, doubts about nuclear fusion arise not only from lay persons' knowledge but also from experts views. This article follows the main criticisms to nuclear fusion and particularly to ITER project, conveyed in the words of three physicists - Georges Charpak, Sébastien Balibar and Jacques Treiner, to address the question of whether fusion is a defensible energy technology.

*«Opposition to the project is headed by Georges Charpak, Sébastien Balibar and Jacques Treiner. All three have made an appeal for the "relinquishment" of this project because it is "expensive and useless"».*

#### **Description**

In the Portuguese article, nuclear fusion and nuclear energy in general terms are compared to the immense power generated by the sun. The sun metaphor is indeed a well-known symbolic reference in media discourse on fusion.

*«“Will readers know that life on Earth would not be possible without nuclear? The light and heat that reach the Earth are a tiny part of the light and heat that are generated by nuclear fusion reactions in the centre of the Sun”».*

According to the Spanish article, nuclear fusion is still undergoing some complex stages of development and therefore is yet to be proven. This contributes to build an undefined image of fusion and of its contribution to future generations. The following sentence seems to cover all possibilities, but in fact it suggests that fusion is presently consigned to a realm of vague hypothesis.

*«The discussion is in terms of whether nuclear fusion is a promising dream or just a costly chimera».*

## **Evaluation**

According to the Portuguese article, fusion energy as part of nuclear energy in a broader sense is vital to provide high amounts of energy in the future. Against all arguments that associate nuclear power exclusively with accidents, bombs and waste, there are also enough arguments to state that either fusion or fission can also be thought-out as ‘friendly’ sources of energy.

*«“Personally, I’m convinced that in the current stage of scientific knowledge and technological development, it is not possible to ensure sustainable and affordable supply of energy to all mankind without the use of nuclear energy”»*

*«“But nuclear power also has ‘good’ things. There are many applications of nuclear power in our everyday lives, in areas of activity and knowledge as diverse as medicine, agriculture, environment, archaeology and industry (...) There are many reasons to say that the nuclear is also a friend».*

The Spanish article confronts three different perspectives with regard to the role of nuclear fusion in present and future scenarios: the holistic view of the EU and World powers that endorse nuclear fusion research; the science oriented view of the three sceptical scientists above-mentioned; the ecologic view of a French environmental organization, to whom the core subject is the relationship between fusion and climate change.

*«In this project, the EU and the World powers have placed our hopes to achieve a clean, cheap and infinite energy for the future during the second half of the century».*

*«Scientists oppose this project mainly because it “endangers other major investigations” in science and energy».*



*«The project does not conform to the urgencies of climate change," stated [the environmental organization] France Écologie».*

### **Relation to other emerging energy technologies**

In the Portuguese article, nuclear fusion is considered the most promising energy technology of the future, but that does not dismiss the possibility to engage with other technologies of the sort in working together for a more consumer friendly supply of energy.

*«“In the current stage of scientific and technological knowledge, nuclear fusion (...) has better prospects of success. But we cannot exclude the possibility of developing other energy technologies, as good as or better than nuclear fusion. The more energy sources available, the better it is for consumers (...)”».*

### **Relation to mainstream renewable technologies**

According to the Portuguese article, with regard to mainstream renewables, fusion energy is not seen as a competitor but rather as a key element that supports the very existence of renewable energy systems. This argument takes into consideration only fusion reactions occurring in the core of the Sun.

*«“Do you know that many renewables are directly or indirectly dependent on these nuclear fusion reactions?”»*

In the Spanish article, the scepticism about fusion strongly contrasts with the positive evaluation of other technologies, namely those that relate to renewable energy sources. Moreover, the high expenditure on fusion research is considered an obstacle to the development of these other technologies.

*«“We oppose to it because it is an undeveloped technology which is economically wasteful and (...) it can reduce investment and public funding toward proven energy technologies such as renewable sources”».*

### **Relation to conventional energy systems**

In the Portuguese article, nuclear fusion is thought-out as the best possible solution to replace conventional energy systems based on fossil fuels and traditional nuclear energy.

*«“(...) traditional sources of energy are not sufficient to ensure the sustainable development of the entire population of the planet”».*

## Feasibility

According to the Portuguese article, when feasibility is brought into question, nuclear fusion is less well appraised. For the time being it is considered more of a dream or an endless experiment than a real technological achievement.

*«“On Earth [fusion] is still a dream. Man has managed to achieve controlled fusion reactions in two machines (TFTR and JET), but the energy gain was less than the unity (JET yielded 16 megawatts of fusion power, but spent up to 25 MW heat the plasma)”».*

According to the Spanish article, supporters of fusion argue that feasibility is a question of persistency. The main problem to overcome is the availability of suitable materials to work with and not the level of energy to process them.

*«The challenge is to work with materials capable of withstanding high energy irradiation».*

## Current stage of development

The Portuguese article states that regardless the fact that feasibility is yet to be proven, there are positive signs that fusion might be fully accomplished in the future. The ITER device is seen in this context as the state of the art in fusion research and development.

*«“In ITER (...) the expectation is to get around 12 to 15 250 MW of fusion power using the same 25 MW to heat the plasma”».*

The Spanish article strongly links nuclear fusion to ITER, despite the existence of other projects related to fusion research methods (e.g. the National Ignition Facility in the USA). Besides the doubts that arise about viability, energy demand and sustainability of fusion energy, the success of ITER is also doubtful and in the best case scenario it will only lead to a fully stage of development in a faraway future.

*«If ITER succeeds to generate electricity on a large scale it will not be before the end of the century. Construction began this summer and will end in 2019. The first evidence of fusion reactions will not be presented before 2026. His successor (Demo) will only produce electricity by 2040».*

## Benefits

In the Portuguese article, the benefits of nuclear fusion are especially emphasized when compared with nuclear fission shortcomings.

