Annex 10 — Spain country case study

BLOSSOM: Support to analysis for long-term governance and institutional arrangements

European Environment Agency

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European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark
Tel.: +45 33 36 71 00
Fax: +45 33 36 71 99
Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

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This report was prepared by Collingwood Environmental Planning Ltd (CEP) and Milieu Ltd as part of a study commissioned by the EEA.

The main author of this report is **Juan Palerm** (CEP).

Project Leader: William Sheate (Collingwood Environmental Planning Ltd)

Project Coordinator: Tony Zamparutti (Milieu Ltd)

The EEA project manager was Axel Volkery.

The following Spanish experts and officials, among others, provided, guidance, reviewed drafts, contributed ideas gave their time for interviews.

- Mr Javier Sierra Andrés, former Head, sub-Directorate-General for Analysis, Foresight and Coordination, Ministry of Environment and Rural and Maritime Environment (short interview, 24 April 2009)
- Mr Ignacio Atance, Coordinator, UAP (Unit for Analysis and Foresight), sub-Directorate-General for Analysis, Foresight and Coordination, Ministry of Environment and Rural and Maritime Environment (interview, 26 May 2009);
- Mr José Miguel Fernández Güell, expert collaborator, OPTI (Observatory for Industrial Technological Foresight) (interview, 24 April 2009)

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The opinions and conclusions presented here are the sole responsibility of the consultants and do not necessarily reflect those of EEA.

Acronyms

ANEP	National Agency for Evaluation and Foresight (Agencia Nacional de Evaluación y Prospectiva)
BLOSSOM	**B**ridging **LO**ng-term **S**cenarios and **S**trategic analysis — **O**rganisation and **M**ethods
CAP	Common agricultural policy
CICYT	Inter-ministerial Commission for Science and Technology (Comisión Interministerial de Ciencia y Tecnología)
EEA	European Environment Agency
ENCYT	National Strategy for Science and Technology (Estrategia Nacional de Ciencia y Tecnología)
EU	European Union
MARM	Ministry of Environment and the Rural and Maritime Environment (Ministerio de Medio Ambiente y Medio Rural y Marino)
OECC	Spanish Office for Climate Change (Oficina Española de Cambio Climático)
OPTI	Observatory for Technological Industrial Foresight (Observatorio de Prospectiva Tecnológica Industrial)
OSE	Observatory for Sustainability in Spain (Observatorio de Sostenibilidad en España)
UAP	Unit for Analysis and Foresight (Unidad de Análisis y Prospectiva)

1 Introduction

1.1 Introduction

This report sets out the current status of the main institutional and governance arrangements for futures thinking in Spain with respect to environmental — and environment-related — policymaking. It is an update of the case study report completed under the previous Blossom project in October 2009 and is based on a review of changes in documentation and other available resources, and a set of interviews with officials and experts in relevant government departments, agencies and institutions. The aim has been to understand how futures thinking is undertaken in Spain, the relationships between different futures programmes, and how these relate to, and influence, environmental policymaking. The report particularly tries to identify the success factors in ensuring futures thinking is embedded in environmental policymaking; however, barriers to success are also identified. It does not seek to explore the whole range of futures work, only those aspects of most relevance to environmental policymaking, and is focused on the institutional and governance structures, not the details of the futures studies or the quality of those studies. Further detail can be found in the Appendices.

In 2009, the previous version of this report, along with similar reports for seven other EU Member States, formed the basis for further cross-country analysis during the summer of 2009 to identify common themes and issues in institutional and governance arrangements, as well as distinctive aspects of different cultural and administrative traditions and approaches to futures thinking. This updated report has been used to inform a revised cross-country analysis, which has also drawn upon new case studies in four additional countries: Germany, Hungary, Austria and Portugal.

This study presents the results of an attempt to synthesise and evaluate current practices: it is meant to shed light on important developments and stimulate discussion but it is not meant to be understood as a comprehensive and concluding assessment of futures-oriented studies or their impacts on decision-making.

2 The landscape for long-term thinking and governance in Spain

Although the concept of foresight in Spain has been around since the 1980s, futures studies are still not as widespread or as formally institutionalised as can be found in some northern European countries. There is no central foresight programme in Spain, although institutions that coordinate foresight studies exist at the sectoral level (namely for the sectors of technology and rural development).

The need for foresight studies was first identified for R&D and technology development in the early 1980s, leading to the creation of the National Agency for Evaluation and Foresight (ANEP). ANEP was specifically created to inform R&D policymaking and the need to coordinate activities in this field. The law that created the national R&D plan established, as one of the main criteria, science and technology objectives for the various areas and programmes, the 'identification of future technological developments'. However, no formal procedure to make such identification was established. The idea of promoting technology foresight arose during the drafting of the Law on Science (1986), but no framework was developed, except for the production of some sectoral reports. Finally, in 1987, ANEP was created as a support unit to the CICYT (Inter-Ministerial Commission for Science and Technology).

ANEP launched a Spanish foresight programme (in 1995), mainly to catch up with other European countries. Although ANEP was basically related to national R&D planning, evaluating project proposals, it also carried out foresight analyses of its own. ANEP is currently based under the Secretary of State for Universities, within the Ministry of Science and Innovation.

Foresight work advanced further in the line of technology. In 1997, the then Ministry of Industry and Energy created the Observatory for Technological Industrial Foresight (OPTI), responding to an identified need to generate a knowledge base and of technological trends relevant for policymaking at the policy and enterprise level. OPTI was later constituted as a foundation under the auspices of the Ministry of Industry, Tourism and Trade.

In terms of foresight for environmental policymaking, a need was identified to enable ongoing monitoring of the state of the environment through the application of sustainability indicators. In this context, the Observatory for Sustainability in Spain (OSE) was created on February 2005, which was the result of an agreement between the then Ministry of Environment, the General Foundation of the University of Alcalá and the Biodiversity Foundation. The activities of the OSE are not strictly foresight, based mainly on the monitoring of sustainable development indicators but, nevertheless, trends are often studied and recommendations for policymaking advanced.

Around the same time as the creation of the OSE, the then Ministry of Agriculture, Fisheries and Food created the Unit of Analysis and Foresight (UAP) in 2006. The sectoral (agriculture and rural development) authorities at the national level were finding themselves having an increasingly narrow role; they were losing competencies to Brussels (responsible for defining the common agricultural policy, CAP) and on the other hand to the Autonomous Communities of Spain (who are directly responsible for implementation of the CAP).

The activities of the ministry were reduced to carrying out general planning of economic activities in the sector. However, they found themselves in possession of key information for the sector as well as of technical personnel (more so than the Autonomous Communities, who focus on the management of resources), and thus in a position to generate analysis useful for policymaking. The role of the UAP centred on three main areas: analysis; foresight; and internal dissemination.

In 2008, the Ministry of Agriculture, Fisheries and Food was merged with the Ministry of Environment, forming the Ministry of Environment and the Rural and Maritime Environment (MARM). In spite of the (recent) merger, working agendas and procedures have not yet been integrated in the case of foresight activities. Monitoring of environmental sustainability remains under the OSE, which has renovated its agreement with the MARM, whereas the work of

the UAP remains centred on agriculture and rural development issues. The UAP now falls under the sub-Directorate-General of Analysis, Foresight and Coordination of the MARM. This has resulted in some confusion in the face of the public, as the generic name for the UAP does not address all areas of competence of the Ministry under which it falls.

