

DRAWING UP A NATIONAL CLIMATE CHANGE ADAPTATION POLICY: FEEDBACK FROM FIVE EUROPEAN CASE STUDIES

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The United Nations Framework Convention on Climate Change (UNFCCC) introduced the adaptation issue at the international level as far back as 1992. At that time, it was specified that the aims of such policies were to minimise the impacts of climate change on countries' economies and public health systems, and on the quality of their environment. However, in terms of practical measures taken by Governments, which have so far mainly focused on the mitigation side, adaptation was considered until recently as a secondary issue among climate policy priorities, and one that was more related to developing countries.

Since the turn of the century, and more specifically since 2005, adaptation has been attracting increasing interest from political decision-makers in developed countries, which are already seeing the first effects of climate change (severe droughts, flooding, etc.). Prompted by public opinion in their countries, and warned by scientists about the increasing magnitude of these events, decision-makers are beginning to draw up and implement adaptation policies and measures at all government levels, from local to international.

Adapting to climate change raises a large number of research, assessment, governance and implementation issues, often differing from those raised by mitigation policies. The aim of this study is to review the institutional processes for drawing up adaptation policies in five European countries (Germany, Spain, France, the Netherlands and the United Kingdom) and to highlight the decisive factors for drawing up adaptation policies and measures. While these countries are relatively similar in terms of their socio-economic features, they differ widely in terms of their vulnerability to climate change and their governance practices.

Although these countries have drawn up framework adaptation policies, few practical measures have yet been implemented. A comparative analysis of their policies enables us to highlight not only their differences, but also their common features, thus providing us with an indication of the key points that apparently need to be addressed in all adaptation policies, namely: i) high-level research into both local climate change impacts and socio-techno-economic solutions; ii) an appropriate institutional framework and the involvement of stakeholders, which is institutionalised according to the country's economic and political environment, and iii) the identification of key issues and of potential measures that can be implemented, which are often linked to existing sector or local policies.

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INTRODUCTION

Since the 1980s, political decision-makers' growing awareness of climate change has led to the implementation of a large number of greenhouse gas emission reduction policies, which are aimed at mitigating the severity of climate change. Adaptation to the impacts of climate change, which represents the other aspect of climate change policies, has only been rolled out more recently on an operational basis. More dependent on academic research on the potential effects of climate change than mitigation policies, and initially focused on developing countries, adaptation policies have been drawn up in Europe, only since 2005.

Climate change adaptation policies consist in anticipating the negative impacts of climate change on countries, in order to draw up and implement the appropriate measures, with the aim of reducing potential future costs linked to new climatic conditions. Adaptation strategies are required at all levels of government, from the local to the international level.

The aim of this Climate Research Report is to examine national climate change adaptation policies in five European countries, in order to highlight their common features and their differences, and to clarify the specific features required by all adaptation policies. Although their socio-economic profiles are similar, in terms of GDP per inhabitant, for instance, these countries display a wide range of vulnerabilities to climate change and political governance policies. Some are in Northern Europe (the Netherlands and the United Kingdom) and others in Southern Europe (Spain); some are coastal (the Netherlands and the United Kingdom), while others are more continental (Germany); and some have a federal system of government (Germany, Spain), while others are more centralised (France). Whilst we will also examine the larger European and international dimensions of their adaptation policies, these are not the focus of our report.

We will address the issues involved in defining a climate change adaptation policy from three different angles, using a comparative analysis of national policies in five European countries, including the role of research and the way in which it is structured to guide the public decision-making process; the institutional processes implemented to draw up adaptation policies, mainly at the national level but also with an eye on their European and international dimension; and the procedures for selecting practical adaptation measures, as well as implementing, funding and re-assessing those measures. A section of the report is dedicated to each of these issues. A large number of examples from the countries that we studied will enable us to illustrate the issues addressed, and particular attention will be paid to the differences that we observed between those countries.

I. THE ROLE OF RESEARCH IN ADAPTING TO CLIMATE CHANGE

Among the five countries examined in our study, four (Germany, Spain, France and the United Kingdom) have created a national institute that is responsible for co-ordinating and disseminating research on adapting to the consequences of climate change, especially in terms of assessing its impacts and the vulnerability of environmental or socio-economic systems, while the Netherlands has adopted a more cross-functional approach. These institutes, and their specific prerogatives, are detailed in Appendix 1.