*«“(…) nuclear fusion facilities [when compared with existing fission facilities] are even more powerful (…) much safer and environmentally friendlier because the radioactive fuel is produced inside the reactor itself and there produces no waste in the long term”».*

In the Spanish article, supporters are aware that nuclear fusion may be a failure. Nevertheless, there is a considerable optimism about the role of fusion in future energy scenarios.

*« “It's a risky bet, but if we are able to do it we will solve humankind energy problems”, says Montserrat Torné, General Director for the International Cooperation of the Ministry of Science and Innovation».*

## **Costs**

According to the Portuguese article, there is no clear arguments stated towards the costs of nuclear fusion, but some doubts regarding its economic viability emerge when feasibility is again brought into discussion.

*«(…) Economic studies predict that a fusion reactor is only viable for gains exceeding 40 [MW] of energy».*

In the Spanish article, the costs of nuclear fusion research are mainly linked to the increase of ITER budget. This is an additional argument that helps to support criticism toward nuclear fusion and contributes to build an image of an “expensive and useless” endeavour.

*«Criticism of ITER has been reiterated after the budget increase. Initially, EU should contribute 5,900 million euros, but in June it gave the green light to a contribution of 6,600 million (of the total of 15,000 million budget for ten years)».*

## **v) Off-shore wind power**

Regarding off-shore wind power, we selected the Portuguese article with the title «*Blades, tower, action: the world's largest wind tower measures 175 meters of vertigo*», published in Jornal de Negócios, on 2012-07-10, and the Spanish article with the title «*Windmills at sea*», published in La Vanguardia, on 2007-09-30.

## **Context**

The Portuguese article describes how off-shore wind power is still taking the first steps towards what is intended to be a vigorous and fully developed industry. The article herein analysed focus on some successful projects that carry great expectations for this new technology, such as the 'Haliade 150' (the highest tower ever built for off-shore wind power), built by Alstom and submitted to several tests in Western French coast. The article also covers the stage of development and level of investments regarding off-shore wind power in other European countries including Portugal.

*«In Le Carnet, in western France, Alstom tests the new limits of offshore wind».*

*[some] countries are now taking the first steps in this market, especially Portugal and Norway(...)"*

The context of the Spanish article is the start-up of an off-shore wind farm (Q7) installed in the Netherlands. Spanish observers investigate the possibility of building a similar facility in the coast of Cadiz.

*«Spain is studying a dozen of 'hidden' offshore wind farms as in the Netherlands».*

*«One of the latest initiatives has being promoted by the company Acciona, which soon shall submit to the Government a project to build a park of 982.8 MW at the coast of Cadiz».*

## **Description**

Off-shore wind is described In the Portuguese article as a growing but very promising energy technology. One of the biggest challenges that lie ahead is the capability to build equipment large enough to capture the strongest winds and thus generate higher amounts of energy, something comparable to the relation between the sail size and the speed of a boat.

*«"In offshore size matters (...) the largest dimension of the blades of the new tower [Haliade 150] allows us to capture more wind and produce more energy than other towers already in operation. (...) the greater the sail the faster the boat. And this is like a sailing boat. Only instead of motion it generates electricity"».*

According to the Spanish article, one of the distinctive features of these off-shore wind farms is that they are located many miles away from the shore, turning them invisible to any observer.

*«Visiting this offshore wind farm construction is comparable to travel blindfolded, because it is invisible from the ground».*

## Evaluation

The Portuguese article argues that the most successful operations in off-shore wind are rooted in strong partnerships. In fact, the major players in this industry are not only engaged in market planning but also in the various stages of equipment building. This is also what pushes the Off-shore segment to a strong position in the renewable energy market

*«(...) the French company [Alstom] will not do everything by herself. The blades will be produced by LM Wind Power. Generators will be manufactured within the partnership between Alstom and American GE.»*

*«“At a global scale the wind power market is growing (...) and the fastest growing segment is the offshore”».*

Off-shore wind power in the Spanish article is mainly evaluated according to two distinct characteristics: the reliability of the power source and the concealment of wind mills, which in this case exempts this technology from any sort of criticisms regarding its visual impact.

*«On one hand, this means to take advantage of a renewable resource, the wind, which is very constant offshore. On the other hand, to ward off windmills from onshore landscapes (...) is to overcome the opposition of those who criticize the visual impacts and inconvenience of wind turbines».*

## Relation to mainstream renewable technologies

According to the Spanish article, the main advantage of off-shore in comparison with on-shore wind turbines is the level of energy that they provide, which has to do with the constancy of wind power at sea.

*«Marine wind farms allow capturing between 30% and 50% more wind than onshore wind farms (...). On the other hand, the gain for the electric system almost doubles that of conventional farms.»*

## Feasibility

According to the Portuguese article, one of the major obstacles facing off-shore wind power is the exposure of equipment to environmental condition which may lead to corrosion and other undesirable casualties. In line with the technological upgrading of wind turbines, there are fewer reasons to be concerned with these conditions.

*«(...) the new machine is prepared for the rigors of the offshore. "It's very important to protect all components from the environment that we find in the sea, in particular salinity and erosion"».*

According to the Spanish article, there are several difficulties to overcome in order to accomplish the best performance of off-shore wind farms, which does not mean that they are not feasible. Construction and settlement involve an ongoing process of investigation that can clash with the most intricate problem of all – the weather. The article also compares the different conditions required for off-shore wind farms installation, found in northern European countries with those of southern European countries such as Spain.

*«Building these modern energy parks involves a continuous learning process. It is needed to design special boats and cranes, the docks must be enabled to move the turbines, and it is required to organize the operations knowing that a four-day work may not be possible to accomplish because of bad weather».*

*«(...) countries such as Denmark, the Netherlands and Germany have taken the lead to Spain, favoured by shallower seas (...)».*

### **Current stage of development**

The Portuguese article mentions that the United Kingdom has been leading the off-shore segment of the wind energy market (in 2011 this country held a share of 55% of the total installed capacity in the northern European sea). Other countries such as Portugal, Denmark, Holland, Germany, Sweden, Belgium, Finland and Ireland are taking the opportunity to start-up with new projects at a commercial scale. At the time that this article was published, the scenario was rather promising for off-shore wind power in Europe.

