DG Research

Monitoring Policy and Research Activities on Science in Society in Europe (MASIS)

National Report, Portugal

October 2011

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Written by

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0 Introduction

The EU recognises the importance of ensuring that European research and research in Member States is firmly rooted in the needs of society, particularly in light of the constantly changing Europe. Efforts to reinforce the societal dimension of research are channelled through the 'Science in society' (SIS) programme. The SIS programme supports activities focusing on the governance of the research system, research ethics, public engagement in science, women in science and the promotion of scientific education and science communication.

The Monitoring Policy and Research Activities on Science in Society in Europe (MASIS) initiative is a major undertaking under the SIS programme. Its aim is to map, steer and monitor the SIS landscape in the European Research Area (ERA) (http://ec.europa.eu/research/era/index_en.htm), in order for EU citizens and society to benefit the most from SIS efforts. MASIS also covers the eleven Associated Countries.

The national MASIS reports are cornerstones in this endeavour, as they contain the knowledge gathered by a network of national correspondents on SIS. The reports will be updated every six months. The reporting format was developed on the basis of advice from the network of national correspondents, as well as discussions with authors of the initial MASIS report (see this LINK, ftp://ftp.cordis.europa.eu/pub/fp7/sis/docs/sis_masis_report_en.pdf). In addition, the Commission and a network of national validators offered comments and advice.

In total, 38 national reports covering 38 (EU and associated) countries have been produced. This is the report on Portugal. It consists of four main sections:

1. National context
2. Priority setting, governance and use of science in policy-making
3. Research related to SIS
4. Activities related to SIS
5. The Fukushima accident.

The intention of this report is to provide a good general overview of the SIS situation in Portugal, including public engagement in science, different models and use of scientific advice and expertise for policy-making, activities related to assessment and ethical issues of science and technology, SIS research activities and scientific culture as well as trends, policies, actors and activities. The last chapter on the Fukushima accident was added later to the original report and contains information on the national coverage and the role of scientific advice in connection with the accident.

Please note, in accordance with the terms of reference for the MASIS project, that the issue of ‘women in science’ is **not included** in the mapping as this has been extensively mapped and reported in other European projects. Please note also that the present report follows the initial MASIS report in using the term ‘science’ in its broadest sense, as in the German ‘Wissenschaft’, covering also the social, economic and human sciences. A few subsections are concerned only with the natural sciences, and in these cases it is explicitly indicated.

Statistical data sheet, Portugal

	2000	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*EU27 average/total, 2008*
Research and development								
Gross domestic expenditure on R&D (GERD), in % of GDP[1]	0,76	0,81	1,02	1,21	1,51	-	-	1,89
GERD by source of funds, % of total GERD[1]:								
- Business enterprise sector	27,0	36,3	43,0	47,0	-	-	-	55,0
- Government sector	64,8	55,2	48,6	44,6	-	-	-	33,5
- Higher education sector	1,1	1,0	0,8	0,7	-	-	-	0,9
- Private non-profit sector	1,9	2,8	2,5	2,3	-	-	-	1,6
- Abroad	5,2	4,7	5,2	5,4	-	-	-	8,9
GPD (million current PPP $)	174746	217911	229279	240156	247323	244764	249421	15285005
Total researchers (FTE) per thousand labour force	3,2	3,8	4,4	5,0	7,2	-	-	6,3
Total researchers (FTE) per thousand total employment	3,3	4,1	4,8	5,5	7,9	-	-	6,6
Gross Domestic Expenditure on R&D -- GERD (million current PPP $)	1324,3	1755,2	2340,7	2905,6	3734,9	-	-	276734,4
Public R&D expenditures (% of GDP)	0,46	0,41	0,43	0,46	0,49*	0,53*	-	0,66*
Business R&D expenditures (% of GDP)	0,21	0,31	0,47	0,61	0,79*	1,03*	-	1,16*
Number of R&D personnel[1], % 1000	4,4	5,0	6,0	6,9	9,5	-	-	
Number of R&D personnel by sector of performance[1], % of total R&D personnel:	21.888	25.728	30.531	35.334	49.114	-	-	2.455.192
- Business enterprise sector	16%	24%	31%	36%	31%	-	-	52%

	2000	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*EU27 average/total, 2008*
- Government sector	27%	18%	15%	13%	10%	-	-	14%
- Higher education sector	44%	45%	42%	40%	49%	-	-	33%
- Private non-profit sector	12%	13%	12%	11%	10%	-	-	1%
Innovation indicators								
- S&E and SSH graduates per 1000 population aged 20-29	-	28,7	30,6	32,6*	34,8*	-	-	41,5*
- S&E and SSH doctorate graduates per 1000 population aged 25-34	1,20	2,17	2,75	3,47*	4,39*	-	-	1,26*
- Public-private co-publications per million population	-	3,0	5,0	-	-	-	-	-
- SMEs introducing product or process innovations (% of SMEs)	-	38,7**	38,7	38,7*	38,8*	-	-	32,0*
- Employment in medium-high & high-tech manufacturing (% of workforce)	3,67	3,30	3,33	3,45	3,57*	3,70*	-	6,78*
- Employment in knowledge-intensive services (% of workforce)	7,28	9,00	9,17	9,65	10,16*	10,69*	-	14,80*
Patents								
Patent applications to the EPO, total[2]	42	114	117	122	-	-	-	
Patent grants at the USPTO, total[2]	17	33	42	57	-	-	-	
Triadic patent families, total[2]	4	12	11	11	-	-	-	
Patent applications filed under the PCT, total[2]								
Human resources in science and technology								

	2000	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*EU27 average/total, 2008*
Total, % of labour force[1]	8	10	10	10	11	-	-	16
- Scientists and engineers, % of labour force[1]	-	2,8	2,9	-	-	-	-	-
Networks and projects								
National share of FP6 SiS budget	-	1%	2%	2%	-	-	-	-
No. of FP6 SiS projects managed in Portugal	-	4	6	2	-	-	-	-
National share of FP7 SiS budget	-	-	-	0%	1%	12%	-	-
No. of FP7 SiS projects managed in Portugal	-	-	-	0	6	5	-	-
Tertiary/higher education								
Students at ISCED levels 5-6 enrolled in the following fields: science, mathematics, computing, engineering, manufacturing, construction - as % of all students[1]	27,3	29,4	29,2	29,6	-	-		24,9[4]
Academic staff (ISCED 5-6), total in full time unit[1]								
Public Understanding of Science (only 2005 og 2010 data) se pdf dokumenterne								
% of population very interested in new scientific discoveries and technological developments	-	15	-	-	-	-	14	
% of population very well informed about new scientific discoveries and technological developments	-	3	-	-	-	-	3	

	2000	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*EU27 average/total, 2008*
% op population regularly or occasionally attend public meetings or debates about science and technology	-	5	-	-	-	-	10	
% op population regularly or occasionally sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment	-	4	-	-	-	-	11	
% of population 'agree' and % of population 'disagree' that thanks to science and technology, there will be more opportunities for future generations	-	68/5	-	-	-	-	65/7	
% of population 'agree' and % of population 'disagree' that science makes our ways of life change too fast	-	69/10	-	-	-	-	62/9	
% of population 'agree' and % of population 'disagree' that we depend too much on science and not enough on faith	-	46/18	-	-	-	-	50/19	
% of population 'agree' and % of population 'disagree' that because of their knowledge, scientists have a power that makes them dangerous	-	61/16	-	-	-	-	65/10	
% of population 'agree' and % of population 'disagree' that in my daily life, it is not important to know about science	-	52/29	-	-	-	-	45/28	

Notes: 1) Data from EUROSTAT, 2) Data from the OECD, 3) Data from EuroBarometer 73.1 (2010) and EB 63.1 (2005) 4) Data from 2007

*: extrapolation of data

**: imputed data

1 National context

This section sets the scene and describes political developments, public debates and policy initiatives of major relevance to the place of science in society in Portugal.