Scientific research in three main areas is indeed essential prior to the implementation of an adaptation policy (Mansanet, 2010), namely:

- changes in climate systems, in order to understand and forecast these changes using climate models, based on scenarios that set out the changes in climate variables such as temperatures, rainfall and even sea levels;
- the vulnerability of the systems involved, in order to assess the vulnerability of each system, i.e. its potential to be affected by climate change that it cannot handle;
- adaptation resources, in order to develop the new technical, methodological, economic, and organisational resources required for the systems to adapt.

The first section of this report examines how each research area is addressed by the national institutes involved, in each of the five countries, and outlines the state of current knowledge.

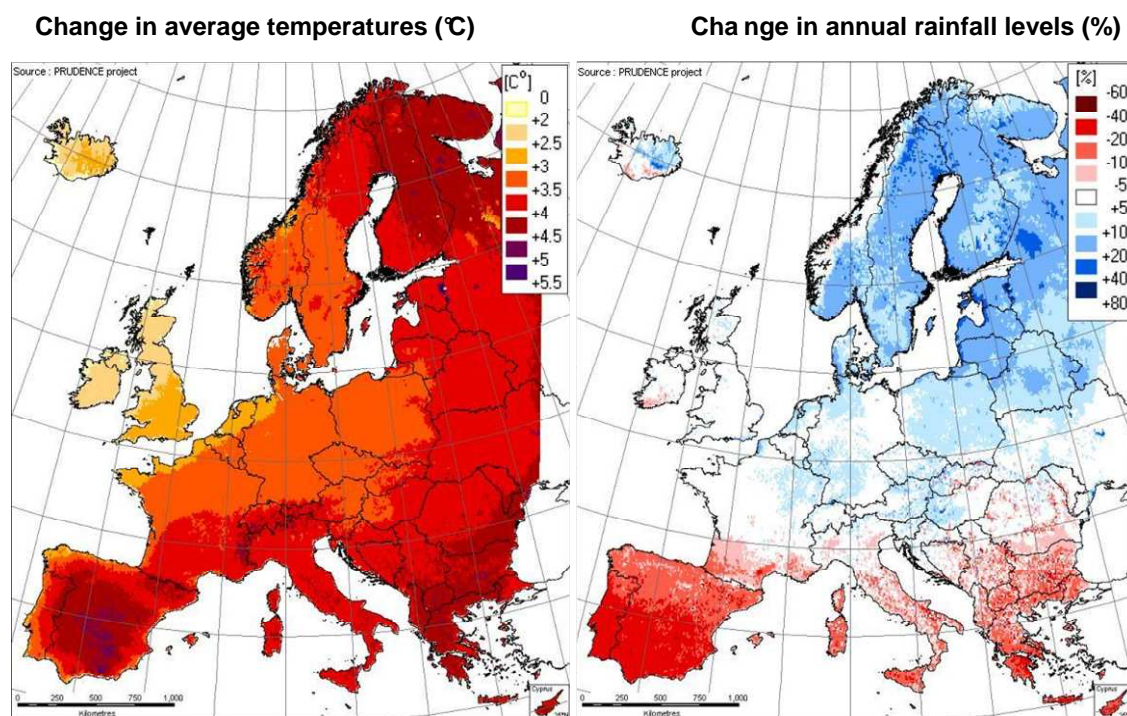
A. Analysing changes in climate systems at the local level: a pre-requisite

At the national level, research on climate systems is normally performed by meteorological institutes³, based on the data available. The results of this research are then circulated among decision-makers and the general public; in accordance with a *top-down* approach.

The aim of this research is to draw up national and sub-national climate forecasts, usually based on SRES (*Special Report on Emissions Scenarios*) socio-economic scenarios, and on the global climate forecasts drawn up by the Intergovernmental Panel on Climate Change (IPCC). Appendix 2 provides an overview of climate systems and the impacts of climate change for the five countries included in the report.