*«“(...) along with the projects created in 2011 and those that are currently under preparation, European sea waters will receive more than 5.2 GW of wind power”».*

The technology behind off-shore wind power is not questioned nor examined in the Spanish article. In fact, the main issues concerning the stage of development of this particular project were the conclusion of the whole wind farm and the timetable for the connection to the grid.

*«With a budget of 380 million euros, the Q7 farm will generate electricity equivalent to the consumption of 125,000 households. Overall it has 60 wind turbines, 16 of which are already installed. The first will be fully operational this October.»*

## Benefits

According to the Portuguese article, partnerships between companies are one of the most appraised features of the off-shore industry. Besides increasing business gains it also contributes to job creation.

*«“Overall, the partnership linked to Alstom offshore project will create 800 jobs, to which 200 more will be added in a new engineering centre”».*

In the Spanish article, the installation of off-shore wind farms far away from urban populations is one of the most valued aspects of this technology. Other aspects such as the compatibility with navigation activities and the absence of environmental impacts to wild life are also highlighted. This is stressed by one of the directors of the project and responsible for its foundation.

*«“(…) We have done studies on birds, fish and marine navigation, and no inconvenience to anyone or anything occurred”».*

## Costs

According to the Portuguese article, although some partnerships are thriving in the manufacturing segment, there are few opportunities for newcomers to compete with the largest companies, especially with pioneering components suppliers.

*«At the European scale, offshore wind is almost a duopoly of suppliers, with 53% of the installed capacity branded by Siemens and 36% of wind turbines [branded by] Vestas».*

In the Spanish article, the investment costs of off-shore wind farms are analysed in comparison to those of on-shore installations.

*« “[in comparison to onshore wind farms] “...investment costs are twice as high (2.2 million euros per MW installed)”».*

## vi) Tidal Power

Regarding tidal power, we selected the Portuguese article with the title *«Soromenho-Marques: reducing emissions requires a “deep” but “possible” change»*, published in Público, on 2008-04-28, and the Spanish article with the title *«Mills at the bottom of the sea»*, published in El País, on 2012-05-17.

## Context

In the Portuguese article, tidal power is mentioned along with other energy technologies as a possible solution to increasing energy demand at a time where

fossil fuels stocks are almost depleted and environmental protection is indisputably one of the major quests of our societies. The main problem arising from fossil fuels is that they became embedded in our economic system making it very difficult to set an alternative pathway for our societies without a profound change in our consumption and production trends. This article is based on an evaluation of a study coordinated by the European Climate Foundation.

*«Decreasing GHG emissions between 80 and 95 per cent by 2050 in the 27 countries of the European Union is “an extremely profound reduction” and requires changes in our lifestyles, economic system and the way we produce, consume and transport [energy] ».*

The Spanish article focuses on how tidal power is taking its first steps in some countries such as Scotland. This article talks about an experimental project leaded by Spanish company Iberdrola in association with its affiliated Scottish Power. The article also provides some information about feasibility of tidal power in the Basque Country, Galicia, Cantabria and Canarias.

*«Iberdrola installs in Scotland a pioneer machine with underwater propellers.*

*«The project seeks to determine whether this energy is competitive».*

## **Description**

In the Portuguese article, tidal power is described as one among other energy technologies that can contribute to comply with CO<sub>2</sub> reduction targets set by the EU for 2050. But similarly to other energy technologies, Tidal power depends on large public support to be effective.

*« (...)”Investments on this new system of energy production and distribution will only take place if there is a guarantee of a serious commitment from the 27 Member States (...) within the next decades”».*

In the Spanish article, the technology employed is mainly described as a prototype which is expected to have a high performance due to the strength of Scottish undersea currents.

*«The prototype is a Hemmerfest HS1000 turbine manufactured in Norway by the company owned by Iberdrola. With a base of 20 meters, to which it must be added the 10 meter measures of the helix radius, the 45 m depth to which the turbine is installed are ideal to take advantage of the strong tides of this sea corridor of Fall of Warness».*



## Evaluation

Since Portugal is now undergoing deep political and economic changes due to the financial crises and the IMF-EU bailout, political endorsement of renewable energies are currently at risk. Tidal power and other clean or renewable energy technologies must be continuously supported otherwise it will be ruinous for the country.

*«"It would be absolutely tragic that a change of government entailed the end of investments that have been made in the renewable energy sector. It would be a historic mistake»".*

According to the Spanish article, tidal power is considered one among other emerging energy technologies that embody the growing human capability to tame sea power. The most appraised feature of tidal power is, however, the possibility that it offers to lower the costs of electricity.

*«The sea is an inexhaustible source of energy. Companies [are] studying how to harness the energy of tides, waves and currents. There are all sorts of devices (...) Similar to what happened with wind power until it reached the three-bladed model there is much research ahead to lower the costs of electricity».*

## Relation to other future energy technologies

The Spanish article mentions also other future sea energy related technologies and tidal power is portrayed as having the advantage of predictability and adaptability to environmental conditions, regardless of being in the early stages of development when compared to off-shore wind power.

*«"I think the wind is already commercial. This is experimental. The advantage over wind is predictability: you do not know when the wind is going to blow or how fast it will blow, but you know the tides and how they are, allowing you to optimize the design and adapt it to the area you are going to installing the propeller. This also does not occur with regard to wave energy"».*

## Relation to mainstream renewable technologies

Tidal power is not the only energy technology mentioned in the Portuguese article. In fact, it is hardly the main technology focus especially when the author addresses other renewables.

*«The study points out several scenarios to move from an "overwhelming dependency" on oil, coal and natural gas to a system energy aimed primarily renewable fuels such as hydro, wind, solar, or photovoltaic, biomass, tidal or geothermal"».*

### **Relation to conventional energy systems**

In the Portuguese article, renewable energy technologies such as tidal power are portrayed as part of a future energy system where fossil fuels will no longer be at the core of energy production.