1.1 The place of science in society - current debates

Over the last five years, science and technology has been the subject of unprecedented political focus and societal demand. The programme of the Portuguese government (2005-2009) defined scientific and technological (S&T) development as a major national priority. Even though, from 2005 to 2008, Portugal was under European pressure to reduce its government budget deficit down to 3% of GDP and the government implemented a major programme of austerity, public expenditure on S&T was unaffected; on the contrary, the budget was protected and even increased. A growing consensus emerged which asserts that S&T will offer not only the way out of the present financial crisis through supporting increased competitiveness in the Portuguese economy – but will also provide the foundations for the development of Portugal as a modern advanced society. The stance of the Portuguese public towards science is one of optimistic expectation and it is likely to remain so for as long as scientific development and economic prosperity are equated. There is, of course, public unease when people are faced with uncertainty and scientific controversy in areas that directly and visibly affect their quality of life, such as environment and health, but this unease does not go as far as to question the importance of science in the construction of a knowledge-based economy. This is the context which drives the most important current debates on the place of science in society in Portugal, which are:

- <u>The development of strategies to build national research capacity</u>. The debate about the place of science in society has focused on defining best strategies for sustainable S&T development and on identifying how these strategies will meet societal, economic and industrial objectives. There is a national consensus about the high priority of policies designed to stimulate and support the private sector R&D. However, the political discussion – particularly in Parliament – has focused on the reform of Higher Education Institutions; this is the case because, historically, scientific research has hardly moved outside the university campus (it was only in 2008 that private investment on R&D reached half the value of national expenditure on scientific research). A key element in this debate was the conversion of

Public Higher Education Institutions into Foundations, a shift designed to increase their sustainability and their openness to the business world, but one that attracted criticism, particularly in terms of the need to safeguard the independence of R&D in university-based research centres and the solidity of academic careers. *Key-word: R&D national capacity; Political arena; endemic debate.*

- Public participation in science governance is another emerging theme in the academic arena, encouraged mainly by scientific societies, university departments and research institutions. This debate is still in its early stages, and has taken place mainly through science communication events predominantly led by learned societies and other academic institutions. The basic themes are (i) bio-ethics concerns, (ii) social and political dimensions of scientific research, and (iii) strategies for democratic involvement of the public with science. *Key-word: Science governance; Academic arena; endemic debate.*

- <u>Risk, health and environment.</u> This emerging theme, both echoed and driven by the media, reflects social concerns about decision making on matters of urban and rural land development, public health safeguards and environmental protection. Visible differences between different scientists create a public perception of uncertainty and controversy, although these are intrinsic to science and scientific advice. This has particularly happened in the case of health issues (the recent H1N1 pandemic threat), environmental risks (the co-incineration government policy) and the management of land development (the implication of government decision on where to build the Lisbon airport or the third bridge over the Tagus). *Key-word: Risk; Public Arena;*

To conclude, any effort to describe an hierarchy of the relative importance of dominant issues relating to the place of science in society necessarily results in an oversimplification of the way in which the Science-Society debate is unfolding in Portugal. Its relative importance varies in the diversity of the social representations of science in Portuguese society, in the types of actors involved and the multiplicity of situations where science has an impact on society.

1.2 Policy goals and priorities

In September 2009, Eurostat identified Portugal as one of the three countries of Europe with the highest growth rate in science activity. The list below shows some of the most important reforms responsible for this growth.

- *The Reform of Higher Education Institutions.* In 2006, in response to a request from the Ministry of Science, Technology and Higher Education, the Education Committee of the OCDE undertook a review of tertiary education to evaluate the performance of the sector and produced a number of recommendations on how Portugal could meet its strategic goals for higher education. In March 2006 a law was passed establishing the legal framework for the implementation of the Bologna process. The Bologna Follow-up Group scored Portugal as ‘very good’, in line with an encouraging picture of the implementation of the Bologna Process in the country. Portugal quickly adopted the Bologna process as a mechanism for restructuring all its policies for the reform of Higher Education Institutions. The traditional autonomy of these institutions (over the past 20 years) had left the country with an unbalanced range of learning and training programmes with notable over-concentration in some areas and a complete absence in others. In 2007, a full reform of the governance of universities and polytechnics institutions was undertaken, which resulted in the consolidation of a binary system, a strengthening of the vocational identify of polytechnics and in an overall strengthening of all institutions particularly affecting the diversity of programmes and, critically, the enlargement of its social base for recruitment. The impact of these reforms is visible in the following figures:

- (i) new enrolments (1st time, 1st year) went up 37% from 2005 to 2008;

- (ii) in 2005, the number of adults (older than 23) enrolled in higher education for the first time was 900 - in 2009 this number rose 13 times, to 10.489 new enrolments;

- (iii) the number of enrolments in technological courses went up 20 times, with 5.832 new enrolments in 2008 (comparing to 294, back in 2005).

- The overall impact of these reforms on the place of science and technology in Portuguese society was unprecedented, particularly in terms of the growth of skilled human resources and of public perception of the social and economic implications of science and technology.

- *Advanced Qualification of Human Resources*. The enlargement of the social base of recruitment in the Higher Education sector was accompanied by an extensive increase in the number of PhDs and researchers, particularly in the areas of science and technology. This was due to the impact of three complementary policies: Firstly, public investment in research scholarships more than doubled when compared to 2005. The budget of the Fundação para a Ciência e a Tecnologia (FCT) for research scholarships reached 127 million Euros in 2008 (it was 85 million Euros in 2005). Secondly, in another unprecedented initiative in Portugal, the FCT introduced a programme for the employment of 1.000 new PhD researchers. This policy had visible consequences in the reinforcement of national scientific capability, alongside increased international competitiveness of Portuguese research institutions and an overall regeneration and refreshment of their human resources. Finally, in 2008, a new policy - Bolsas de Iniciação à Investigação (BIIs) –, was implemented in order support young university students through their first research projects, carried out in partnership with national R&D institutions.

- *Tax Incentive Schemes for private R&D.* In 2005, Portugal introduced a full and comprehensive "Sistema de Incentivos Fiscais à I&D em empresas" (SIFIDE). This was extended in 2008, and became one of the most competitive tax incentives for R&D in Europe, with possible tax deductions of up to 82.5% of R&D investment. An indicator of its impact, which underlines a decisive shift in the position of science in the Portuguese society, is the fact that, in 2008, expenditure in private R&D reached up to 50% of the total R&D expenditure in the country, three times greater than in 2005).

Public Awareness of Science. In 2007, public Funding for the promotion of scientific and technological culture reached 5% of public S&T investment funding.

1.3 National challenges, opportunities and trajectories

Portugal was both the first European colonial empire and the last to put an end to its colonial past. This process was carried out after a long colonial war (1961-1974) with the help of democratic revolution driven by an army already tired of war. The Portuguese democratic revolution of 1974 (the “Carnations Revolution”) drew to a close one of the oldest European dictatorships (1928-1974), itself a singular survivor of World War II. This 48 year-old totalitarian regime took its toll on the literacy levels of the Portuguese. Three decades have not yet been enough to erase the effects of an indelible deficit in education (compulsory education went as far as the 4th grade of elementary; in 1960, 52% of the Portuguese, 50 to 54 years-old, was illiterate).

One of the main effects of the above cultural underpinnings was both a persistant deficit in science literacy and a lasting perception of science (and *of* scientists) as an elite endeavour. This is the background in which the promotion of scientific culture in the Portugese society is carried out: as a balance between an in-depth science education effort and a participatory and democratic public engagement with science.

2 Priority setting, governance and use of science in policy-making

This section focuses on the different actors involved in shaping the relationship between science and society and the processes for governing science at national level. This includes government initiatives, institutions and organizations as well as public involvement and policy-making processes at all levels related to science and technology.

Different themes will be elaborated in the Portuguese context, including ethics in science and technology, equality, diversity and inclusiveness in scientific institutions, and ethnic or social minority groups in scientific contexts and careers. Moreover, this section will highlight actors in science communication and technology assessment. Public involvement in science and technology decision-making as well as the use of science in policy-making at the national level will be covered in this section.

2.1 Public engagement in priority setting

2.1.1 Formalised procedures for citizen involvement

Formal structures and procedures have been set up to involve individual citizens, as well as representatives of social, cultural and economic organizations, in S&T decision-making.

- The most important is the *Conselho Superior da Ciência e da Tecnologia* (CSCT) [High Council for Science and Technology], an independent consultative body with administrative autonomy. The CSCT was subject to a restructuring process designed to enhance its independence and enable it to provide financial and support services. The CSTC includes representatives of a wide spectrum of organizations, such as industrial consortia, universities and polytechnics, trade unions, students' associations, municipalities, political parties, learned societies and science academies. (see current legislation at http://alfa.fct.mctes.pt/apoios/unidades/regimejuridico.phtml.en)

- Another body in S&T policy making is the *Gabinete Coordenador da Política Científca e Tecnológica* [Coordinating Group of for Science and Technology Policy). This an advisory body, mainly composed of representatives from academic and scientific institutions, such as higher education organizations, Associated Laboratories and other private and public S&T organizations.