It is hard to compare the results obtained for the different countries, as both the socio-economic scenarios and the models used (and sometimes even the time horizons) are not identical in each case. However, work on regional climate scenarios, such as the one performed as part of the JRC's (the European Commission's Joint Research Centre) PRUDENCE project⁴, has been carried out at the European Union level, and enables more relevant comparisons to be made⁵. In this regard, the maps in Figure 1 show possible changes in temperature and rainfall levels between now and the end of the century.

Figure 1 – Changes in average annual temperature and rainfall levels in Europe between 1961 and 1990, and between 2071 and 2100, Scenario A2



Source: PRUDENCE Project (JRC), HadCM3 and HIRHAM models.

³ Germany: Max-Planck Meteorological Institute, and the German Weather Service (DWD); Spain: the Government Meteorological Agency (AEMet); France: Météo-France (French Weather Service), IPSL, and CERFACS; Netherlands: Royal Dutch Meteorological Institute (KNMI); United Kingdom: the Met Office's Headley Centre

⁴ The PRUDENCE Project is a pan-European research project that was launched in 2001 and focuses on improving climate forecasts at the European level. The project partners are meteorological research institutes as well as certain universities. The project is managed by the Joint Research Centre, which is the European Commission's research centre.

⁵ A large number of research projects are also being conducted at the pan-European level (ENSEMBLES, STARDEX, CLAVIER, MICE, CIRCE, etc.). See Behrens *et al.* (2010) for a more complete review.

The maps indicate that climate change will be more severe in the South of Europe than in the North (with the exception of Scandinavia), especially in Spain, where most of the country is expected to experience a temperature increase of over 3 °C. The North-South divide is even more visible where rainfall is concerned. Average rainfall is likely to increase in the North and decrease in the South, with an especially strong decrease in Spain. The potential climate change in the five countries included in the report is therefore very varied (PESETA, 2009), which ought to imply distinct adaptation policies.

However, broad brush scenarios at the country level are not enough. A micro-level (or downscaled) scenario assessment is required in order to capture the impacts of climate change at the local level as closely as possible, and to draw up adaptation policies. Indeed, the impacts need to be addressed on a regional basis, in order to take specific local geographical features into consideration; likewise, adaptation measures will be more relevant if they factor in specific local socio-economic features. Small scale climate scenarios are therefore useful, while remaining relatively under-developed, even though research in this area is ongoing.

B. Analysing the vulnerability of our natural and socio-economic systems: the need for information

Assessing the vulnerability of natural and socio-economic systems to the impacts of climate change requires both a high level of information for each system and a good understanding of climate dynamics. Research on natural and socio-economic systems is harder to carry out, as the players involved in these systems must gather and then disseminate the information to the bodies responsible for aggregating it (usually the national institutes listed in Appendix 1), following a *bottom-up* approach.

The central authorities have a large amount of information and sectoral expertise for most economic sectors, or the natural areas concerned by adaptation issues. Nonetheless, a large number of other public and private players (other authorities, information or research centres, etc.) need to be involved in the process, in order to adopt an inter-disciplinary and multi-organisational approach, to touch on the various bodies' remit and areas of expertise, and finally, to involve all the public and private players concerned by the measures and ensure that those measures are properly defined and accepted. In particular, we would highlight the working methods of the UKCIP (*United Kingdom Climate Impacts Programme*), which involve a very broad spectrum of players in the public and private sectors.

As the published scientific research is still sparse⁶, each country had to carry out a specific study in order to assess the vulnerability of their own region to the impacts of climate change: Three areas emerge:

- the management of natural resources: water resources, biodiversity, soils, etc.;
- economic activities: tourism, agriculture, forestry, energy, transport, construction, trade and industry, etc.;
- risk management, in the widest sense: human health, managing floods and coastal areas, and the management of other climate risks relating to regional development, etc.

Table 1 refers to each sector that has been identified as vulnerable to the impacts of climate change by each of the five countries in the national impacts studies that preceded the drawing up of national adaptation policies.