*«"The aim to reduce greenhouse gases emission (...) involves a profound change in the economic and productive system. But with the focus on renewables and energy efficiency, this is a possible change"».*

On a similar vein, the Spanish article states that tidal power is still an experiment which may offer an alternative to fossil fuels, mainly with regard to energy prices and cost efficiency.

*«"What we want to know is if this energy is competitive and that depends on the performance it offers, the cost of power generation and what is the situation [in comparison to] its competitors, such as the price of oil"».*

### **Feasibility**

According to the Spanish article, ecologic and geographic conditions are the two prime aspects to cover in feasibility analyses of tidal power. In fact, the article states that location is a variable of great importance for tidal power technology by detailing the differences between the Scottish and Spanish backgrounds.

*«The prototype of Scottish Power Renewables is submerged southwest of the island of Eday, "a perfect area because the currents are very strong, there is little distance between the islands and the depth is very good: 45 meters"».*

*« [Location] does not help because the Peninsula only has a continental platform, which increases the depth of the sea near the coast. Furthermore, the Spanish tourism industry has many objections to these projects sited at the coastal front zone».*

### **Current stage of development**

The Spanish article claims that tidal power is at an early stage of development and the project described in the article is a major test to its efficiency and future

prospects. The success of the project itself is understood as a window of opportunity for commercialization.

*«This is the world's largest project and it will be a litmus test to tidal energy efficiency. If it works, Iberdrola and other companies could prompt a much more ambitious project to generate 1,600 megawatts (...)».*

## **Benefits**

According to the Portuguese article, political support of renewable energy systems in which tidal power can play an important role, will not only benefit the environment but it will also give each Member State a powerful means to tackle the problem of energy dependence from oil producing countries.

*«In addition to positive environmental effects (...) "we are increasing our autonomy, as a Union and as Member States by reducing our dependency on external markets"».*

In the Spanish article, the benefits of tidal power are assessed according to the particular characteristics of the Iberdrola project. Concealment and stability are considered its main benefits, especially when compared to the features of a French company' tidal power device.

*«"The structure that we see a little further belongs to a French company that uses a different system. Ours is a helix similar to that of wind mills, which remains fixed on the ocean floor. Theirs is more like the propeller of a boat and is supported between two pillars hovering 40 meters above the surface (...) Ours is invisible and does not obstruct navigation because is several feet below the surface of the sea "».*

## **Costs**

The Portuguese article claims that future energy supplying systems that incorporate tidal power among other energy technologies as alternative to fossil fuels are economic viable, although the real problem is a lack of public confidence in their efficiency.

*«"There is money (...) even with the current economic situation, but there is a big crisis of confidence"».*

The Spanish article affirms that on one hand the installation at the bottom of the sea offers many advantages to the Iberdrola tidal device, but on the other hand it demands greater efforts and higher costs of maintenance. The estimated amount of

these costs is not mentioned by the COO of Off-shore Renewable Energy of Iberdrola.

*«"Maintenance is one of the challenges because once submerged, access to the turbines is difficult. The plan is to make them work for five years and then carry them ashore to do a review and then re-install them (...) «Martinez avoids to talk about costs and replies: " It's hard"».*

## **vii) Wave power**

Regarding wave power, we selected the Portuguese article with the title *"Peniche has a project for wave energy"*, published in Público, on 2012-03-04, and the Spanish article with the title *«Waves of light»*, published in La Vanguardia, on 2011-11-16.

### **Context**

Wave power in Portugal is beginning to draw some attention to foreign companies. In Peniche, a district in the north coast, a joint venture of three Finnish companies found the perfect conditions to build a platform for wave power production. The equipment began to be constructed in Peniche Shipyard and is expected to generate around 300 Kw per hour. The project is supported by the European Commission and involves other foreign companies, Portuguese research institutes, private stakeholders and the city council.

*« Named 'Surge - Simple Underwater Renewable', the project's partners are AW Energy Oy, Multimart Oy and ABB Oy, all Finnish".*

*« (...) a project funded by the European Commission through the 7th Framework Programme».*

The Spanish article reports on three experimental devices installed in Portuguese and Spanish sea areas.

*«Marine energy is beginning to be implemented in Portugal and in the Cantabrian»*

### **Description**

Similar to other initiatives related to wave power technology in Portugal, this project is mainly described as an experiment with a considerable scope for future enhancement and energy production at a commercial scale.

*«The aim is therefore to experiment, improve and optimize, so that later we can produce more and better technology and expand this energy source».*

The Spanish article explains that each target area adopted different devices according to their own plans. It is interesting to notice that the Portuguese devices are compared to sea serpents, positioned in such a way as if they were defying the tranquillity of a tourist village.

*«Three metal red serpents of 150 meters in length and 3.5 in thick have been quivering in the past weeks, half submerged in the harsh Atlantic sea forward-facing Póvoa de Varzim, a tourist village in northern Portugal».*

*«[There are three mechanisms in use] Sea serpents (Portugal), turbines (Basque Country) and buoys (Cantabria)».*

## **Evaluation**

According to the Portuguese article, the evaluation about wave power is shaped according to the idea that it has no environmental or visual impacts.

*«(...) this source of energy which is clean and renewable has no negative environmental impacts, not even in the landscape because the equipment is [installed] at the bottom of the sea».*

The Spanish article states that Portugal has taken the lead on wave power exploitation in the Iberian context by benefiting from strong government support, while Spain stands behind due to a less political oriented planning. Notwithstanding, the prognosis is not favourable to Portuguese operations in the years ahead. It is quite notable how the article pictures this state of affairs as a replication of what happened in the age of Overseas Discoveries when the two countries competed for the supremacy over international trade.