- A third example of such formal structures is the Comissão Parlamentar de Ciência e Tecnologia [Parliament Commission for Education and Science]. This has been a particularly active body throughout the last 5 years. Public debate sessions have been organized not only around matters of scientific policy but also with a particular attention to the social impact of S&T (www.parlamento.pt/sites/com/XLeg/8CECposRAR/Paginas/default.asp)

These are examples of institutional devices designed to bring together industry, the scientific community, student associations, academies and scientific societies across the country to share their views and provide advice on S&T policy. There is still a need for a legal framework capable of integrating less institutionalized public voices, particularly from NGOs and other active civic movements.

2.1.2 Citizen- or CSO-initiated activities with political impact

There have been some citizen-initiated activities (understood here in the sense of a form of social movement) with political impact, not directly on S&T decision making but more in influencing scientific advice in the political decision-making process. In a number of cases political decisions were taken as a result of both public opinion and pressure from scientists, which paved the way to institutional reform leading towards an ever-growing use of scientific advice and expertise in decision making. Here are some examples:

- The co-incineration crisis. The implementation of co-incineration plants in Portugal was (and still is) a very sensitive matter, not only in the choice of technical solutions but also, and mainly, in terms of their specific locations across the Portuguese landmass. Strong resistance from local populations to the installation of these systems in their neighbourhood, together with public concerns about their environmental effects, led to an unprecedented shift in the role played by scientific commissions: firstly, and in this particular case, their role moved from providing advice to exercising decision-making power; –the view expressed by the scientific committee determined the political action taken in these matters; also, there has been a growing effort to ensure the independence of scientific committees and their members.

- The Foz Coa controversy is another well-known example of the strength of an association between scientific demands from the archaeologists' community and social movements driven both by the media and scientists. The pressure exercised by this alliance was strong enough to cancel the construction of a dam which would have flooded the Portuguese Coa Valley, which is a major open air site for Palaeolithic art in Europe. It succeeded in replacing this project with – the creation a park for archaeological study but also open to the public.

2.1.3 Importance of upstream engagement

The involvement of citizens in key scientific policies at the early stage of the decision making process is still in an embryonic stage, but it is growing and consolidating in specific fields of research, especially those associated with emergent areas of R&D. Nanotechnology is an example of this type of public engagement:

- *The INL – a case study of upstream engagement*. Portugal is currently involved in a partnership for transnational investment in this area: the construction of the largest nano laboratory in the Iberian Peninsula, in partnership with the government of Spain. The Laboratory – the *International Iberian Nanotechnology Laboratory (INL)* is planned for 200 scientists, with a built area of 20.000 m2. (http://www.iinlrecruitment.com/home.php).

- Prior to this investment, a number of initiatives were launched, starting in 2006, to engage the public in two-way dialogue on nanotechnologies and nanosciences in Portuguese society. Three examples are noteworthy: (i) the creation of a Ciência Viva centre for the promotion of the public awareness of nano science and technology, which will also be located in the city of Braga, along with the INL; (ii) participation in the European *Nanodialogue* initiative, with an exhibition at the Pavilion of Knowledge, in Lisbon (2006), "*cafes of science*" in several science centres across the country, dedicated to the debate on advantages and risks involved in nano R&D, and also in the *Time for Nano* project, which now operates in Portuguese schools; (iii) the Centre for Social Studies at the University of Coimbra has been particularly active in the DEEPEN project – a research partnership for integrated understanding of the ethical challenges posed by emerging nanotechnologies and their social, political and scientific implications for civil society –; several focus groups were conducted in 2008, with NGOs and other civic movements.

These initiatives, although limited to the specific S&T domain of nanotechnology, constitute a significant example of recent shifts in the Science –Society dialogue in Portugal.

2.2 Public - private interaction

Portugal has been active in setting up instruments and procedures to stimulate cooperation between universities and industry.

- Some of these procedures are integrated within European Union policies and programmes. This is the case with the Strategies for Collective Efficiency (SCE) project and their Competitiveness and Technology Centres (PCT) and other EEC- clusters. In 2009, Portugal formally recognized 19 SCE, including 11 PCTs and 8 Clusters. (see http://www.pofc.qren.pt/PresentationLayer/conteudo.aspx?menuid=749)

- There has been also a growing effort to develop Parques Tecnológicos (Science and Technology Parks), a kind of industrial park that is particularly focused on technology and innovation, with a significant input form university research. There are now 11 Parques Tecnológicos in Portugal (see http://www.tecparques.pt/associados.htm).

- As well as EU driven policies in this area, other programmes are worth highlighting, particularly for their innovative approaches. One example is an unprecedented strategic initiative for international partnerships in science, technology and higher education, that brings together large Portuguese universities and industrial concerns with leading universities worldwide, including MIT, Carnegie Mellon University and the University of Texas at Austin. These initiatives, which began in 2006, have already created thematic networks contributing to the internationalisation of Portuguese institutions and companies. Examples include (i) the MIT-Portugal Programme, http:/www.mitportugal.org, which has identified over 30 priority areas for R&D within an extensive industrial affiliation programme with up to 49 affiliates; (ii) the Carnegie Mellon - Portugal programme, http://.cmuportugal.org/, which has a close relationship with Portuguese industry, focused on information and communication technologies – it already works closely with 30 corporate partners; (iii) the University of Texas in Austin - Portugal Programme, launched in 2007, http://www.utaustinportugal.org, which already works with 12 corporate partners.

A key strength in the above strategies is that transnational institutions provide a useful framework that fosters the independence of university-based scientific institutions, enriches the search for knowledge through cooperative endeavours and supports efforts to address new social and technological problems in close partnership with business and industry.

2.3 Use of science in policy making

2.3.1 Formal procedures and advisory bodies involved

Policy making processes in Portugal are increasingly supported through scientific knowledge and technology assessment. For example, extensive legislation and best practice guidance have been drawn up in the area of environmental protection, particularly under EU recommendations and directives (all the legislation produced in this area is available at

http://www.inag.pt/index.php?option=com_content&view=article&id=19&Itemid=58 .

The input of scientific knowledge in policy making is formalized by the legislation that regulates two main types of scientific institutions: State Laboratories and Associated Laboratories.

The network of State laboratories has been subject to considerable reform addressing their mission, structure and activities (http://alfa.fct.mctes.pt/laboratoriosestado/).

- State Laboratories are public research institutions created with the explicit mission of supporting the Government in matters of S&T policy. In parallel with their R&D activities they are frequently commissioned to provide public services, including support for industry, expertise, standard setting, certification and technical assessment. A practical example of the effectiveness and scope of their influence in policy making was the recent shift in the government decision about the location of the future Lisbon airport. After years of public (and political discussion) of the strengths and weaknesses of the initial location at OTA, north of Lisbon, the comparative technical study carried out by the LNEC (Laboratorio Nacional de Engenharia Civil) in 2008 was decisive in changing the government's decision in favour of a different site, located to the south of Lisbon. Given the strategic importance of the airport, this was a clear example of the influence of S&T information produced by Sate Laboratories on the process of political decision-making.

- Associate Laboratories are research units that aim to demonstrate, through the results of evaluations, the capacity of organisations to implement, in a stable, competent and effective manner, the scientific and technological policies laid down by the government. They usually involve several research units from multiple Portuguese universities or research institutes. The status of Associated Laboratory is awarded by the Ministry of Science, Technology and Higher Education to research institutions with the highest scores in an evaluation process carried out by international panels. Associated Laboratories are also required to assist the government in designing public policies (see http://alfa.fct.mctes.pt/apoios/unidades/regimejuridico/#art6).

2.3.2 Trends at national level

The use of research and scientific advice in policy making has been building up in recent years. This reflects not only the political decision to place S&T development as *the* national priority, but also the recent developments in public funding for S&T, the commitment to pursue quality in the setting up of Associated Laboratories, the extensive reform of the State Laboratories and, finally, the development of better infrastructure at both national and transnational levels.