Some follow-up and scenario analysis is also carried out for climate change by the Spanish Office for Climate Change (OECC, created in 2001), which is at the sub-Directorate-General level of the MARM. Its functions include to 'promote evaluations related to impacts, vulnerability and adaptation to climate change'.

Other public bodies have sections that may engage in foresight activities. Such is the case of the Public Service for State Employment (Servicio Público de Empleo Estatal), which has an Observatory of Occupations (Observatorio de las Ocupaciones). This observatory has recently completed (2010) a study 'Foresight of renewable energies in Spain', which assesses the current status of the renewable energy sector in Spain, which will be key to energy generation in Spain in the future, and in order to identify skills development and training required.

Other foresight studies are produced outside formally established foresight bodies. An example is the 'Energy 2030' foresight study, commissioned by the government to inform its energy policy. This study began in 2006, produced a first report, and should have been finalised by the end of 2008 (but was not). The study was extended beyond 2006 to incorporate new variables, especially the energy consumption expected from electric vehicles.

Other public bodies which have foresight as their main activity exist at the regional level (Autonomous Communities). These include the Mediterranean Institute (Institut de la Mediterrània, formerly the Institute of Mediterranean Studies) of the Government of Catalonia; the Catalan Centre for Foresight; the Andalucian Centre for Foresight (Centro Andaluz de Prospectiva); and the AUNA Foundation. There are also some private bodies that focus their activity on producing foresight studies, such as Prospektiker, Periscopi and the Institute of Strategic Foresight (Instituto de Prospectiva Estratégica).

Government in Spain is a constitutional monarchy. It has a central government, with a large degree of devolution of competencies to its 17 autonomous communities. The degree of devolution depends on the 'Statutes of Autonomy' negotiated between each region and the central government. The autonomous communities with the highest degree of devolution are Catalonia and the Basque Country.

In terms of environmental policy and legislation, the central government defines the policy and legal framework, as well as legislation applicable to circumstances where more than one autonomous community is concerned (e.g. Environment Impact Assessments (EIAs) for projects affecting two or more regions). Each autonomous community defines its own legislation in line with that at the central level. In practice, this means that often an environmental aspect is regulated by 18 different regulations in Spain (17 regional and one national).

Government in Spain is highly hierarchical and compartmentalised. Horizontal coordination mechanisms are weak, as well as those between the central and the regional levels, some autonomous communities sometimes looking directly to Brussels for their policy framework rather than to Madrid. Some cross-sectoral mechanisms that have been put in place (e.g. the network of environmental authorities) have proved weak and not long-standing.

Participative culture is generally weak in Spain, often attributed to its past under a relatively recent dictatorship. However, important advances have been made in issues such as transparency and public participation. For example, in terms of environment, the Aarhus Convention and Directive 2003/4/EC (Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information) have set the basis for the Spanish legislation on access to environmental information, public participation and access to justice in environmental matters (through Law 27/2006 of 18 July 2006). The information society and the media have contributed to bringing the administration closer to the attention of the public and, subsequently, to their scrutiny: organised civil society has also grown and gained ground in the last decade.

2.1 Responsibilities

ANEP, the National Agency for Evaluation and Foresight has the level of sub-Directorate-General, under the Directorate-General for Research and Management of the I+D+I ([1]) Plan of the Secretary of State for Research (Ministry of Science and

([1]) Research (Investigación), Development (Desarrollo) and Innovation (Innovación).

Innovation). Its remit includes undertaking foresight analyses and studies on scientific research and technological development. ANEP's functions are stated as follows:

- Objective and independent technical-scientific evaluation of the research units, teams and proposals to participate in the national plan's (for science and technology) programmes and projects, and the follow-up of results. Also, to evaluate technical-scientific proposals as requested by the Secretary of State for Universities.
- Foresight studies and analyses on scientific research and technological development.

In May 2005, ANEP created an Advisory Commission for Evaluation and Foresight, formed by relevant members of the scientific community, who advise ANEP management and the Secretary of State on decision-making and procedures. The Advisory Commission's functions include, inter alia, the development of strategic documents to undertake scientific-technological foresight.

ANEP's activity has centred predominantly on the technical-scientific evaluation of research proposals, with no evidence of any foresight work, according to a review of the publicly available reports, results and presentations produced to date by ANEP. When ANEP was created, the primary motivation was to ensure that scientific evaluation was a process independent of political decisions carried out by anonymous experts; foresight was (and remains) defined as a possible area of work for ANEP, but not as its primary aim ('contribute to undertake foresight studies and analyses in the area of scientific research and technological development, as requested'). A recent report by the Advisory Commission for Evaluation and Foresight, *Challenges and Opportunities in the immediate future for R&D and Innovation in Spain*, highlights the capacities available and potential to engage in other foresight work.

OPTI, the Observatory for Technological Industrial Foresight is a foundation under the auspices of the Ministry of Industry, Tourism and Trade. It is governed by a Board of Trustees consisting of a mix of public and private institutions. The chair is held by the ministry, currently represented by the Secretary-General for Industry.

The objective of OPTI is to 'generate a knowledge base on the technological trends more relevant for the future economic and social development, which could also be used as support for decision-making on technological issues, both in the public and entrepreneurial sectors'. Its main area of work are foresight studies which, as of 2000, is complemented with services on technological monitoring, design of strategies based on foresight and preparation of reports on the evolution of technology, based on a system of indicators.

Foresight studies carried out by OPTI include some touching on environmental issues, carried out under different bilateral institutional agreements and for different clients. These are summarised in Table 1.

The **UAP** is the Unit of Analysis and Foresight within the MARM: its main objective is to generate information, analyses and rigorous debates on agricultural, environmental, fisheries, food and rural development economy and policy, with a view to facilitating knowledge and decision-making in the MARM and society in general.

Outputs include a series of newsletters addressing policy-relevant aspects; for example, there is a newsletter on the environment (environment series) of which two issues have been produced, 'Climate change policy in the EU and Spain' and 'Carbon trading in the EU: evolution and the future'. In addition, seminars are organised to generate discussion on policy areas; two such seminars have been organised so far: 'Implications of climate change on the environment and the rural and maritime environment' (February 2009) and 'Biodiversity: a global focus' (December 2009).

In spite of its wide scope of work, the UAP focuses its activities on agriculture and rural development issues, as a continuation to its work under the former Ministry of Agriculture, Fisheries and Food.

Work done by the UAP normally responds to information and analysis needs identified by the UAP itself, or to requests from the MARM (approximately an equal number of requests from each). The UAP will sometimes produce analyses destined for other government institutions (outside the MARM), in order to support proposals and positions of the MARM. Although the UAP is not closed to receiving requests from outside the MARM, this has not yet occurred.