*«It is an Atlantic race in which, as it happened in the era of Overseas Discoveries of the fifteenth century, Portugal has taken advantage (...) But Lusitanian experts say that with the current administrative situation they will lose their advantage and be overtaken by Spain, as it happened in the era of the caravels».*

## **Relation to other future energy technologies**

In the Spanish article, wave power is seen as part of a cluster of sea energy related technologies that are also beginning to be exploited.

*«In addition to waves, there are two other marine energies such as tides and thermal»*

### **Relation to mainstream renewable technologies**

Despite the optimism conveyed with regard to this project in the Portuguese article, there is a clear understanding that for now Wave power is not yet a major player in the field of renewable energies, such as mainstream wind power.

*«The revenue thus obtained will be residual, as it is also the amount of energy produced. Three hundred kilowatts per hour is less than 1% of the capacity of a wind mill».*

According to the Spanish article, in the case of Portugal, wave power along with other sea energy related technologies is seen as a possible competitor to onshore wind power, one of the most developed renewable energies in the country.

*«In Portugal it is expected that marine energy will compete with wind energy in the medium and long term (...)».*

### **Relation to conventional energy systems**

In the Spanish article, expectations about wave power are very optimistic, mainly with regard to a future scenario in which traditional energy sources will be drained. Nevertheless, the article does not present any argument to support this view rather than a vague assumption.

*« (...) this sector (...) promises an ocean of possibilities facing the depletion of traditional [energy] sources».*

### **Feasibility**

The Portuguese article affirms that sea energy related technologies are much dependent on environmental conditions, such as waves, tides or wind strength, salinity, depth of sea zones, stability of undersea currents, among other elements that vary according to location. In Peniche, the conditions seem to satisfy the criteria to install wave power machinery.

*«" (...) this area has interesting conditions for hosting this type of project and (...) it would make sense to use our local expertise in shipyard building and [professional] diving"».*

According to the Spanish article, the feasibility of wave power development in both Portugal and Spain is highly dependent on environmental and logistic aspects that ultimately increase investment costs.

*«The high level of investment stems from the harsh conditions of the sea, wave currents and marine corrosion as well as the need for mechanisms to transfer the energy to the shore».*

### **Current stage of development**

The aim of the project mentioned in the Portuguese article is to test and improve wave power machinery. A successful outcome will be a first step towards commercialization.

*«For 2013 the Finnish plan to install a pre-commercial version with a capacity of 5 Mw/ hour, accounting for 17 times more than the platform now under construction».*

The difference between the two countries by the time that the Spanish article was written is that in Portugal the wave power devices are already connected to the grid, while in Spain they were still submitted to tests. Overall, in both countries wave power is portrayed as an embryonic technology rather than a full developed one.

*«Since late September the Portuguese first marine energy plant is already connected to the grid. Along with the buoys being installed in Santoña (Cantabria) and turbines under construction in Mutriku (Basque Country), these are the first steps of marine energy in the Iberian Peninsula».*

### **Benefits**

According to the Portuguese article, besides the possibility to develop and expand wave power without any environmental impact, foreign investment and stakeholders may also help to maintain the workforce in a company that has been undergoing some economic difficulties. Furthermore, this kind of projects may also be the starting point for a promising industry in Portugal.

*«(...) this project represents 25,000 hours of work (...) if it succeeds the company [Peniche Shipyard] might be the embryo for a "cluster" comparable to what is now known as the wind energy "cluster"».*

In the Spanish article the benefits of wave power are not assessed on a single basis. In fact, wave power is part of a complex set of sea energy related technologies that might be able to replace traditional energy sources in the future. As a Spanish engineer puts it, there will be an interdependent relationship between the exhaustion of terrestrial energy sources and the increase of sea energy. In addition, the ecologic perspective conveyed by Greenpeace is also very optimistic about the future impact of sea energies like wave power in the long term.

*«"The use will be intensified when the exploitation of terrestrial energy is depleted," says Eguíluz. Greenpeace estimates that in 2050 the whole of the Spanish energy demand could be covered from the sea».*

## **Costs**

In the Spanish article, the high costs of wave power and other sea energies are highlighted by comparing them to wind energy. However, it is not clear if the article is referring to costs of on-shore wind or off-shore wind power, or even to the combined costs of both technologies.

*«Marine energy is expensive. In the first phase of Santoña, with buoy and electrical infrastructures, the costs were up to three million euros. In Mutriku they accounted for 6.1 million and in Póvoa de Varzim, 9 million. "The costs are four times higher than wind energy," said the engineer Rui Barros».*

## **viii) IV Nuclear Gen**

Regarding IV Generation Nuclear energy, we selected the Spanish article with the title *«Spain investigates new nuclear reactors»*, published in Público.es, on 2008-06-17.

## **Context**

The IV Generation nuclear reactors are emerging as a new solution for nuclear energy in a time when some governments, including the Spanish plan the phase out of traditional nuclear power plants.



*«Public institutions are involved in the development of the fourth generation plants, despite the progressive closure of nuclear power stations announced by the Socialist government».*

## **Description**

The IV generation technology is described as an advancement in comparison to traditional reactors mainly because it reuses nuclear fuel producing a considerable less amount of waste.

*«(...) a new batch of nuclear reactors able to reuse the fuel and ensure the availability of uranium for thousands of years. And of course, generate less waste. Looks like a utopia, and it could be, but it has a name: Generation IV».*

## **Evaluation**

The development of IV Generation nuclear engines captures the attention of major companies and is portrayed as a key factor for the continuation of nuclear energy.

*«Some companies, such as Endesa, have also shown interest in the so-called nuclear energy of the future. According to the physic scientist Maria Teresa Dominguez, "the Spanish industry is leading the way and we are ready for the relaunch of nuclear energy in Spain."»*

## **Relation to other future energy technologies**

The comparison between IV Generation and other future technologies is only made in terms of ecologic impacts. While other emergent technologies such as renewables and nuclear fusion are appraised, IV Generation is inherently linked to the perils of traditional nuclear energy.