2.4 Key actors

2.4.1 Ethics in science and technology

Name of actor	Type of actor	Sector	Influence on public	Influence on political

			opinion	decisions
Comissão Nacional de Ética para as Ciências da Vida	Ethics councils / committees	Mixed	3	3
Instituto de Bioética Universidade Católica Portuguesa	Universities and other higher education institutions	Private	3	4
Ordem dos Biólogos	Other civil society organisations	Mixed	3	3
IBMC	Other civil society organisations	Mixed	3	3
CARED (Comissão de Apoio à Reflexão Ética e Deontologica)	Ethics councils / committees	Mixed	4	4

2.4.2 Equality, diversity and inclusiveness in scientific institutions and in educational systems

Name of actor	**Type of actor**	**Sector**	**Influence on public opinion**	**Influenc political sions**
Alto Comissariado para a Emigração e Minorias	Other civil society organisations	Public	3	3
Comissão para a Igualdade e Contra a Discriminação Racial	Other civil society organisations	Public	3	3
Entre Culturas	Government and ministries	Public	3	3
Alto Comissariado para a Imigração e Diálogo Intercultural	Government and ministries	Public	3	3
CIGA-NOS	Other civil society organisations	Public	3	3

2.4.3 Science communication

Name of actor	**Type of actor**	**Sector**	**Domestic or foreigner**	**Influence on political initiatives**
Ciência Viva - Agência Nacional para a Cultura Científica e Tecnológica	Other civil society organisations	Mixed	Domestic	2
Fundação Calouste Gulbenkian	Foundation	Private	Domestic	2
Instituto de Patologia e Imunologia Molecular da Universidade do Porto	Universities and other higher education institu-	Mixed	Domestic	2

IPATIMUP	tions			
Instituto de Biologia Molecular e Celular IBMC	Universities and other higher education institu-tions	Mixed	Domestic	2
Instituto de Medicina Molecular IMM	Universities and other higher education institu-tions	Mixed	Domestic	2

2.4.4 Technology assessment

Name of actor	**Type of actor**	**Sector**	**Influence on public opinion**	**Influenc political sions**
Laboratório Nacional de Engenharia Civil	Government and ministries	Public	2	1
Infarmed - Autoridade Nacional do Medi-camento e Produtos de Saúde	Government and ministries	Public	2	2
Laboratório Nacional de Energia e Geo-logia	Government and ministries	Public	2	2
Instituto Ricardo Jorge	Government and ministries	Public	2	2
Instituto Hidrográfico	Government and ministries	Public	2	2

3 Research related to Science in Society

This section is concerned with research activities related to science in society. The purpose is to describe the efforts in Portugal, including the SIS research being undertaken and how SIS issues are embedded in mainstream research. The section will also elaborate on how SIS research is being funded and what the scale of funding is.

A distinction is made between *SIS research* on the one hand and *SIS issues embedded in mainstream research* on the other. SIS research are the studies particularly targeting public understanding of science, governance of science, science policy, science education, science communication, ethics in science and technology, the reciprocal relations of science and culture, young people and science and similar issues. However, SIS issues may also be present in other research activities, in which the main objectives of research are *not* SIS related issues, but in which SIS practices or perspectives are embedded. This could include studies within the natural sciences which apply innovative or extensive use of public involvement in the research process, new ways of communicating research results, ambitious efforts to bring ethical and societal issues into research, innovative ways of involving a variety of stakeholders (politicians, NGOs, industry, social scientists etc.). Such efforts are referred to as SIS issues embedded in mainstream research.

The section provides examples of Portuguese research projects and funding programmes related to SIS, cross-cutting and emerging themes of SIS. Moreover, the role of SIS in evaluative practices of research programmes and institutions are elaborated.

It should be noted that this section is concerned with mapping research activities which are **not fully EU funded**. The subsections are concerned with national as well as international research efforts, but not activities funded solely under the European framework programs. Such research activities are already well-documented elsewhere.

3.1 Research on Science in Society

3.1.1 Research projects

Name of project	LNC	Institutions participating	Budget and funding source	Field of study
Forensic DNA databasing in Portugal - contemporary issues in ethics, practices and policy	N	CICS/ICS/UM	108.157 € FCT	Ethics in S&T Governance of science
Science Engaging Society: Life Sciences, Social Sciences and Publics (BIOSENSE)	N	Centro de Estudos Sociais (CES)	155.071 € FCT	Public understanding of science
SCRAM - Crises, risk management and new socio-ecological arrangements for forests: a perspective from science and technology studies	N	Centro de Estudos Sociais (CES)	171.771 € FCT	Risk management
Choice beyond (in)commensurability: controversies and public decision making on territorial sustainable development (BECOM)	N	Centro de Estudos Sociais (CES)	143.931 € FCT	Risk management
SOCSCI Scientific Societies in Contemporary Science	N	Instituto de Ciências Sociais (ICS/UL)	81.034 € FCT	Scientific associations and associative participation
Evaluating the state of public knowledge on health and health information in Portugal	N	CES	291.790 € FCT	Social perceptions of health sciences
Health information of Portuguese population: Knowledge and perceived quality and accessibility of health information sources	N	Instituto de Ciências Sociais (ICS/UL)	248.712 € FCT	Social perceptions of health sciences
DEAP - Developing Environmental Awareness with Persuasive systems	N	Fundação da Faculdade de Ciências e Tecnologia (FFCT/FCT/UNL)	123.000 € FCT	Environmental awareness
Health, Risk and Governmentalisation	N	Instituto Superior de Ciências Sociais e Políticas (ISCSP/UTL)	100.000 € FCT	Risk management
CHANGE Changing Climate, Changing Coasts, Changing Communities - global erosions, risk conceptions and sustainable solutions in Portugal	N	Instituto de Ciências Sociais (ICS/UL)	168.000 € FCT	Risk management
Disease in the news	N	Centro de Estudos de Comunicação e Sociedade (CECS/UM)	63.634 € FCT	Health Communication
Science Education for Citizenship through a Problem-Based Learning approach	N	Centro de Investigação em Educação da Universidade do Minho (CIEd/UM)	163.000 € FCT	Science education
Reading newspapers: an open window	N	Centro de História das	45.000 €	Public under-

to representations of science and technology in the Portuguese press		Ciências (FC/UL)		standing of science
Improving the Teaching of Experimental Sciences		Faculdade de Ciências e Tecnologia da Universidade de Coimbra (FCT/UC)	50.076 €	Science education

3.1.2 Trends in research

It is possible to identify two distinctive periods of research on SiS during the present decade:

- The first period, from early 2000s up to 2008, was dominated by case studies on a number of specific incidents and/or controversies that were perceived by the public and the media as risk factors or threats to the environment or to public health. This was the case of the BSE crisis, the Combo project, the Foz Coa debate, the co-incineration controversy and the Balkan syndrome. As well as these small-scale studies, a major research program was carried out from 2003 to 2006 called OBSERVA – Environment, Society and Public Opinion (http://observa.iscte.pt/index2.php). This focused on researching interactions between social and environment contexts, via the analysis of social practices related to environmental issues in particular social and geographical contexts.

- The second, since 2008, is a period in which research on SiS became part of the "Call for Funding of Research and Development Projects in all Scientific Domains" – funded by FCT, as a domain of research in its own right, designated as Social Sciences - Studies on Science and Society (http://alfa.fct.mctes.pt/apoios/projectos/consulta/areas?idconcurso=88). On the one hand, there is continuity of the main topics that shaped the SiS research agenda over the first half of the decade, particularly in the societal implications of science and technology on health and environment. On the other hand, there are emergent themes which are paving the way for new trends in research on SiS.

- One emergent trend is the research on the relations between Science, Technology and Law. This is a domain where matters of ethics, values and human rights occupy a central place in research on the societal, practical and political impacts of science and technology in society. One example is the project called "Mothers and fathers after the "biological truth"? Gender, inequalities and parental roles in cases of investigation of paternity" (http:// http://alfa.fct.mctes.pt/apoios/projectos/consulta/areas.phtml.en?idElemConcurso=264). This study aims at understanding how biotechnology shapes the configuration of parental roles and reproduces gender differences that expose the vulnerability of both women and children born outside matrimony and without civil registration of the male progenitor. Another example is the "Forensic DNA data basing in Portugal - contemporary issues in ethics, practices and policy" (http://alfa.fct.mctes.pt/apoios/projectos/consulta/areas.phtml.en?idElemConcurso=2777). The fast growing relationship between science and justice has been attracting the attention of scientific research in Portugal, particularly in the area of the storage, dissemination and use of personal data, especially genetic data. Here, as in the previous example, issues of values and human rights are the major societal implications under scrutiny. There is public unease about the social implications of science and technology in as it affects privacy and personal data protection. DNA profiles are seen by some of the public as a possible source of discrimination, particularly where it covers intimate aspects of people's lives and their families (e.g. predisposition for certain diseases, behaviours or sexual orientation), which risk being misused by government, insurers, employers, banks and other institutions. Research on the societal implications of genetic databasing seems to be gaining momentum and is being called upon to inform political decision in matters of human rights and the protection of personal data. One project aims at understanding the ethical, political and societal issues raised by the implementation of a national DNA forensic database. Its main focus is on the impacts on civil society, governance, and scientific and criminal investigation, as well as issues of crime control, governance, public trust and involvement of civil society.