The **OSE**, the Observatory for Sustainability in Spain, is the result of an agreement between the Ministry of Environment, the General Foundation of the University of Alcalá and the Biodiversity Foundation. Its agenda and funding are provided by the MARM, but remains an independent body which also promotes a high level of participation

Table 1 Examples of foresight studies by OPTI

Foresight study	Year	Client
Technological and industrial opportunities for the development of the Spanish economy	2010	No client specified, carried out by OPTI
Mobility in the large cities	2010	No client specified, carried out by OPTI
Nutrigenomics, nutrition and health	2009	In collaboration with AINIA Centro Tecnológico
Foresight study on social behaviour towards sustainable development	2007	VALORA Consultores (private consultancy)
e-Health 2020	2006	Spanish Federation of Health Technology Enterprises (FENIN)
Hydrogen and fuel cells	2006	Carried out with CIEMAT and INASMET-TECNALIA (not clear who requested the study)
The future of fisheries technologies	2005	Carried out by CETMAR under OPTI coordination under the collaboration agreement with the Directorate-General for Research and Development of the Council of Innovation, Industry and Trade of the Xunta de Galicia
Maritime aquaculture	2005	Carried out by AINIA under the collaboration agreement with the Directorate-General for Research and Development of the Council of Innovation, Industry and Trade of the Xunta de Galicia
Technologies for the monitoring and control of the maritime environment	2005	Carried out by OPTI under the collaboration agreement with the Canary Institute of Marine Sciences
Impacts of biotechnology on the agriculture, livestock and forestry sectors	2005	Carried out by OPTI with the Genoma Foundation Spain
The future of biomaterials	2004	Carried out by OPTI and the Spanish Federation of Health Technology Enterprises, FENIN
Materials for transport and energy	2003	Carried out by OPTI with the INASMET Foundation
Industry and environment	2002	Request not clear

amongst the community of academics, scientists and experts. It consultative body is a scientific committee composed of researchers and prestigious experts from the different areas of sustainability, and includes the participation of economic and social agents.

The OSE's stated functions include:

- integrated follow-up of the sustainability of development;
- support to decision-making and public participation processes;
- development of knowledge capacities;
- information on sustainability processes;
- recording and dissemination of results of scientific research;
- production of annual reports on the sustainability in Spain, based on indicators;
- sectoral and thematic reports on different aspects related to sustainability ([2]);
- compilation of the most relevant information on sustainability;
- connect to the centres that produce data and information;
- support to sustainability programmes in Latin America;
- development of indicators, scenarios, models.

After the creation of the MARM in 2008, the OSE has remained the main institution carrying out monitoring of environment and sustainability indicators.

2.2 Resources, staffing involved

ANEP is divided into 26 thematic areas each led by an area coordinator, recognised scientific experts in the field and who work in research or technological development public or private institutions and are responsible for selecting evaluators.

([2]) Some of the titles produced include *Green employment in a sustainable economy,* 2010; *Study on the natural, cultural and landscape heritage,* 2009; *Local sustainability: an urban and rural approximation,* 2009; and *Water and sustainability: functionality of watersheds,* 2008.

Coordinators are supported by a coordination team (approximately 120 associate coordinators).

The permanent staff of ANEP include the director; director's secretary; five technical counsellors; head of management service; head of section on general affairs; administrative support; 12 area secretaries; two staff for the registry; three other support staff (e.g. telephone, reception).

OPTI works on the basis of a 'network of knowledge' using existing technological entities as complementary expertise. These entities include, for example, Ciemat (Centre for Energy, Environmental and Technological Research), AINIA (Research Association of the Agri-Foods Industry), Genoma Foundation Spain, Inasmet (Technological Centre for Materials), and the Chemical Institute of Sarrià. In case of need, OPTI can seek other external expertise; it has a collaboration agreement with CSIC (Superior Council of Scientific Research) to incorporate experts needed for specific studies. OPTI also offers its services to autonomous communities.

The **UAP**, the Analysis and Foresight Unit of the MARM retains the staff it had when it was under the Ministry of Agriculture, Fisheries and Food. Although now under the MARM, its staff is mainly composed of agronomists and veterinaries, with no immediate prospect of expanding the areas of in-house expertise.

The **OSE** has a staff of 15, as follows: executive director; administration (2); social area (2); economic area; environmental area (2); sustainability processes; territorial analysis and GIS (2); officer responsible for communication and liaison with the media; officer responsible for information systems; officer responsible for the urban and territorial sustainability platform; and one collaborator.

Furthermore, the OSE has a scientific committee composed of 14 members.

2.3 Stakeholders and external relationships

Foresight studies carried out in Spain are generally carried out with the support of external expertise, mainly from universities and research centres. However, in the UAP (MARM) in-house expertise is predominant.

Currently, there are no ongoing foresight programmes, but rather specific foresight studies.

Foresight work by ANEP is not evident, as it has centred its activities on the of R&D proposals. As far as the other bodies are concerned, OPTI and the OSE publish their foresight studies and other reports, which are publicly available on their corresponding websites. However, work done by the UAP is mainly produced internally and not made publicly available, with the exception of certain thematic publications.

OPTI relies on its 'network of knowledge', as described above, members of which also form part of the Foundation's board:

- Public institutions:
  - MITYC — Ministry of Industry, Tourism and Trade
  - CDTI — Centre for Industrial Technological Development
  - OEPM — Spanish Office for Patents and Brands (OEPM)
  - IDAE — Institute for Diversification and Energy Savings
  - CIEMAT — Centre for Energy, Environmental and Technological Research
  - CSIC — Superior Council for Scientific Research
  - Genoma Foundation Spain
  - EOI Foundation
  - FECYT — Spanish Foundation for Science and Technology.

- Private institutions:
  - AINIA — Research Association for the Agri-foods Industry
  - ASCAMM Foundation
  - INASMET — Technological Centre for Materials
  - INESCOP — Spanish Institute of Footwear
  - IQS — Chemical Institute of Sarrià.

Each of these institutions may get involved in foresight studies related to their area of knowledge. However, the activities of the network are guided by a common strategy, making use of the same methodologies and responding to a single coordinating body. In order to facilitate this, mechanisms have been put in place for a participatory management.

2.3.1 Parliamentary and external scrutiny

The UAP sometimes undergoes external evaluation of its studies, mainly through peer review of its reports, but there is no obligation to evaluate, nor a formal procedure on how to go about it.

OPTI foresight studies normally involve a large number of experts during their preparation, but post hoc external scrutiny does not take place.

Similarly, activities by the OSE, although subject to review by numerous experts, are not subject to external scrutiny on a systematic basis.

2.4 Relative balance between quantitative and qualitative approaches

Of the bodies that have as part of their remit to undertake foresight studies, it is really OPTI and the UAP that have engaged in this in a more systematic basis. ANEP has focused its activities on the evaluation of R&D proposals, whereas the OSE has a focus on monitoring of indicators.

Foresight studies undertaken by the UAP to date have been limited. Although few of the analyses — those which answer internal requests by other MARM units — are not publicly available, the foresight analyses follow a three-step approach: firstly, internal analysis, secondly external revision and, lastly, publication. The analyses carried out make use of a mixture of quantitative and qualitative methodologies.

It is the work carried out by OPTI which can best exemplify the trends in use of foresight methodologies, using a mix of both qualitative and quantitative methods.