*«For the activist of nuclear Ecologists in Action, Castejón Francisco, the fourth generation reactors can promise the reduction of waste, but it will not supress it. "It would be better to spend money researching clean technologies, which do not have that original sin, such as renewable or nuclear fusion"»*

## **Current stage of development**

Apart from all these assumptions and evaluations, the truth is that IV Generation remains on the drawing board of nuclear scientist and engineers.

*(...) experimental prototypes have not yet been built. The Generation IV will not be commercially available until 2030, in the most optimistic scenario».*

## **Benefits**

Reuse, safety, less amounts of nuclear waste and shorter timetables for construction are the main benefits ascribed to this technology.

*«The Generation IV consists of six types of nuclear reactors with common goals: fuel reuse, less generation of high-level nuclear waste, more passive safety measures and reduced construction time.*

## **Costs**

The costs of IV Generation technology are part of a confrontation between the work of Spanish nuclear scientists, which is integrally sponsored by the EC and the lack of government support to the full development of this technology.

*«The director of the program in CIEMAT, Enrique González explains the apparent contradictions in the government's position: "The Ministry cannot close our eyes to the R & D that is being done in Spain (...)" The researchers will be paid by the state budget, but the projects related to Generation IV are fully funded by Brussels».*

## Conclusions and summary of results

The quantitative analysis of the articles regarding emerging energy technologies shows some common trends and differences between Portugal and Spain that are worth mentioning. First, it is possible to conclude that nuclear fusion is less covered than offshore wind power and hydrogen in both countries and, additionally, wave power in Portugal. The differences in the proportion of articles written about nuclear fusion are minor when comparing the two countries, whereas the approaches clearly diverge: news coverage in Portugal is more enthusiastic and in Spain more critical. Second, the larger proportion of news was written by journalists and news agencies, in contrast to the very low number of texts written by scientists and other experts. Third, the majority of articles are brief news, thus containing only superficial information about energy technologies. In this case, the most interesting difference between the two countries is the considerable proportion of Spanish articles that present extensive information about wave power.

Notwithstanding, the lack of news with in-depth and detailed content about the emergent energy technologies is cause for concern, since these issues are crucial in the near future for both countries. Another notable difference emerges when comparing the two countries with regard to the technology mainly focused in the articles. In the Portuguese case, it is possible to identify a strong concentration on sea energy related technologies such as offshore wind and wave power (with the exception of tidal energy). This trend reflects the greater political and economic support that was given to these technologies at a time when renewable energies were a political priority. The centrality of the global financial crises, mainly from 2009 onwards, led to a steep decrease in the rate of articles published about these and other future energy technologies, combined with a change in policy of the government elected in 2011, which withdrew the support for the renewable energy programme - until then a landmark of the former government. In the Spanish case, there was a constant growth in the number of articles published, without any specific technology in focus during the whole period of analysis (the majority of Spanish news focus on multiple technologies).

In both countries the proportion of articles about nuclear fusion reached its peak in 2010 (the year of an important meeting of the board of directors of ITER), declining sharply afterwards. This also indicates that media interest on nuclear fusion is primarily linked to the decision processes, research activities and budgetary issues that arise from the ITER cooperation framework.

Content related to the various emerging energy technologies is primarily and most frequently shaped around scientific developments and political or economic issues. Energy policy is the leading primary theme covered by Portuguese newspapers and it is more closely associated with wave power and offshore wind power than

any other technology. This also has to do with the importance that the sea has now acquired as the key national project on multiple areas, including energy. Investment costs on energy is also a relevant theme, frequently associated with a broader range of technologies, but mainly with biofuels from microalgae, offshore wind power, hydrogen and wave power. In the Spanish case, most articles report on research project and results and are mainly associated with biofuels from microalgae, nuclear fusion, wave power, nanotechnology and hydrogen. In both countries there are few articles that cover other thematic areas such as climate protection, safety, environment and culture.

At a secondary level it is possible to find a wider range of themes covered in each country, but here again we find a strong concentration in one or two thematic categories: hydrogen vehicles in Spain (exclusively associated with hydrogen) and investment costs on energy in Portugal (mostly associated with wave power and offshore wind power). There are few articles written about feasibility in both countries, which is quite unexpected since all energy technologies covered in the study are still at the experimental stage. Contrastingly, there are much more articles written about the stage of development of these technologies, mainly in Spain. Finally, in both countries the news articles about nuclear fusion tend to focus primarily on scientific research and secondarily on ITER, which means that, as we saw in the previous report (WP12-SER-ACIF-1), fusion remains a very exclusive affair of the complex field of science and, for this reason, disconnected from the public and published opinion.

Portugal and Spain differ significantly with regard to the overall evaluation of the emergent energy technologies. In Portugal there is a clear orientation towards a positive evaluation of all the technologies surveyed, especially in the cases of nanotechnology, biofuels from microalgae and offshore wind power and less in the cases of nuclear fusion and wave power. In Spain there is a more neutral orientation in the coverage of all technologies, with the exceptions of nanotechnology and wave power, which are more frequently evaluated in a positive way. Finally, it is in Portugal that we find a more diverging trend in the evaluation of nuclear fusion: more articles with positive assessments, mainly linked to its low environmental impact and unlimited energy, but also more articles with negative assessments, mainly linked to the fact that the technology is still not ready.

Nuclear fusion is primarily appreciated in both countries for its low environmental impact, unlimited production of energy and the possibility to replace nuclear fission and fossil fuels. Other technologies such as wave power, biofuels from microalgae and nanotechnology in Portugal, or wave power and IV nuclear generation in Spain, are also valued for its low environmental impacts; we have also found that a considerable number of news articles from Portugal and Spain present hydrogen and biofuels from microalgae as credible alternatives to fossil

fuels. Additionally, wave power is also frequently considered as an unlimited source of energy in Spain. According to these data, we might say that in Portugal nuclear fusion is distinctively valued in comparison to other emergent energy technologies both as an alternative to nuclear fission and for the unlimited amount of energy that it is expected to provide in the future, whereas in Spain fusion is more appreciated than other technologies only when alternatives to nuclear fission are discussed.