Risk perception and management is another emergent theme in current SiS research. Risk evaluation is a domain where the links between science and political decision-making are particularly strong. In risk management in domains such as the environment, food or health, science is often called upon to support political decisions, and in doing so exposes itself to two opposing forces: on the one hand, the demands of a political agenda which is often driven by national concerns, and, on the other hand, the pressure of social movements which are driven by local preoccupations. Social vulnerability and risk perception are related not only to natural threats but also to technological ones, so they are often at the centre of the relationships between science and society. Projects such as SCRAM and BeCOM are examples of this emergent trend on SIS research. "SCRAM - Crisis, risk management and new sociological arrangements for forests: a perspective from science and technological studies" seeks to analyse how the forest crisis is perceived by the state and by forest stakeholders and examines the implications for practical intervention. The project looks at these dimensions from a socio-technical perspective that takes into account the intensity of the public and political debate in a country that is frequently and cyclically disrupted by catastrophic forest fires. SCRAM explores the weight of S&T in both political decision-making and intervention in the field, and in doing so aims to integrate and facilitate the dialogue between local communities and the different actors, such as forest producers, national environment agencies, experts and forest stakeholders. The BeCOM project explores decision-making instruments and procedures and their role in dealing with conflicts and socio-technical controversies emerging from projects with major impact on the environment. A second line of research in the BeCOM project is a comparative study of how science and technology research instruments have been deployed in controversies about the location of the new Lisbon airport and the decision on the extension of Milan airport.

A third emergent trend sets its focus on science communication itself, seeking to examine and propose models of science-society dialogue which are more responsive to public needs and concerns. BIOSENSE is an example of this approach. It seeks to study the effectiveness of science shops as a strategy for public engagement with science. The project acknowledges recent developments in science communication in Portugal, but it also identifies some gaps in the current predominant model of interaction between scientists and the public, in particular, the fact that scientists themselves, and their organizations, define the agenda and the science communication themes, ands see these as processes of dissemination, or as ways of keeping the citizens informed of recent scientific and technological developments. On the other hand, science shops propose a different kind of connection between scientists and the public, in which the citizens' questions, doubts and concerns become the starting point of the dialogue.

3.2 Main stream research embedding Science in Society issues

3.2.1 Trends and good examples

In recent years, SiS issues are increasingly addressed in mainstream research in Portugal. However, this shift tends to be confined to research areas where the human and societal implications are obvious to the general public. These is certainly the case for environmental and health sciences.

- Examples of health sciences research projects of this kind include HMSP-IISE-03 "Evaluating the state of public knowledge on health and health information in Portugal", and the HMSP-IISE-04 and the "Health information of the Portuguese: knowledge and perceived quality and accessibility of health information sources". Both projects are part of the Call for Projects on the Evaluation of the Socio-Economical Impact of Medical Information's Systems, in the Framework of the Cooperation Agreement between Portugal and Harvard Medical School. (alfa.fct.mctes.pt/apoios/projectos/consulta/areas.phtml.en?idElemConcurso=3137).

- Environment and Global Change is a specific area of mainstream research, funded by FCT, where SiS issues are being addressed (http://alfa.fct.mctes.pt/apoios/projectos/consulta/areas.phtml.en?idElemConcurso=2733). "DEAP — Developing Environmental Awareness with Persuasive Systems" (is a project whose main purpose is the study of how to stimulate responsible environmental behaviour changes through interactive ambient public displays that sense and react according to users' activities. It includes, as a research issue, the assessment of the citizens' receptivity towards new these new forms of interaction. Another example is " CHANGE: changing climate, changing coast, changing communities - local erosion, risk conceptions and sustainable solutions in Portugal", a research project which studies shore erosion in its social dimension, with a particular attention to land management in a context of change.

3.3 Funding for research on Science in Society

Funding programmes specifically targeted at SiS research are organized solely by FCT, the National Foundation for Science and Technology, through its annual programme of R&D funding.

Name of program and link to 'call'	**Primary funding agency**	**Total budget in € per year**	**total amount in € applied for per year**	**Average no. of applicants per year**	**Average no. of successful applicants per year**
Studies on Science and Society http://alfa.fct.mctes.pt/apoios/projectos/concursos/2008/	2	*NA*	658. 000 E	*NA*	5

3.4 Importance of Science in Society issues as evaluative elements in national research programmes

The evaluation of national research programmes is carried out on two levels: (i) the evaluation of research programme proposals and (ii) the evaluation of research institutions, which determines their annual funding. At the first level SiS issues are taken into account only when they are part of the body of knowledge that is the focus of the research. At the second level, SIS issues play an important role as elements in the evaluation of R&D institutions. Such evaluation is carried out by international panels of experts and is subject to a standards framework (http://alfa.fct.mctes.pt/apoios/unidades/regulamento.phtml.pt). Here, SiS considerations are one of four evaluative strands, specifically addressing the level of "participation in activities aiming at promoting scientific culture and the public understanding of science and technology".

4 Activities related to Science in Society

This section relates to SIS as a field encompassing a variety of different activities particularly concerned with public communication of science and technology in Portugal. The issues addressed are formats for science communication and the actors involved in science communication as well as trends at the national level.

4.1 National science communication trends

The recent history of scientific and technological culture in Portugal has seen a growing pressure for wider public discussion of processes that extend the involvement of citizens and civic movements and increase the level of participative democracy in the debate on science in society. This pressure is spreading from more scientifically literate sectors of Portuguese society to the general public and society at large.

This has been helped by the fact that fostering scientific and technological awareness has been a central part of national science policy for over a decade; its success is reported in a European report "Benchmarking the promotion of RTD culture and Public Understanding of Science", which acknowledges the leading role of national public awareness programs such as Ciência Viva, implemented in Portugal since 1996. International acknowledgment of emerging Portuguese leadership in this area was the 2007 European Convention of Science Centres and Museums (ESCITE) which brought over 1000 experts in the public understanding of science to Lisbon, and the first Iberian Congress of Science Centres and Museums was held in Portugal. Domestically, a decisive indicator of the high priority placed on promoting science scientific and technological culture is the fact that it has received 5% of public S&T investment.

An adequate picture of science communication in Portugal must be seen and understood within the context of recent developments.

In the early 1990s Portugal was a country with few modern scientific resources; science communication activities were scarce and the interaction between scientists, teachers and the public was minimal. Public expenditure in R&D was one of the lowest in Europe, scientific production was fragile and the scientific community itself was far removed from other spheres of Portuguese society. Public funding of science communication initiatives was almost non-existent. This meant that the Portuguese scientific community, under supported and underdeveloped, were mainly focused on research and academic work and paid little attention to communicating with the general public.

The creation, in 1996, of the Ciência Viva Agency marks a turning point in Portuguese science promotion and communication. The first Ministry for Science and Technology was created in 1995; scientific and technological development now became a national priority, *alongside* the promotion of scientific and technological culture. The consequent growth of the scientific community and scientific production created the conditions for major change in the science-society dialogue. The state played a central role in growing the commitment of the scientific community to an extensive national programme for scientific culture. In this context, by the turn of the millennium, science communication in general and science-public relations in particular, whereas merging into what can be described as a "public education model", where scientists take the lead in educating and informing the public in science related matters. Quite quickly, this dialogue started to evolve into more participative models of the science-society relationship, with a higher degree of public engagement. This shift was driven both by intrinsic developments in the philosophical approach to science communication approach, and to extrinsic factors related to the increasing democratization and modernization of the Portuguese society.