Delphi surveys, a qualitative methodology based on the opinion of experts, is the main methodology that has been employed. The starting point is always the development of a series of hypotheses on the future by a panel of experts, which are then validated through a series of surveys.

Design of scenarios is used when different and antagonistic trends can be envisaged, each with the same level of uncertainty. For example, the 'foresight study on social behaviour towards sustainable development' employed this methodology. It consisted of four stages: (i) characterisation of the concept of sustainability and identification of key factors; (ii) analysis of the trends that affect sustainability; (iii) creation and development of scenarios of alternative futures that contemplate the possible evolution of the sustainability paradigm; and (iv) determination of the implications of the scenarios at local level. All stages of the process imply continuous participation and evaluation by experts.

- The first scenario was the so-called blue planet scenario, where there is a proactive and favourable response at the global level by the main social, economic and political actors and, at the same time, there are abundant technological, economic, human, institutional and natural resources to meet a sustainable development. This scenario exemplifies an environmentally aware society that participates in public decision-making.
- The second scenario, 'predatory development', takes place in a global context of abundant resources to meet sustainable development, but where the social, economic and political actors are reactive and not aligned to the criteria of sustainability. The 'predatory development' scenario shows a society with a low level of environmental awareness and a political, economic and scientific power that prevails over civil society.
- The third scenario, the 'start again' scenario, considers the situation where the planet suffers from significant scarcity of technological, economic, institutional and natural resources to meet sustainable development, whilst social behaviour is favourable towards adopting sustainability criteria. This scenario shows the failure of a model, leading to inconsistent attitudes justified by the crisis.
- Finally, the fourth scenario, 'social and environmental decline', produced in a global context of scarcity of resources and neglect by social, economic and political actors of sustainability criteria: this scenario shows a model of society radicalised between neoliberals and ecologists.

Critical technologies is another qualitative methodology that consists in identifying lists of critical technologies based on a joint reflection by a panel of sectoral experts, analysis of the possible evolution of these technologies.

This methodology was used in the 'hydrogen and fuel cells' study, whose objective was to identify the emerging technologies in the sector in order to define a foresight vision on their development. A panel of experts was chosen and they selected themes and technologies related to hydrogen and fuel cells, this was the basis for a consultation of relevant actors in the sector to determine which of these would be key in the 2030 horizon. The themes represented a series of hypotheses with reference to a technological development or specific technology based on a series of variables upon which a consultative panel is invited to reflect. Questionnaires were statistically analysed. The final

version of the questionnaire contained 44 themes as futures hypotheses structured under areas that ranged from production, storage and final use of hydrogen, as well as fuel cells and their use in transport, stationary and mobile applications, together with a section on safety, norms and legislation.

Road mapping is another qualitative methodology based on a vision. A panel of experts analyse the starting point and identify the technological actions and agents that can contribute to reach the vision.

Many of the foresight studies prepared by OPTI make use of defining a vision, futures hypotheses and questionnaires (often in the form of a Delphi survey). For example, a foresight study on nutrigenomics, nutrition and health in 2009 had as an objective, the identification and valuation of research trends and technological developments in the sector; it defines a strategic vision on the possibilities for development of these technologies and their impact at national level, identification of associated trends and technologies, identification of opportunities and new areas of activity, identification of actions. The methodology implied a literature review to establish the baseline and the use of a panel of experts who develop the vision, hypotheses and analysis of questionnaires.

Other tools employed by OPTI include SWOT analysis, in-depth interviews, statistical analysis of interviews, etc.

Nevertheless, analytical methodologies have become more sophisticated in the recent years. An overview of 'foresight' studies carried out in the 1980s (Sanz-Menéndez et al., 1998) identified the use of seminars and meetings as the sole 'methodologies' used. The 1990s saw a shift to more formalised methodologies, such as Delphi, scenarios, trends analyses and bibliometric studies.

Studies carried out by the OSE, although not considered foresight studies, do, to a certain extent, analyse trends in sustainability indicators, which are useful for policymaking. Depending of the indicators, these trends are described either qualitatively or quantitatively.

3 Analysis

3.1 Relationship between futures programme

There is no real relationship between futures programmes and/or studies, either formal or informal. The different institutions carrying out foresight studies follow independent objectives, set either by themselves (e.g. in the case of the UAP) or on request from their sponsors (in the case of the OSE, OPTI) or the institutions under which the fall (ANEP and the UAP). Other foresight studies have been carried out explicitly to inform policymaking, such as the foresight studies carried out to inform the National Strategy for Science and Technology (ENCYT) (2008) or the energy policy (in process). The ENCYT is a position document that compiles the main principles and objectives that are to determine the science and technology policies in the 2007–2015 horizon; the foresight study on the ENCYT was carried out to inform the sixth national plan for R&D and Innovation (I+D+i). It was triggered by the Secretary of State for Universities (Ministry of Science and Education) and carried out through the Spanish Foundation for Science and Technology (FECYT) with the assistance of ANEP and OPTI. Amongst the areas of R&D covered by the ENCYT is the area of 'natural resources and the environment'; the foresight study proposes specific areas for R&D.

3.2 Impact on environmental policymaking

Impact of foresight studies on policymaking in general is very difficult to ascertain as no studies or evaluations have been carried out to measure it. Foresight studies which have been commissioned specifically to provide an input to policymaking (e.g. the foresight study for the National Strategy for Science and Technology, which, in turn, is meant to influence science and technology policymaking; the foresight study meant to influence the national energy policy) will show a more direct influence on policymaking, as opposed to foresight studies which are not specifically linked to policy proposals.

In terms of environmental policymaking in particular, this is narrowed down to the influence of the activities carried out by the UAP and the OSE. According to an interview with the head of the UAP, foresight studies carried out by them may be having only a limited impact on environmental policymaking, although the degree of influence is difficult to ascertain. Impact on policymaking would require in-depth case studies of a specific policy.

The above, together with the lack of systematic evaluation of impact of foresight into policymaking, is a further indication that foresight in Spain has not developed deep enough roots as a basis for public policymaking. Foresight in Spain is still limited to the generation of information which is deemed useful for analysis and decision-making, but not more.

High-level political interest on foresight has been absent; government or quasi-government bodies that have a remit on foresight also address other areas of work, and foresight has been put at the bottom of priorities (e.g. in the UAP, ANEP). Maybe the only exception is OPTI, which grew into a foresight-dedicated organisation. Nevertheless, the usefulness of foresight for policymaking is acknowledged and seems to be starting to be better accepted in the current context of increasing demands on the government for accountability and transparency. Development in foresight in other European countries is also a driving force behind the government's efforts to build on it to influence policymaking. Positive examples are already developing, especially in R&D (which pioneered foresight in Spain) as shown by the study on the ENCYT. In other areas, such as the environment, a larger role for foresight is envisaged, but is yet to materialise.

Currently, public scrutiny of foresight projects is very limited, mainly because the links to policymaking are not evident. At the moment, there is a clear link between foresight and policymaking, rigorous public scrutiny (including parliamentary) will follow. This can already be seen through the 'Energy 2030' foresight study, commissioned by the

government with the explicit aim of informing the government's energy policy, and which has been subject to close scrutiny. In this particular case, the energy foresight study has been much politicised, allegedly because some of its preliminary findings did not support stated government policy (e.g. on nuclear power), and thus release of results remain delayed.