⁶ Various reports outline the potential consequences of climate impacts on natural, economic or major regional systems: the IPCC (2007) provides a list of fairly general consequences, which are analysed in further detail in various reports (AEE, 2008; European Commission White Paper, 2009; PESETA 2009, Behrens *et al.*, 2010). Agrawala has analysed the potential consequences of climate change in the Alps, while at the French level, for example, Solier and Mansanet (2009) have analysed the impact on the power-generating system and Cochran (2009) has analysed the impact on transport infrastructure.

Table 1 – Sectors that are vulnerable to climate change, as identified in background reports

	Germany*	Spain**	France***	Netherlands****	United Kingdom*****
Natural resources					
Biodiversity	X	X	X	X	X
Water	X	X	X	X	X
Economic sectors					
Agriculture, fisheries and forestry	X	X	X	X	X
Trade and industry	X				X
Energy	X	X	X	X	
Infrastructure - Built-up environment	X			X	X
Transport infrastructure	X		X	X	X
Finance and insurance sector	X	X	X		X
Tourism	X	X	X	X	X
Risk management					
Regional development	X		X	X	
Flooding and coastal areas	X	X	X	X	X
Natural risks		X	X		
Human health	X	X	X	X	X

*Federal Government report on the German adaptation strategy, 2008; ** ECCE project, OECC and University of Castilla-la Mancha report, 2005; ***ONERC Report on "Adaptation costs and strategies", 2009; ****National adaptation strategy report by the VROM (Dutch Ministry for Housing and the Environment), 2007; ***** "A framework for action", DEFRA (UK Ministry for the Environment), 2008.

Source: CDC Climat Research based on the above reports.

There is a broad consensus on identifying the sectors sensitive to climate change. However, each country can emphasise a particular aspect depending on its specific features. The approach in the Netherlands, for example, focuses on adapting the land and its development, while France and Spain are focusing on natural risks, specifically the issue of drought in Spain's case. Other countries, meanwhile, have dealt with these risks in the context of other issues.

The central authorities can rely on scientific research for these vulnerability studies. In France, for example, the GICC (Climate Change Impacts and Management) programme drawn up by the MEDDTL (Ministry for Ecology, Sustainable Development, Transport and Housing), which is dedicated to research on the impacts of climate change, aims to help define public policies.

However, analysing the vulnerability of natural and socio-economic systems to the impacts of climate change is not solely the responsibility of the central authorities or research institutes. As they seek to be as close as possible to their region, often under pressure from public opinion or particularly committed elected officials, sub-national or regional governments are conducting their own studies. In Germany, for instance, the Länder have carried out sectoral studies based on regional climate scenarios. In the United Kingdom, the British regions and the Devolved Administrations (or *constituent countries*, i.e. Scotland, Northern Ireland, and Wales), are also working on this issue and benefit from the UKCIP's support. The UKCIP also supports local councils, companies or individuals' initiatives in this area, by providing them with tools (see Box 1).

Box 1 – The UKCIP’s tools

The *United Kingdom Climate Impacts Programme* (see Appendix 1) helps public and private organisations to adapt to climate change. A number of tools and methodologies have been created for this purpose. These tools and methodologies are based on various climate or socio-economic scenarios, which enable the impact of climate change to be estimated on a local basis (“*A local climate impacts profile*” tool), the financial implications of climate change (“*Costing the Impacts of Climate Change*” tool) to be assessed, or the organisations’ vulnerability to climate change to be determined and adaptation strategies to be drawn up (“*Adaptation Wizard*” tool). Some tools are more specifically intended for certain types of organisation: this is the case of the “*Business Assessment Tools*” for companies, and the “*Local Climate Impacts Profile*” tool for local governments. In addition, the UKCIP has also put in place a new database called BRAIN (*Base for Research, Adaptation, Impacts and News*), which allows information on climate change and adaptation to be collected and shared.

C. Research on adaptation measures: a new area for exploration

Scientific research on the implementation of adaptation measures involves many academic areas, such as technological innovation (e.g. developing new materials for transport infrastructure) or economic and organisational innovation (e.g. drawing up an adaptation strategy methodology at the regional level). In addition, this research may rely on the scientific results obtained in respect of other issues, like water-saving techniques, for example, which will be one of the possible responses to an increased risk of drought resulting from climate change.