The character of science communication, largely instigated and promoted by the work of Ciência Viva, can be summarized as (i) a focus on *authentic* science education, where students and teachers collaborate with experienced scientists and engage in a dynamic form of contextualized learning through which they reach and understanding of not only of specific science issue but of the scope and nature of research itself. The aim is that they recognize the values and norms held by the scientific community and ultimately understand science as both culture and practice; (ii) prioritizing the creation of networks of scientific, educational and industrial communities which can share resources, knowledge and strategies to promote scientific culture, and (iii) major investment in establishing a national network of modern science centres, designed to be both interactive environments for promoting public awareness of science and technology, and also as regional scientific, cultural and economic development centres of excellence, brining together the work of active scientists in each region. By 2010 the network had grown to 18. In 2002, the European Commission chose Ciência Viva as one of the continent’s 5 most relevant case studies in the Science-Society panorama, describing it as ‘an open programme, promoting alliances and fostering autonomous actions’ (European Commission, 2002). Ciência Viva was also the subject of an extensive multi-case research study, [Educational Partnerships in the Promotion of Practical Work and Scientific Culture], 2002), whose main findings show that the enhancement of science education and scientific culture was successfully addressed by a full dialogue with, and engagement between students, teachers and scientists. A recent sociological study (Costa et al., 2005) depicts Ciência Viva as a ‘social movement’, in the sense that it involves diverse social actors joined together by a common cause and aiming to stimulate and support social change (2005: 114).

Social factors are also contributing to the emergence of a participative model of science communication, particularly in terms of media coverage, the active involvement of key scientists and technologists and increasing public access to scientific information. This is supported by (i) higher levels of scientific literacy (a comparison of the results of a large survey of scientific culture undertaken in 1997 and in 2000 showed an increase in public awareness of the impact of science on society) (OCT, 2000); (ii) greater availability of scientific information on the internet; (iii) rapidly increasing mass media coverage of news about science, especially about controversial issues; (iv) a growing activism and participation of social organizations and movements, mainly in the area of environment and health issues; and (iv) extensive improvements in overall access to upper secondary and higher education.

For most of the decade, government strategy targeted the improvement of scientific culture as a strategic enabler of both innovation and economic growth. This view has been – and still is – an element within a broad range of political and economic perspectives, all of which share the belief that science and technology provide the foundations and the drivers for Portugal to become a modern advanced society. In recent years this has incorporated the view that a more scientific culture will not only deliver the skilled manpower needed to ensure prosperity, but also provide a framework for active and rational engagement by the public and the media in scientific debates. Communication about the myriad issues that emerge from, or involve engagement with science and technology, is a central requirement in making this strategy effective in reality.

4.1.1 Good practises

Summer Science: the most extensive and effective science communication project in Portugal, this national awareness campaign fostered the creation of science associations and provides the population with opportunities to make scientific observations and establish direct, personal contact with experts in various fields. The activities – open and free to all – invite members of the public to take part in various experiments, allowing them to experience a form of the empirical confrontation between theory and practice. Since 1996, more than 15.000 people every year have taken part in open air activities, particularly in astronomy, geology, biology and engineering. Ciência Viva makes the most of the summer season to organize this type of large scale out-door campaign.

Astronomy in the Summer is an eloquent example of the guiding principles involved. Bridging the gap between the public and science is often best done by taking science to the people, and the Portuguese beach in summer is probably the most popular leisure environment. That is why hundreds of astronomers appear at dozens of beaches and also at the tops of the mountains and in the countryside and make both their telescopes and their expertise available to whoever shows an interest.

Geology and Biology in the Summer extends this model into other fields of science. Promoting awareness of national geo-resources and the understanding of geological phenomena is well suited to the process of scientific "co-observation". Organized in scientific tours, members of the public comes into direct and personal interaction with scientists and experts who guide them through a range of activities such as field trips to the countryside, visits to rural and urban places of interest from a geological or ecological point of view, visits to mines and quarries and tours of museums and interactive science exhibitions.

The essentially human quality of these encounters between the real "people of science" and the public they serve is at the heart of these science communication campaigns and has given a decisive boost to the scientific association movement at regional and local levels. An important consequence is a growing interest from city councils seeking to integrate these activities into mainstream cultural initiatives such as sport, theatre and music; science communication is acquiring a new "brand" which depicts it as not only as an intellectual and academic specialism but also a culturally relevant and potentially entertaining activity with public appeal that can have a positive impact on local tourism and the wider economy.
Social studies of these phenomena[1] characterise Summer Science as a distinct form of social movement with full engagement of both the public and a network of universities, scientific societies, research institutions, science clubs, civic movements and schools. Full information and evaluation reports on *Summer Science* can be obtained at www.cienciaviva.pt/veraocv/2009.

4.2 Science journalism and training activities

Science journalism in Portugal is still in its early days. The first science journalists' association - ARCA (Associação de Repórteres de Ciência e Ambiente), was created in 2005 with an official website at http://arcaportugal.org/. ARCA is a non-profit organization aiming to promote science journalism and improve its quality. Science journalism is also appearing as part of the curriculum of journalism and communication in Portuguese Universities.

However, in 2010 we have been observing a major shift in the way science communicators, communication officers and journalists have been finding new organization trends, namely the recently created a facebook group – **SciCom**, with more than 200 members. The use of social networking boosted the emergence of an unprecedented science communication community.
Another major advancement in this area was the creation in 2011 of the first mphil in Science Communication, at Universidade Nova de Lisboa.

4.3 Young people and science education in schools

4.3.1 Skills and interest

Portugal has been particularly active in setting up engagement and enrichment programmes aiming to promote science education in schools and raise young people's interest in science and scientific careers. Here are some examples of the most successful initiatives.

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[1] Costa, A.F., Conceição, C.P., Pereira, I., Abrantes, P., & Gomes, M.C. (2005) Cultura Científica e Movimento Social: Contributos para a Análise do Programa Ciência Viva [Scientific Culture and Social Movement: Contributions to the Analysis of the Ciência Viva Programme]. Oeiras, Portugal: Celta Editora.

Funding and support for science projects in schools. This programme, *Science at School*, has been carried out systematically since 1996. Its main goals are to promote and reinforce links between schools and scientific institutions through science education projects, build and sustain a solid and strong relationship between the scientific and educational communities, create and promote scientific and technological culture, facilitate the sharing resources and knowledge and encourage constructive dialogue. It has reached a large number of students, teachers and scientists. In 2007 and 2008, about 1100 new projects in schools were approved by Agência Ciência Viva (www.cienciaviva.pt) and are being implemented through close cooperation with schools and research centres, representing a public investment of approximately 14 million Euros (see http://www.cienciaviva.pt/concurso/). This programme, its objectives and its scope build on a continuously evolving process starting with an initiative set up in 1996. Both sociological and educational research have been conducted to assess the macro impact of this programme. Costa *et al.* (2005) provides a range of relevant quantitative data about the scale and implementation of the Ciencia Viva school interventions: from 1998 to 2001 more than one million students were involved in 3,139 science education projects, with an investment of more than 24 million Euros. Since 1996, 5 calls for projects have been held, and 3.088 projects (involving over 3,000 schools and 7,000 teachers) have been approved and financed with a total investment of more than 15 million Euros. The last call extended its funding criteria to include the development of learning resource centres, publications, technological projects and web sites. Participation of higher education and polytechnic institutions, research centres, associations and scientific societies has provided technical support and scientific and pedagogical education for elementary and secondary teachers and pupils.

Summer Science Internships for Secondary School Students. This is the most extensive on-going science internship programme for secondary school students in Europe. It is designed to promote science learning through work experience and attract young people to careers in natural science and technology. The extent and impact of this type of science workplace learning is demonstrated by the increasing number of junior and senior secondary school students choosing to learn science in university and industry research facilities under the mentorship of science and technology practitioners.

An annual average of 70 research and higher education institutions receive up to 1000 secondary school students for internships during summer holidays. Activities centre on practical research carried out alongside professional science and technology practitioners at their workplace. The potential of transfer to other countries is very high, particularly in the light of the accumulated experience in the setting up of the programme (including its organizational on-line platform, the extensive networking with science research institutions and scientists already involved and, finally, the educational research undertaken on this subject and currently available). An evidence of this type of transfer to other countries is the on-going via an exchange programme between Portuguese and Spanish scientific research institutions which began in 2007, Here are some of the main characteristics of this programme:

- *Applied learning – putting theory into practice*. Students have had extended opportunities to gain knowledge of up-to-date scientific knowledge. They learned scientific concepts from multiple sources, including direct tutoring by experts in the field, reading up-to-date research papers and guided access to relevant information on the Internet.

- *Practical work and hands-on learning*. Apprentices spend a significant amount of time doing hands-on work in laboratory activities, using the tools that are common in the scientific community, and with access to equipment and techniques not available or possible at school.

- *Student-Scientist Interactions*. Scientist mentors play a crucial role in shaping the learning of their apprentices but the apprentices themselves are challenged to extend their own interactions with their laboratory colleagues. The mentors stimulate this networking both by inviting the contribution of other researchers for specific instructional tasks, and by introducing the apprentices to workplace social norms - "the everyday reality of doing science in the lab".