Nuclear fusion is negatively evaluated in Portugal, especially with regard to its stage of development (incipient) and costs of investments. It is also considered the only technology that consumes more energy than it produces. In Spain, fusion is considered the most costly technology of all, but still shows less negative evaluations when compared to hydrogen with regard to the stage of development and to IV nuclear generation with regard to public acceptance and future prospect.

In a nutshell, this analysis has shown that public information regarding fusion could benefit from addressing some of the criticisms that are usually conveyed in the media, emphasizing the aspects there are more highly valued and learn some lessons from what is valued in the portrayal of other emerging energy technologies.

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## **Annex 1 – Codebook**

### **Codebook for Fusion and other emerging energy technologies**

*V1. Code*

*V2. Country*

Spain

Portugal

*V3. Keyword*

Nuclear fusion

Off-shore wind power

Hydrogen

Wave power

Tidal power

Nanotechnology

Biofuels from microalgae

*V4. Which is the energy technology mainly focused in the article?*

Nuclear fusion

Off-shore wind power

Hydrogen

Wave power

Tidal power

Nanotechnology

Biofuels from microalgae

Multiple/none in particular

*V4.1. How would you characterize the information about this technology provided in the article?*

Extensive (explains the basics of the technology, discusses potential risks and benefits)

Superficial (provides a simple definition)

Not relevant (it just mention the technology)

*V5. Does the article also mention the following energy technologies?*

*Yes/No/Does not apply*

5.1 Nuclear fusion

5.1 Off-shore wind power

5.2 Hydrogen

5.3 Wave power

5.4 Tidal power

5.5 Nanotechnology

5.6 Biofuels from microalgae

*V6. Newspaper*

Name of newspaper

*V.7 Type of newspaper*

National mainstream

Business newspaper

*V8. Publication date*

yyyy-mm-dd

*V9. Caption*

*V10. Category of author*

Journalist

Agency

Scientific expert

Risk management expert

Other expert

Representative of NGO

Representative of an interest group

Politician

Other

*V11. Background of author*

Public science institution

Private science institution

Insurance company

Electric utility



Other industry  
Civil service  
Alternative science institution  
NGO  
Background not named

*V12. Accentuation*

Lead story of a section  
Single page only article  
At least two page article  
One of many  
No accentuation

*V13. Form of presentation*

News in brief  
Report / reportage / feature  
Commentary/opinion column  
Interview  
Portrait  
Other

*V14. Theme*

*V14a. Primary theme*

**Science and technology**

Research projects and results  
Scientific events (conference, debates, controversy)  
Cooperation activities and know-how transfer (scientific cooperation, training)  
Progress and stage of development  
Feasibility  
Personnel matters (biographies, obituary)

**Policy**

Science policy (includes public funding of research projects, facilities, prototypes, etc.)  
Energy policy  
International relations  
Regional and/or nationwide development

Public opinion

**Economy and energy economy**

Investment costs on energy (private funding)

Shared investments and business cooperation

Energy scenarios/foresight (emerging energy technologies are linked to the debate on more sustainable and cost-effective energy systems, growing energy demand, scarcity, etc)

Energy issues (energy justice, legislation, social equity)

**Safety and Environment**

General impact on biodiversity and habitat

Land use/location

Pollution/contamination

Accidents/emergency

Health effects

**Climate protection**

**Culture** (lifestyles, practices of individual and community living, consumption patterns)

*V14b Other primary theme (freehand)*

*V14.1a. Secondary theme*

The same set of categories as in *V14a*

*V14.1b Other secondary theme (freehand)*

*V14.2a. Tertiary theme*

The same set of categories as in *V14a*

*V14.2b. Other tertiary theme (freehand)*

*V15. General valuation of the technologies mentioned in the article*

Positive

Negative

Neutral

- |      |                          |
|------|--------------------------|
| 15.1 | Nuclear fusion           |
| 15.1 | Off-shore wind power     |
| 15.1 | Hydrogen                 |
| 15.1 | Wave power               |
| 15.1 | Tidal power              |
| 15.1 | Nanotechnology           |
| 15.1 | Biofuels from microalgae |

*V16 Statements about the technologies mentioned in the article*

Yes

No

No statements (technology not mentioned in the article)

Positive statements

No/low environmental impact (clean, general)  
Climate neutrality (no CO2 emissions)  
Unlimited production of energy  
It will be ready/it will produce energy in the near future  
Abundant or unlimited resources  
Good for energy security (no dependency on foreign energy)  
Cost-effectiveness of energy production  
There are successful projects  
Alternative for nuclear fission  
Benefits for the economy (investments, jobs)  
Answer to growing energy demand  
Alternative to energy technologies based on fossil fuels  
Part of mixed energy supply portfolio (with renewable and/or fission)  
Promotes international collaboration

Negative statements

Not clean (dangerous by-products)  
Human health risks (cancer, etc.)  
Risks to the environment  
High costs of investment  
Based on non-renewable resources  
Conflicts with other activities/land use  
Consumes more energy than it produces (energy penalty)

Too far in the future  
Technology not ready (not proven)  
There are better options to tackle energy problems  
Not a real solution to climate change  
Form of nuclear energy  
Threat for investments in mainstream renewable  
Government support needed (dependent on subsidies)  
Uncertain public acceptance  
Centralized form of energy production

*V17. Does the article compares fusion with other emerging energy technologies?*  
(Yes/no)

*V17.1. In what terms are they compared?*

Fusion is the best option for the future  
Other technologies are better than fusion  
Fusion and other technologies are equally good options for the future  
Not Mentioned

*V18. Valuation grade of arguments stated towards fusion in comparison with other emerging energy technologies*