To reach a better coordination of foresight studies, and better address aspects of a cross-cutting nature (such as the environment), improvements will have to be made to enhance cross-sectoral coordination, which is currently absent.

4 Conclusions

4.1 Success factors

Foresight in Spain is relatively recent but slowly gaining recognition as a tool to inform policymaking. We cannot really yet talk of foresight as a successful tool for policymaking, and certainly not when referring to environmental policymaking. Everything indicates that, although advancing in the right direction, impact on policymaking is very limited.

However, in the context of the youth of foresight in Spain and the limitations it faces, some factors have shown to be successful and could be reproduced in future efforts.

- Publicly available foresight studies are used by a wide range of stakeholders, such as those produced by OPTI, and other ad hoc studies produced, for example, by ANEP.
- As a hypothesis for Spain, well-publicised foresight studies, whose purpose is explicitly to influence policymaking, will invite further controversy and debate, which is useful to secure the involvement of a wider range of stakeholders and legitimise policies. More controversial foresight results will also force policymakers to ensure transparency in the motivation of the policies they promote. This point would merit in-depth study to validate, but seems to be initially supported by the debate around the ongoing study aimed at influencing the energy policy.
- Flexibility in involving a wide range of experts, as needed, has been key to success.
- The use of more rigorous and explicit methodologies, as employed by OPTI, has been important to ensure transparency and objectivity. Transparency by the UAP is still lacking, but efforts are being made to enhance it.

4.2 Barriers to success

As noted above, although slowly gaining ground, foresight in Spain is far from being a formal tool influencing policymaking, especially environmental policymaking. There are barriers to success, some of which follow.

- Foresight has not been institutionalised as a tool for policymaking.
- Restructuring of the government means that agriculture and fisheries have merged under a single ministry (MARM), but the working structures remain unaltered. Work carried out by the UAP does not address foresight for environment.
- Foresight undertaken by the UAP to date is mainly focused on addressing internal requests, with little availability to the public. Foresight by the UAP is only one of three lines of work, and has received the lowest priority. The foresight work carried out so far is still considered preliminary and pilot; once methodologies are calibrated and evaluated, foresight work is expected to be made as transparent as that of the analysis area. This should imply making reports publicly available and publication of foresight methodologies and procedures.
- Foresight is generally not seen as an ongoing effort, and is generally limited to specific projects, rather than ongoing programmes.
- There is very little cross-sector interaction, which is a serious limitation for the prospects of environmental foresight, environment being inherently of a cross-cutting nature. Formal mechanisms to secure cross-sector communication would need to be developed in the context of environmental foresight.

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Appendix 1
Approaches to futures studies

Country: Spain		
Title of futures programme(s):		Foresight and Analysis Unit, UAP (Unidad de Análisis y Prospectiva) of the Ministry of Environment and the Rural and Maritime Environment (MARM) Observatory of Sustainability in Spain, OSE (Observatorio de la Sostenibilidad en España) Technological foresight programme (1998–2001) Observatory for Industrial Technological Foresight (Observatorio de Prospectiva Tecnológica Industrial) National Agency of Evaluation and Foresight, ANEP (Agencia Nacional de Evaluación y Prospectiva) NB: There are no foresight programmes currently in Spain, but rather foresight studies.
	Date programme(s) introduced	Foresight projects are more common than ongoing programmes, and various projects have taken place, especially in R&D and technology areas. Such projects have been carried out since the mid 1980s. OPTI began its activities with the technological foresight programme 1998–2001. Sectoral foresight studies carried out by OPTI include: • Foresight study on social behaviour towards sustainable development (2007) • e-Health 2020 (2007) • Hydrogen and fuel cells (2006) • The future of fisheries technologies (2005) • Maritime aquaculture (2005) • Technologies for the monitoring and control of the maritime environment (2005) • Impacts of biotechnology on the agriculture, livestock and forestry sectors (2005) • The future of biomaterials (2004) • Materials for transport and energy (2003) • Industry and environment (2002). In terms of the environment, the Analysis and Foresight Unit of the MARM (UAP), produces 'analysis and foresight' reports in the following areas: agriculture (AgrInfo, since 2006); Environment (since 2009); Maritime environment (since 2008); and on indicators (since 2007). They also carry out other foresight studies and analyses which are not placed in the public domain, especially on agriculture and rural development. The Observatory for Sustainability in Spain (OSE) began in 2005 as a result of an agreement between the then Ministry of Environment, the General Foundation of the University of Alcalá and the Biodiversity Foundation. It produces annual reports on sustainability in Spain; specific, thematic or sectoral studies; development of the Espon programme, acting as a focal point for Spain; organisation of permanent sustainability forums to generate public debate; development of a network of observatories; and development of thematic communication platforms.

Country: Spain		
		Publications produced by the OSE include: • *Annual Sustainability in Spain* reports (so far for 2005, 2006, 2007, 2008, 2009) • *Green employment in a sustainable economy* (2010) • *Study on the natural, cultural and landscape heritage* (2009) • *Local sustainability: an urban and rural approximation* (2009) • *Water and sustainability: functionality of watersheds* (2008) • *Air quality in the cities — key for urban sustainability* (2007) • *Land-use changes in Spain: implications for sustainability* (2006).
1. Overall governance culture of country	***Description***	Spain has a pseudo-federal system of government. It has a central government, with a large degree of devolution of competencies to its 17 autonomous communities (ACs). The degree of devolution depends on the 'Statutes of Autonomy' negotiated between each region and the central government. The autonomous communities with the highest degree of devolution are Catalonia and the Basque Country. In terms of environmental policy and legislation, the central government defines the policy and legal framework, as well as legislation applicable to circumstances where more than one autonomous community is concerned (e.g. Environmental Impact Assessments (EIAs) for projects affecting two or more regions). Each autonomous community defines its own legislation in line with that at the central level. Government in Spain is highly hierarchical and compartmentalised. Horizontal coordination mechanisms tend to be rather weak, as well as those between the central and the regional levels. Some cross-sectoral mechanisms that have been put in place (e.g. the network of environmental authorities) have proved weak and not long-standing. Participative culture is generally weak in Spain, often attributed to its past under a relatively recent dictatorship. However, important advances have been made in issues such as transparency and public participation.
2. Institutional/ organisational structures of futures thinking	***Nature of futures organisation(s)***	Foresight in Spain is relatively recent and still not as widespread or formally institutionalised as can be found in some northern European countries. There is no central foresight programme in Spain, although institutions that coordinate foresight programmes exist at the sectoral level. The organisations described below are permanent, although foresight programmes may not always be ongoing. In the case of the environment, there is the Analysis and Foresight Unit (Unidad de Análisis y Prospectiva) within the Ministry of Environment and the Rural and Maritime Environment (MARM), which is meant to coordinate foresight studies in the environment to inform environmental policymaking. This unit falls under the sub-Directorate-General of Analysis, Foresight and Coordination of the MARM. The UAP was established in July 2006, under the Ministry of Agriculture, Fisheries and Food. In March 2008, the Ministry of Agriculture, Fisheries and Food merged with the Ministry of Environment, creating the MARM. Under the former Ministry of Environment, analysis and foresight work was commissioned to the Observatory for Sustainability in Spain (OSE), based in the University of Alcalá. With the merger of both ministries, the OSE continues to work under the former arrangements as an observatory for sustainability in Spain, whilst the UAP focuses its activities on agriculture and rural development issues. Thus, there is potential confusion in the role of the UAP which, although nominally addressing all areas of competence of the MARM, in practice, does not. The OSE reports mainly on the state of sustainability in Spain, based on a series of indicators, which may not be considered foresight studies in strict terms. However, it often provides an insight into trends (for the indicators analysed) and recommendations for policymaking. As for scientific research and technological development, foresight programmes, these are coordinated by the National Evaluation and Foresight Agency (ANEP — Agencia Nacional de Evaluación y Prospectiva), under the Secretary of State of Universities, within the Ministry of Science and Innovation.