- *Participation in scientists' work*. The students work closely with their mentors so as to get to know and understand their current work. This means that, as part of their laboratory activity, students must apply techniques of monitoring and data analysis to their mentor's current experiments. By empowering their apprentices to take responsibility for some of the tasks that are required as part of their own research, the mentors promote collaborative working and foster their apprentices' confidence by giving them a strong sense of the authenticity and importance of their learning tasks.

- *Teamwork and Peer Support*. The apprentices work as part of a team at all times, facing the problems and arriving solutions together. Throughout the internship, there are plenty of opportunities to build strong personal ties with one another, which allows them to organize and distribute tasks between each other. Even the writing of final reports and the preparation and delivery of the final presentations, are carried out through collaboration and teamwork, which presents a quite dramatic contrast with normal practice in the school science classroom.

- *Autonomy*. Many students have reported their enjoyment of having conducted their projects with full autonomy, guided support or through team collaboration and negotiation. They become acclimatised to the on-going practice of science by conducting research experiments that are part of their mentors' genuine research agenda, playing an adult role by taking on the responsibility to play their part.

Full data on the development of this initiative can be found in http://www.cienciaviva.pt/estagios/jovens/edicoesanteriores.asp/.

4.3.2 Societal issues and critical reflection

In science education, societal issues and critical reflexion about the role of science in society has been addressed mainly through aspects of science and technology areas in which civil society is more engaged such as biodiversity, protection of the environment and energy. Two noteworthy examples of on-going large scale projects in this area are:

Biodiversity - Um Bosque Perto de Si (*A Bush Next to You*). This project involves more than 100 schools and 7 science centres nationwide, coordinated by a leading research institution in the area of forest ecosystems, the Jardim Botãnico da Universidade de Lisboa. Its goals is to engage secondary school students in the identification and mapping of biodiversity in Portuguese forests and their ecosystems, to raise their awareness of the importance of science in environmental protection and to recognise the need for risk management and for the redesign of socio-ecological environments within forests. (http://www.cienciaviva.pt/projectos/bosque/)

Renewable energy technologies - *Rali Solar* **-** This nationwide school project, active since 2005, is based on a partnership between EDP, Portugal's main electricity provider , the Museum of Electricity and the Ciencia Viva Agency, with the scientific support of both LNEG (Laboratório Nacional de Energia e Geologia) and SPES (Sociedade Portuguesa de Energia Solar). The project engages secondary school students teams all round the country in the design and manufacture of prototypes of self-renewing powered devices. The educational agenda stresses the importance of renewable energy technologies, addresses both environmental concerns and related climate change issues and focuses on the challenge of maintaining a secure supply of energy while simultaneously reducing emissions of carbon dioxide. Teachers receive specific training from scientists from LNEG in science museums and centres close to the schools involved. In terms of scale the project consists of: 356 teams (each producing its own device within a school science project); 215 schools and more than 1000 students competing at a final event, which took place in Lisbon, 15th May 2010. (http://www.cienciaviva.pt/ralisolar/)

4.4 Communication activities

Means	**Much less**	**Less**	**Same**	**More**	**Much more**
Science TV programmes				X	
Radio				X	
Newspapers			X		
Magazines			X		
Large scale festivals			X		
Web-based communication					X
Museums, exhibitions				X	
Citizen- or CSO initiatives				X	

4.4.1 TV programmes

Programme title	Frequency	Duration	Target audience	Themes covered
Falar Global	Weekly	30’	General public	Science and Technology
4 x CIÊNCIA	Weekly	30’	General public	Scientific debate and controversy
AB CIÊNCIA	Weekly	30’	Families	Practical Science for the family
Biosfera	Weekly	2’	General public	Environment
BOMBORDO	Weekly	30’	General public	Marine sciences
Futuro hoje	Weekly	5’	General public	Technology
Ovo de Colombo	Weekly	10’	General public	Science, Technology and Innovation in Portugal

4.4.2 Radio programmes

Programme title	Frequency	Duration	Target audience	Themes covered
Avenida do Conhecimento - Um Programa sobre Ciência, Tecnologia e Ambiente	Weekly	15’	General public	Science and Environment
Os dias do futuro	Weekly	60’	General public	R&D and Innovation
Terra à Vista	Daily	2’	General public	Environment
A1 CIENCIA	Daily	5’	General public	News of S&T
3 minutos de ciência	Daily	5’	General public	Mathematics and Astronomy
CIENTIFICA MENTE	Weekly	10’	General public	S&T
Medicina e Saúde	Weekly	5’	General public	Health
Vida saudável	Weekly	5’	General public	Environment and Health

4.4.3 Popular science articles in newspapers and magazines

Title of newspaper	Frequency	No. of print runs	Target audience	Themes covered
Público	Daily	60000	General public	General
Diário de Notícias	Daily	50000	General public	General
Superinteressante	Monthly	51000	General public	Science and Technology
National Geographic	Monthly	50000	General public	Science and Technology

4.4.4 Festivals, science weeks, etc.

Activity title (and web-	Type	Organiser	Fre-	Number of	Venue	Short description

link if possible)			**quency**	**participants (approx)**		
Semana da Ciência e da Tecnologia		Ciência Viva		50.000	National	Science and technology events across the country
Mostra de Ciência http://www.eng.eseig.ipp.pt/vivamatematica/index.php?option=com_content&task=view&id=38&Itemid=53		Fundação EDP e Fundação da Juventude		2.000	Lisboa	Science fair
Mostra de Ciência, Ensino e Inovação http://sigarra.up.pt/up/noticias_geral.ver_noticia?P_nr=5100		Universidade do Porto		4.000	Porto	Science festival in health sciences, experiments, workshops with scientists and young students
Feira de Ciências		Centro Ciência Viva de Vila do Conde		1.000	Vila do Conde	Science fair
Ciência na Rua http://www.estremoz.cienciaviva.pt/exposicao/cienciarua/		Centro Ciência Viva de Estremoz		15.000	Estremoz	Science festival
Semana Internacional do Cérebro		Dana Alliance for Brain Initiatives		2.000	Lisboa	Science communication events promoting recent developments in neurosciences
Ciência 2010 www.ciencia2010.pt		Conselho de Laboratórios Associados		6.000	Lisboa	The most important science communication event in the country

4.4.5 National portals, blogs

Activity title	**Activity type**	**Number of users**	**Themes covered**	**Short description**
Ciencia Viva	Scientific and technological culture	10.000	Science and Techonology, science education, science communication	Site of the National Agency for Scientific Culture
Ciencia Viva TV	News	5.000	General science	On-line S&T magazine
TV Ciencia	News	2.000	General science	On-line S&T magazine
Ciencia Hoje	News	15.000	General science	On-line S&T magazine
Associação Viver a	Promotion of	3.000	Scientific research and	Science communication

Ciência	scientific culture		science education	
CienciaPt	News and science inventory	4.000	General science	On-line S&T magazine
Ciência no Parlamento	Science in Society	5.000	Science policy	Parliament web site of the Science & Education Commission

4.4.6 Science museums and centres

Activity title	**Activity type**	**Number of visitors/year**	**Themes covered**	**Venue (city)**	**Short description**
Centro Ciência Viva de Lagos	Interactive Science Centre	10500	Astronomy and Maritime Discoveries	Lagos	Science centre
Centro Ciência Viva do Alviela	Interactive Science Centre	17100	Geology	Alviela	Science centre
Centro Ciência Viva de Proença a Nova	Interactive Science Centre	15400	Environment	Proença a Nova	Science centre
Centro Ciência Viva de Bragança	Interactive Science Centre	11000	Energy and Environment	Bragança	Science centre
Centro Ciência Viva de Sintra	Interactive Science Centre	18800	S&T Human body	Sintra	Science centre
Planetário Calouste Gulbenkian Centro Ciência Viva	Interactive Science Centre	78700	Astronomy	Lisbon	Science centre
Centro Ciência Viva de Estremoz	Interactive Science Centre	33900	Geology	Estremoz	Science centre
Centro Ciência Viva de Tavira	Interactive Science Centre	2600	Water and Energy	Tavira	Science centre
Centro Ciência Viva de Porto Moniz	Interactive Science Centre	3900	S&T	Porto Moniz	Science centre
Fábrica de Ciência Viva	Interactive Science Centre	30800	S&T	Aveiro	Science centre
Centro Ciência Viva de Constância	Interactive Science Centre	14000	Astyronomy	Constância	Science centre
Centro Ciência Viva da	Interactive	12600	S&T	Amadora	Science cen-