Positive  
Negative  
Neutral (balanced)  
Not mentioned

V18.1. Cleanliness  
V18.2. Climate protection  
V18.3. Energy limits  
V18.4. Availability of resources  
V18.5. Cost Competitive  
V18.6. Expensiveness (research, infrastructures)  
V18.7. Benefits for the economy  
V18.8. Alternative to energy technologies based on fossil fuels  
V18.9. Feasibility  
V18.10. Stage of development  
V18.11. Expectation about future commercialization

*V19. Does the article compares the energy technology mainly focused with mainstream renewables?*  
(Yes/no)

*V20. Does the article states or argues that the energy technology mainly focused will provide more energy in the future than mainstream renewables?*

It will provide more energy

It will not provide more energy

It will provide less energy

It will provide the same amount of energy

Not mentioned

*V20.1. Does the article states or argues that the energy technology mainly focused will provide energy at lower prices than mainstream renewables?*

It will provide energy at lower prices

It will not provide energy at lower prices

It will provide energy at higher prices

It will provide energy at similar prices

Not mentioned

*V20.2. Does the article states or argues that the energy technology mainly focused will be more cost-effective than mainstream renewables?*

It will be more cost-effective

It will not be more cost-effective

It will be less cost-effective

It will be equally cost-effective

*Not mentioned*

*V20.3. Does the article states or argues that the energy technology mainly focused attracts more investments than mainstream renewables?*

It attracts more investments

It does not attract more investments

It attracts fewer investments

It attracts a similar level of investments

Not mentioned

*V20.4 Does the article states or argues that the development of the energy technology mainly focused is more expensive than the fostering of mainstream renewables?*

It is more expensive

It is not more expensive

It is less expensive

It is equally expensive

Not mentioned

*V20.5. Does the article states or argues that the energy technology mainly focused is more sustainable than mainstream renewables?*

It is more sustainable

It is less sustainable  
Both are equally sustainable  
Not mentioned

*V20.6 Does the article states or argues that the energy technology mainly focused is more efficient for climate protection than mainstream renewables?*

It is more efficient  
It is not more efficient  
It is less efficient  
It is equally efficient  
Not mentioned

*V21. Does the article compares the technology mainly focused with conventional energy technologies based on fossil fuels or nuclear energy?*

Yes/no

*V22. Does the article states or argues that the energy technology mainly focused will provide more energy in the future than conventional energy technologies?*

It will provide more energy  
It will not provide more energy  
It will provide less energy  
It will provide the same amount of energy  
Not mentioned

*V22.1. Does the article states or argues that the energy technology mainly focused will provide energy at lower prices than conventional energy technologies?*

It will provide energy at lower prices  
It will not provide energy at lower prices  
It will provide energy at higher prices  
It will provide energy at similar prices  
Not mentioned

*V22.2. Does the article states or argues that the energy technology mainly focused will be more cost-effective than conventional energy technologies?*

It will not be more cost-effective  
It will be less cost-effective  
It will be equally cost-effective  
Not mentioned

*V22.3. Does the article states or argues that the energy technology mainly focused is more efficient for climate protection than conventional nuclear energy?*

It is more efficient  
It is not more efficient

It is less efficient  
It is equally efficient  
Not mentioned

*V23. Does the articles states or suggests the idea that the technology mainly focused is prime among other emerging energy technologies?*  
Yes/no

## Annex 2 – Sample of qualitative analysis

	Portugal	Spain
<b>Biofuels from microalgae</b>	<i>Automobiles powered by algae</i> , in Público, 2008-02-14	<i>A company from Alicante generates the world's first bio-oil from algae</i> , in ABC, 2007-11-23
<b>Hydrogen</b>	<i>GM invests in hydrogen and looks beyond the crisis</i> , in Público, 2008-12-06	<i>Ciemat opens a pilot facility to produce hydrogen from solar energy</i> , in El Mundo, 2008-04-08
<b>Nanotechnology</b>	<i>FotOrg - The "low-cost" reached the photovoltaic</i> , in Jornal de Negócios, 2011-01-27	<i>Nanoscience and nanotechnology to achieve alternative energy</i> , in El Mundo, 2011-11-28
<b>Nuclear fusion</b>	<i>Nuclear Pros and Cons</i> , in Diário de Notícias, 2013-12-09	<i>Leading scientists are appealing for the relinquishment of the nuclear fusion reactor</i> , in La Vanguardia, 2010-08-26
<b>Off-shore wind power</b>	<i>Blades, tower, action: the world's largest wind tower measures 175 meters of vertigo</i> , in Jornal de Negócios, 2012-07-10	<i>Mills at the bottom of the sea</i> , in El País, 2012-05-17
<b>Tidal power</b>	<i>Soromenho-Marques: reducing emissions requires a "deep" but "possible" change</i> , in Público, 2008-04-28	<i>Windmills at sea</i> , in La Vanguardia, 2007-09-30
<b>Wave power</b>	<i>Peniche has a project for wave energy</i> , in Público 2012-03-04	<i>Waves of light</i> , in La Vanguardia, 2011-11-16
<b>IV Nuclear Gen</b>		<i>Spain investigates new nuclear reactors</i> , in Público.es, 2008-06-17



## **Annex 3 – Analytic codes**

**Context** - How is the technology presented in the article? What is the context of the discussion?

**Description** - How is the technology described? What is aimed at? What metaphors are used?

**Evaluation** - How is the technology evaluated in the article? What kind of arguments are presented towards it?

**Relation to other future energy technologies** – Does the article relates this to other future energy technologies? In what sense?

**Relation to mainstream renewable technologies** – Does the article relates this technology to mainstream renewables? (such as Wind power, Hydropower, Solar energy, Biomass, etc). In what sense?

**Relation to conventional energy systems** - Does the article relates this technology to conventional energy systems? In what sense?

**Feasibility** - What is said about the feasibility of the technology?

**Current stage of development** – Does the article provides any information about the current stage of development of the technology?

**Benefits** - What are the benefits of this technology? How are they characterized?

**Costs** - What are the main costs/disadvantages of this technology according to the article? How are they discussed?