Country: Spain		
		In terms of technological foresight for industry, the then Ministry of Industry and Energy created, in 1997, the Observatory of Technological Industrial Foresight (OPTI — Observatorio de Prospectiva Tecnológica Industrial), later constituted as a foundation under the auspices of the Ministry of Industry, Tourism and Trade. Other foresight studies are carried out outside formally established foresight bodies. An example is the 'Energy 2030' foresight study, commissioned by the government to inform its energy policy. This study began in 2006, produced a first report, and should have been finalised by the end of 2008 (but was not). The study was extended beyond 2006 to incorporate new variables, especially the energy consumption expected from electric vehicles.
	Resources	OPTI, a not-for-profit foundation, obtains its economic resources directly from its clients. Its expertise is obtained through its 'network of knowledge', which includes public and private entities, as well as from external expertise (e.g. through cooperation agreement with CSIC) as needs arise. ANEP has a budget from the Ministry of Science and Innovation, which has caused some confusion in public perception as it functions as part of the administration. The UAP and the OSE are funded by the MARM (the UAP as part of the government structures, and the OSE through agreements with the government). The UAP has its own expertise, on which it normally relies (mainly experts in agronomy and rural development); however, sometimes it hires external expertise to undertake some of its studies when capacities are not available in-house. In terms of modelling, the UAP is still in the process of developing its own model for agriculture and rural development; in the meantime it makes use of external expertise from a modelling group formed by representatives of different organisations, especially academics. Application of models done by this group is financed by research funds. As for the MARM, external expertise if used for its foresight and analysis work on the environment, through the OSE.
	Responsibility	**OPTI** is a foundation under the auspices of the Ministry of Industry, Tourism and Trade. It is governed by a Board of Trustees consisting of a mix of public and private institutions. The chair is held by the ministry, currently represented by the Secretary-General for Industry. OPTI works on the basis of a 'network of knowledge', using existing technological entities with complementary expertise. These entities include, for example Ciemat (Centre for Energy, Environmental and Technological Research), AINIA (Research Association of the Agro-alimentary Industry), Genoma Foundation Spain, Inasmet (Technological Centre for Materials), and the Chemical Institute of Sarrià. In case of need, OPTI can seek other external expertise; it has a collaboration agreement with CSIC (Superior Council of Scientific Research) to incorporate experts needed for specific studies. OPTI also offers its services to autonomous communities. **ANEP**, the National Agency for Evaluation and Foresight is a unit under the Secretary of State for Universities, of the Ministry of Science and Innovation. Its functions include undertaking foresight analyses and studies on scientific research and technological development. The **UAP** is the Unity of Analysis and Foresight of the MARM. Its main objective is to generate information, analyses and rigorous debates on agricultural, environmental, fisheries, food and rural development economy and policy, with a view to facilitate knowledge and decision-making in the MARM and society in general. In spite of its wide scope of work, it focuses its activities on agriculture and rural development issues, as a continuation to its work under the former Ministry of Agriculture, Fisheries and Food.

Country: Spain		
		The UAP sometimes undergoes external evaluation of its studies, mainly through peer review of its reports, but there is no obligation to evaluate, nor a formal procedure on how to go about it. Work carried out by the UAP normally responds to information and analysis needs identified by the UAP itself, or to requests from the MARM (approximately an equal number of requests from each). The UAP sometimes produces analyses destined for other government institutions (outside the MARM), in order to support proposals and positions of the MARM. Although the UAP is not closed to receiving requests from outside the MARM, this has not yet occurred. The **OSE**, the Observatory for Sustainability in Spain, is the result of an agreement between the Ministry of Environment, the General Foundation of the University of Alcalá and the Biodiversity Foundation. Its agenda and funding are provided by the MARM, but it remains an independent body which also promotes a high level of participation amongst the community of academics, scientists and experts. It consultative body is a scientific committee composed of researchers and prestigious experts from the different areas of sustainability, and includes the participation of economic and social agents. After the creation of the MARM in 2008, the OSE was retained as the main institution carrying out analysis and foresight on environmental matters (although prioritising monitoring of key indicators rather than foresight).
	Perceived institutional need	Institutional needs have been identified at different moments in time. The first area where foresight studies were identified as necessary was R&D and technology development. This gave rise to the creation of ANEP in 1986. The context was the policy to develop R&D and the need to coordinate activities in this field. The law that created the National R&D Plan established as one the main criteria to define science and technology objectives for the various areas and programmes, the 'identification of future technological developments'. However, no formal procedure to make such identification was established. The idea of promoting technology foresight arose during the drafting of the Law on Science (1986), but no framework was developed, except for the production of some sectoral reports. Finally, in 1987, ANEP was created as a support unit to the CICYT (Inter-Ministerial Commission for Science and Technology). ANEP launched a Spanish foresight programme (in 1995), mainly to catch up with other European countries. Although ANEP was basically related to national R&D planning, evaluating project proposals, it also carried out foresight analyses of its own. OPTI was created under the initiative of the then Ministry of Industry and Energy, responding to the identified need to generate a knowledge base and of technological trends relevant for policymaking at the policy and enterprise level. The UAP was created initially under the Ministry of Agriculture, Fisheries and Food (2006). The Ministry was then facing a narrowing-down of its competence. On the one hand, it was losing some areas of competence to Brussels (through the common agriculture policy (CAP)) and on the other to the Autonomous Communities (who are directly responsible for the implementation of the CAP). The activities of the ministry were reduced to a general planning of economic activities in the sector. However, they are in possession of key information and technical personnel (more so than the Autonomous Communities, who focus on the management of resources) and, thus, in a position to generate analysis useful for policymaking. Their activities include analysis, foresight, and internal dissemination. The OSE was created in February 2005 as a response to an identified need to objectively evaluate, in an integrated manner, the sustainable development processes through an independent body and based on indicators. Its activities are not strictly foresight, based mainly on the monitoring of sustainable development indicators but, nevertheless, trends are often studied and recommendations for policymaking advanced.