Amadora	Science Centre				tre
Pavilhão do Conhecimento - Ciência Viva	Planetarium	240000	S&T	Lisbon	Science centre
Exploratório Infante D. Henrique	Interactive Science Centre	40500	S&T	Coimbra	Science centre
Centro de Ciência Viva do Algarve - Faro	Interactive Science Centre	10000	The Sun	Faro	Science centre
Planetário do Porto	Planetarium	30300	Astronomy	Oporto	Science centre
Centro Ciência Viva de Vila do Conde	Interactive Science Centre	17000	Water	Vila do Conde	Science centre
Visionarium	Planetarium	90000	S&T	Vila da Feira	Science centre
Museu de Ciência da Universidade de Lisboa	Science Museum	20000	History of Science	Lisbon	Science centre
Museu de Ciência da Universidade de Coimbra	Science Museum	14000	S&T and History of Science	Coimbra	Science Museum
Museu Nacional de História Natural	Science Museum	20000	Natural History	Lisbon	Natural History Museum
Centro Ciência Viva do Lousal	Interactive Science Centre	6500	Mining	Lousal	Science centre
Centro Ciência Viva Rómulo de Carvalho	Interactive Science Centre	2000	S&T	Coimbra	Science centre

4.4.7 Citizen- or Civil society organisations initiatives

Activity title (and web-link if possible)	**Activity type**	**Frequency**	**Number of partici-pants**	**Short description**
AstroFesta	Science fair	Yearly	1500	Annual open air party of astronomers, open to the public
Ciencia no Parlamento	cafe scientific	Yearly	50	Science shop, with the participation of scientists, members of the parliament and general public
Seeds of science	Science award	Yearly	350	Annual award metting

5 The Fukushima accident

5.1 Media coverage and public debate

In tune with the major international broadcasting networks, the Portuguese media coverage of the accidents at the Fukushima Daiichi power plant was intense, with an almost minute-by-minute follow-up of the evolution of the situation in each of the reactors.[2] This initial phase was characterized by a building up of the tension towards a disaster that was about to unfold right in the public eye. In this context, the center of attention was occupied primarily by the discussion of the technical aspects of both the meltdown and the efforts to tackle it, together with the estimates of the immediate consequences of the accident for the Japanese local communities and to the world at large. The initial media reaction was also extended to the political and economic background, but primarily focused on the local circumstances, such as the way the Japanese government and the Asian stock markets' were reacting to the disaster.

The media treatment of the risks for the Portuguese population was, at this stage, focused on the potential threats posed by the proximity of the Spanish nuclear facilities (one of them, the Almazar nuclear power plant, only 100 km distant from the Portuguese border), alongside the reporting of the detection of Fukushima isotopes at the ITN[3] station of Ponta Delgada (Azores). Moreover, as far as risks were concerned, the media echoed government warnings and guidelines in the face of eventual food contamination.

As the Fukushima reactors were set under control, the media turned their attention to the debate of the wider implications of the nuclear option. Like in many

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[2] For further reading on the subject please see:
- Rosenthal, Elisabeth (2008): 'Portugal Gives Itself a Clean-Energy Makeover'. The New York Times. 10. august 2010. Available at http://www.nytimes.com/2010/08/10/science/earth/10portugal.html?pagewanted=all.
- DGS (2011) Nota Informativa Acidente Nuclear de Fukushima Japão – Questoes de Saúde Pública. 16. march 2011. Available at http://www.dgs.pt.
- APA (2011) Nota sobre o ponto de situação no Japão e nas Centrais Nucleares. 12. April 2011. Available at http://www.apambiente.pt/Destaques/Documents/Centrais%20Jap%C3%A3o/Nota_APA11_Sismo_Jap%C3%A3o_12Abr2011Rev%20(2).pdf

[3] Instituto de Tecnologia Nuclear [Institute of Nuclear Technology], a Portuguese State Laboratory.

other European countries, the Fukushima crisis brought the nuclear debate back to the table. By then, the use of scientific expertise had already shifted to environmental and economical terms.

The incident has sparked a mild political and social debate in Portugal, one of the few countries in Europe that does not have a nuclear power station on its territory. Indeed, what was seen, at first, as an evidence of scientific and technological underdevelopment, became later a clear political statement. Particularly over the last decade, public policy has been consistently unambiguous about the refusal of the nuclear as an energy option. The government itself has publicly denied several times that the nuclear option would ever be in the political agenda. The government attitude has been in tune with the Portuguese public who is notably conservative in matters of energy, always favoring safety against eventual risks to local communities – the prevalent public stance is a “not-in-my-backyard” attitude, as demonstrated by the intense public reactions and strong local activism against the recent building of co-incineration stations throughout the country.

The Portuguese trends in matters of energy have been focused on intensive renewable energy programmes. The rational underpinning this option rests not only in the absence of fossil fuel in the Portuguese territory but also in its large resources of wind and river power – the relative success of these renewable policies has attracted international media attention (Rosenthal 2010). Within this context, the disaster at the Fukushima power plant reinforced notably the public debate and support of more risk-free, renewable and sustainable energy technologies.

5.2 Levels and modes of public involvement

As early mentioned, the public involvement in discussions at the aftermath of the Fukushima disaster was nearly inexistent. There were some science communication activities in this area, mainly promoted by universities (e.g., Instituto Superior Técnico, 25. May 2011) and environmental organizations, but the bulk of the public engagement in the debate was only noteworthy in the media, and mainly via blog commenting and letters to newspapers. The Portuguese debate has basically invited proponents and opponents to state their cases. Proponents have invoked a number of key arguments: (i) economic reasons, such as the end of cheap energy, the costs of fuel, and the ever shortening oil reserves; (ii) geopolitical (i.e., the growing dependence of unstable political realities in some of the top oil-producing countries); (iii) technological, such as new and safer light water reactors (III and III+ generation), and, finally, (IV) environmental issues, particularly those related to the fact that nuclear energy helps reducing CO2 emissions. Opponents, on the other end of the spectrum, focused on the safety risks involved; for them, although the consequences of the violent earthquake and subsequent tsunami in Japan did not match those of Chernobyl, the indisputable fact is that the partial destruction of the Fukushima Daiichi power plant shacked severely the arguments in favor of the growing safety levels in nuclear power plants. The yet unsolved issue of the nuclear waste (and storage) debate was also brought up and revived by the nuclear accident in Japan, providing opponents with a strong argument.

Back in 2008, Portugal was one of the European countries that were less supportive of nuclear energy (only 4 % was “totally in favor”) - the Eurobarometer survey showed that only 23 % of the Portuguese citizens were in favor of the production of nuclear energy, a value that is quite distant from the European average (44 %). However, unlike in many European countries, the consequences of Fukushima did fuel any kind of public demonstrations in Portugal.

5.3 Political responses and scientific advice

The political responses to the accident were as moderate as the ones expressed by the above mentioned public debate. Indeed, the Portuguese government used the opportunity to reinforce the public engagement in the strategy of renewal energy that has been carried over the past decade. The political intervention was one of protection of the citizens against eventual risks directly steamed by the Fukushima accident. The government was quick to adopt official guidelines, which were then disseminated by the Regional Health instances of central Administration: An informative note available at the website of the DGS (Direccao Geral de Saude 2011), related with the Fukushima nuclear accident states that the public health measures needed to ensure the exposure of the Portuguese citizens to increased levels of radiation. These measures were supported by scientific information, which was made available to the public, namely to justify the administration of potassium iodide pills, a thyroid protection in the case of nuclear accidents. Moreover, the Ministry of the Environment (APA 2011) kept a close monitoring of the situation, both in Japan and in Europe, issuing regular updates including information on environmental radiation monitoring, together with other relevant scientific information. The scientific advice was, in this case, provided by a State Research Laboratory - the Instituto Tecnologico e Nuclear, along with RADNET, a network of 13 radiation alert stations throughout the country, and experts from the Direccao Geral de Energia e Geologia. However, scientific advice from non governmental institutions was not publically noticeable.

In another political arena – the Portuguese Parliament –, the main opposition party (at the time of the accident) challenged the government demanding update information on the measures being taken to protect the citizens against the risks posed by the proximity of the Spanish nuclear power stations, particularly those closer to the border; but it did not led to any noticeable political debate.

In general, scientific advice has been extensively used in the support of public action and regulation in matters of energy policy, but not with a focus on the nuclear alternatives.