Country: Spain		
		During 2009, it will work on the framework of three specific agreements between the General Foundation of the University of Alcalá with the Secretary of State for the Rural Environment and Water, with the Secretary of State for Climate Change and with the Biodiversity Foundation.
3. Institutional structure for environmental policymaking	***Relevant government departments, minister, agencies, etc.***	Environmental policy is a competence of the Ministry of Environment and the Rural and Maritime Environment (MARM). The MARM is responsible for proposing and implementing the government's policy on climate change, protection of the environment, biodiversity and the sea, water, rural development, agricultural and fisheries resources, and food. The following are under the direction of the minister: • Secretary of State for Climate Change • Secretary of State for the Rural Environment and Water • Secretariat General for the Sea. The Assessment Council for the Environment (CAMA — Consejo Asesor para el Medio Ambiente), which allows an involvement of social and economic actors in discussing environmental policies, is under the MARM. The CAMA was created in 1994 but has not been functioning continuously; the Council was reconvened in 2004 after it had stopped operations during the previous government.
4.Foresight/ scenario culture traditions	***Description***	According to the Hofstede classification, Spain has a Francophile culture. It is generally distinguished by a high power distance, high individualism, a top-down approach to business. Structures in Spain are highly hierarchical and bureaucratic; decision-making processes are very centralised and there is little flexibility. Furthermore, there is little communication across hierarchical levels.
	Approach to futures thinking	In Spain, foresight activity started mainly in the area of R&D, as a perceived need to guide priorities. More recently, foresight has started to expand to other areas (e.g. environment, social behaviour), but still with a dominant focus on technology development, innovation and R&D. In this sense, foresight initiatives are mainly of an exploratory type; trying to envisage trends, and future scenarios and developments in order to adapt today's policies, rather than visioning a desired future and defining policy with the aim to create the conditions that will lead to achieve the vision.
	Thematic or issue	Most foresight activities in Spain are thematic and sectoral, with little cross-sector work.
5. Summary of programme(s) as a whole, including within agencies		Foresight studies in Spain are a relatively recent thing. They initiated in the 1980s in the area of R&D and technology. Foresight programmes are rare and experiences are mainly one-off foresight studies, commissioned by either government institutions or private sector to generate information deemed necessary for planning and policymaking. Concerning the environment, however, experiences are even more limited. Most of the work carried out is oriented to the monitoring of key environmental indicators, mainly through the Observatory for Sustainability in Spain (OSE), which often includes trends analysis, but does not produce futures studies based either on visioning or scenario analysis. Although the term 'foresight' has entered the environmental institutions (there is the Unit for Foresight and Analysis within the MARM), again its work is mainly on analysing state of key indicators and trends; furthermore, work within the UAP is currently limited to agriculture and rural development rather than the wider environment dimension (i.e. staff and agenda still respond to the needs of the ministry under which the UAP was originally created — the Ministry of Agriculture, Fisheries and Food). Foresight studies carried out by the UAP and the OSE are based on information needs identified by the institutions themselves (in the case of the UAP) or the MARM. There is still little or no cross-sectoral coordination. In practice, this means that environmental integration is still weak in this regards; futures studies are not yet structured so as to influence policymaking in other sectors.

Country: Spain		
		Although some evaluation of work takes place, this is not done on a systematic basis nor are the results published. Impact of foresight studies (and analyses) on environmental policymaking is very difficult to measure and, in any case, would require in-depth case studies following in detail a policymaking process and making use of research techniques such as discourse analysis to try to ascertain degree of influence and changes in behaviour of key actors and institutions. Outputs of bodies such as the UAP, the OSE and OPTI are mainly publications on the state of the environment (or other elements) and trends used to inform the baseline needed for policymaking, and not really to explore scenarios and/or visions and inform policymakers on the necessary policy elements to achieve a desired vision or to best respond to likely scenarios. Foresight work carried out by OPTI is more advanced in a methodological sense, working often on the basis of scenarios. OPTI clients are very varied, including private companies and the different levels of the public sector. However, OPTI work focuses on technology issues, although it may touch on certain environmental aspects (e.g. such as the study on social behaviour towards sustainability in Spain). Influence on policymaking is deemed to be low to very-low, although again this is difficult to ascertain without detailed case studies of specific policymaking processes.
	Actors	Of the above institutions, ANEP and the UAP are units under government institutions. Sometimes they may rely on external expertise, but their work is mainly for internal consumption within their own sectoral public institutions. Nevertheless, some outputs are placed in the public domain (e.g. analysis notes by the UAP), but the majority of outputs remain for internal use exclusively. The working agenda of the UAP is defined by a mixture of the analysis and foresight needs they identify themselves as well as requests from the MARM itself. However, the possibility of carrying out analyses and foresight for other public institutions is not closed, but has not yet occurred. The working agenda of the OSE is defined also by the MARM based on agreements. Their reports, which include the state of sustainability in Spain reports and other thematic reports, are placed in the public domain. Dissemination of work is also done through internal or open channels — both by the UAP and the OSE — with the aim to generate public debate. In most cases of analyses and foresight studies, external expertise is used, especially universities. This is less so in the case of the UAP which has more in-house expertise. OPTI, a foundation, responds to requests from various clients (mainly public) to undertake foresight studies. Their reports are also in the public domain through its website.

Appendix 2
Examples of futures studies

Country: Spain				
Futures programme(s): OPTI (Observatory for Industrial Technological Foresight) NB: Not a futures programme, but OPTI launches foresight studies, some addressing environmental variables and this case study focuses on the first study (foresight behaviour towards sustainable development).				
1. Description/ characteristics of future study	***Examples of specific studies***	Foresight Study on Social Behaviour towards Sustainable Development (2007)	e-Health 2020 (2007)	Hydrogen and Fuel Cells (2006)
	Exploratory/ normative?	Alternative futures	Alternative futures	Alternative futures
	Qualitative/ quantitative?	Qualitative	Statistical analysis of responses to questionnaire prepared by panel of experts	Statistical analysis of responses to questionnaire prepared by panel of experts
	Thematic focus?	Socio-economic	Health	Energy
	Specific issue focus?	Sustainable Development	Information and Communication Technologies in Health	Fuel cells
	Spatial/ temporal scale	20 years	15 years	24 years
	Ad hoc/ongoing established futures process?	Ad hoc	Ad hoc (in context of partnership with the Spanish Federation of Medical Technology Enterprises — FENIN)	Ad hoc
	Sector/cross-sector based?	Cross-sector	Sector-based	Sector-based
	Science based/ multiple stakeholders?	Multiple stakeholders	Multiple stakeholders	Multiple stakeholders

Country: Spain		
2. Original purpose and application	***For what purpose?***	The foresight study on social behaviour towards sustainable development has the following objectives: 1. identify and assess the trends that have an influence on the evolution of the sustainability paradigm in a 15–20 year horizon; 2. design scenarios of alternative futures that take into account the possible evolution of the sustainability paradigm; 3. determine the implications that such scenarios will have in the social behaviour of citizens; 4. detect new areas of opportunity for production and services linked with the concept of sustainability. The overall objective of the study is to be used by public entities and private enterprises to motivate a social behaviour which is more respectful with the sustainability of natural resources and the physical environment in general.
	Requested by a specific entity?	This study was promoted jointly by OPTI and VALORA Consultores, a consulting company. It was funded entirely by VALORA Consultores.
	How used? And by whom?	In spite of the fact that the report is in the public domain, it is uncertain how the study has been used in practice for policymaking. It seems the case that the study was proposed and paid by a consulting company in order to help them in their planning processes for their activities, as well as to raise their profile by issuing a study in a relevant business area and with the stamp of a recognised quasi-government institution (OPTI). Since it was not commissioned by a public body, it is unlikely to have entered swiftly any policymaking process (this study was not part of the Ministry of Industry's agenda), although it would necessarily become important background information available for policymaking.
3. Outcomes (immediate and long term)	***Where and how used in policy (if at all)***	This cannot be determined yet, and would require a detailed case study following specific policymaking processes. In any case, due to the recent completion of the study, a relevant case study to measure degree of influence could only be carried out after allowing a reasonable period of time where influence can be identified.
4. Evaluation	***Any formal evaluation of effectiveness or updates***	No formal evaluation process has been undertaken of the study.
	Success factors/drivers	The study was prepared by OPTI and the results disseminated. Uptake of results or debate generated is not yet evident. No success factors can therefore be identified. However, if in the near future it can be shown that this study has influenced policymaking, it would be a very interesting example of how private initiative can influence policymaking by generating debate through futures studies carried out in a context of objectivity and scientific rigour.
	Barriers to success	A key barrier to success is the lack of more formal mechanisms for linking the results of the study to policymaking. This is difficult in this particular case as, although carried out by OPTI, the study was commissioned by a private company and not part of the government's agenda. This particular case is of interest due to the subject of study — the social dimension of sustainability — which had not been addressed before. The study is fully relevant to policymaking, not only environmental but also social, and would merit a more detailed follow-up.
5. References	Fundación OPTI and VALORA Consultores (2007) *Estudio de Prospectiva sobre el Comporatamiento Social ante el Desarrollo Sostenible* (http://www.opti.org). Sanz-Menendez, Luis, Cabello, Cecilia, and Antón, Fina, *Technology Foresight in its science and technology policy context in Spain*, CSIC Institute for Advanced Social Studies, Madrid, working paper 98-08. Böhle, Knud, 2003, Review and Analysis of National Foresight Case Study, Spain — Technological Foresight Programme (OPTI).	

e-Health 2020 foresight study

The e-Health 2020 foresight study was carried out by OPTI in collaboration with the Spanish Federation of Health Technology Enterprises (FENIN), and addresses the role of Information and Communication Technologies (ICTs) in the health sector. The study sought to:

- identify the trends in the implementation if ICTs in the health sector over a 15 year horizon;
- identify the needs for innovation and associated critical technologies;
- analyse the impact of applying ICTs in the health sector;
- identify frameworks and future strategies, in relation both to their impact on health as well as on business development;
- offer a consultation tool valid for decision-making associated to R&D policy;
- provide support to business planning in the sector.

The methodology included the following.

- Literature review, to establish the baseline.
- A panel of experts, composed of recognised experts in the sector. The role of the panel was to lead and validate the study, and its functions included the proposal of themes to address in the survey, compiling the list of consultees and analysing the results of the survey. The 16 experts on the panel come from industry, research centres, universities and hospitals.
- A questionnaire, which covered the 37 futures hypotheses identified by the panel, which were crossed in a matrix with a list of variables on which opinion was sought. The questionnaire was distributed to 167 experts, covering a wide range of areas, including researchers, manufacturers and end-users.
- Statistical analysis of the survey.
- Conclusions and drafting of final report.

Findings of the study include:

- e-Health will be the most important revolution in the health sector since the advent of modern medicine;
- e-Health will lead to a health model for and by citizens that are increasingly informed, who demand new and more advanced technology applications, accelerating their implementation in Spain;
- health centres will compete with each other to attract patients, leading to further specialisation: in the short term, this system will lead to the online collaboration amongst health centres;
- the pharmaceutical industry will develop 'ad hoc' drugs adapted to the type of illness and the genetic profile of the patient;
- virtual health centres will be created, where services requested by the patient will be analysed, managed and distributed;
- the use of radio-controlled ID tags will be common on patients with dependencies and chronic illnesses; these can also be used to identify their location, through wireless transmission of data such as their vital constants, etc., such that almost immediate assistance can be provided in case of risk situations;
- non-invasive biosensors will be developed, implanted in the body and capable of detecting, analysing and transmitting real-time information on the state of the health of a person; furthermore, in time, implantation in clothing will be common for patients with dependencies;
- the use of new 3D technologies will allow diagnosis and distance medical or chirurgical treatment;
- risk patients will carry alert systems capable of being activated automatically, and mobile sanitary equipment in critical situations;
- the use of electronic prescriptions will be common, in the future right up to delivery of the drugs to the patient;
- all clinical records will be electronic and accessible by the whole of the health system;
- the use of intelligent cards will be common, containing the electronic clinical history of the patient, or the information most relevant to him/herself.

Hydrogen and fuel cells foresight study

This foresight study on hydrogen and fuel cells took place through the participation of CIEMAT and INASMET-TECNALIA, who were responsible for managing and carrying it out.

The objectives of this study were to identify the emerging technologies in the hydrogen and fuel cells sectors in order to define a realistic and shared foresight vision on the development of these technologies in the Spanish context. The idea was to identify their feasibility according to the potential interest for their development taking into account the current context, and identify the R&D and innovation needs that could define possible areas of work and act as an information baseline for decision-making.

A panel of experts was formed with the purpose of selecting themes related to hydrogen and fuel cells. An initial literature review was initially carried out based on the results of the most recent studies related to the themes in order to gather initial information on the current state and the main R&D programmes in other countries. The panel selected a group of themes and technologies as a baseline to consult with actors in the sector, in order to determine the key technologies in the 2030 horizon. The themes represented a series of hypotheses, referred to technological developments or a specific technology, on which the consultative panel was invited to reflect upon. Each of these themes was analysed according to a series of variables in order to assess the different aspects of their possible development scenarios.

Finally, the panel of experts convened a second meeting to analyse and synthesise the quantitative results obtained from the survey, integrating their opinions and comments. The final version of the questionnaire contained 44 themes as futures hypotheses, structured under different areas covering production, storage and final use of hydrogen and fuel cells, and their use in transport, stationary and mobile applications, together with a section on safety, norms and legislation.

Some of the findings of the study include:

- in the future, hydrogen may substitute current fuels, and fuel cells will substitute combustion motors;
- by 2020, it is expected that, in Europe, there will be around nine million vehicles fuelled by hydrogen, corresponding to approximately 5 % of all vehicles: for this to happen by this date, the EU will need at least 5 000–10 000 hydrogen service stations; Spain would need 500–1 000 stations;
- hydrogen fuel cells will be used in the future to provide energy to mobile electronic devices such as computers and mobile phones, as well as in stationary applications.

European Environment Agency

Annex 10 — Spain country case study
BLOSSOM: Support to analysis for long-term governance and institutional arrangements

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European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark

Tel.: +45 33 36 71 00
Fax: +45 33 36 71 99

Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

Publications Office
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European Environment Agency