A forward-looking initiative in this area has emerged in the Netherlands as part of the *Knowledge for Climate Programme*, which aims to develop practical adaptation strategy solutions (see Box 2).

Box 2 – The *Knowledge for Climate* programme

This Dutch research programme over the period between 2008 and 2014 emerged from the collaboration between various research centres and universities. Its objective is to “develop the scientific and applied knowledge required for adapting to climate change in the Netherlands”. In order to do so, the programme is primarily working on eight areas (8 *hotspots*) which are deemed to be representative of the Netherlands’ regional diversity. Practical strategic solutions will be developed in each of these hotspots, and applied in collaboration with all the stakeholders. In order to ensure that the work accomplished actually responds to a local need, a team including local authorities, businesses and researchers has been set up for each hotspot, in order to draw up an inventory of its knowledge requirements and assess solutions. The results of the research will be used in the Netherlands’ adaptation strategy, but should also be able to be used at the international level.

D. Decision-making: including the uncertainties raised by research results

Although the level of information on climate change scenarios and assessment of regional impacts is increasing, huge uncertainties remain, primarily regarding:

- future global climate changes, due both to the complexity of the physical phenomena and to doubts over whether the socio-technical-economic assumptions in the scenarios studied will actually materialise;
- the local consequences of climate change: the more precise the model aims to be in terms of location and timing, the more the results depend on the model and the assumptions used, which means that they will not stand up well to changes in the modelling system or alternative assumptions. The uncertainty of the results therefore grows accordingly.

- the vulnerability of the natural and socio-economic systems of a region and their ability to adapt: for example, a number of research projects on the impacts of climate change on eco-systems (e.g. Boe, 2007 and Lebourgeois, 2001) and on assessing those impacts from an economic standpoint are ongoing⁷. In Europe, recent studies such as PESETA or ADAM have tried to estimate the costs and benefits of adaptation, particularly for coastal regions and the energy sector.

Ultimately, it seems that there is still considerable uncertainty about climate change and its effects, which complicates the decision making-process, but should not be an obstacle to action. Indeed, a residual level of uncertainty is unavoidable. Blocking the whole adaptation process on this pretext could turn out to be damaging, particularly in the event that the effect is irreversible, as well as unjustified from an economic viewpoint: Stern (2006), in particular, has emphasised that the cost of doing nothing to counter climate change could amount to the loss of several GDP basis points per inhabitant at the global level.

A number of strategies have therefore been designed in order to enable decisions to be taken in an uncertain environment. For example, the German strategy specifically describes several principles allowing action to be taken in an uncertain environment:

- starting with measures that are known as *no-regrets* measures, i.e. measures that will bring benefits even if the changes envisaged do not materialise;
- favouring flexible measures, i.e. measures that can be taken at a lower cost in order to factor in known climate change developments on an ongoing basis;
- promoting measures that allow people to adapt to several kinds of impacts at the same time;
- explicitly attaching a probability, or level of uncertainty, to each expected climate change development, in order to facilitate the decision-making process.

In the United Kingdom, the likelihood of climate change scenarios materialising is explicitly taken into account and can be used as part of economic calculations. In the Netherlands, the Delta Programme was designed on the basis of a worst-case climate change scenario, in order to be almost certain that the level of protection for the country's dykes, which were built for the long term and at a high cost, is adequate. An interesting initiative to improve the way issues are understood and uncertainty is handled comes to us from Canada, where the Ouranos⁸ organisation has been working with local adaptation players for a long time and has been developing a multi-disciplinary research approach in the adaptation field. This approach enables the organisation to improve its understanding of the different aspects of the issues raised, particularly those relating to uncertainty levels and the implications of such uncertainty, and to offer possible solutions. In fact, Ouranos, like the UKCIP, is acting as an interface between research and the multi-level decision-making process, by providing a link between national, sub-national, regional and local bodies, and other groups involved in the adaptation process. In addition to promoting inter-disciplinarity, Ouranos' actual structure and operating methods allow for the involvement of various players, and enable experts in different fields to come together to analyse the issues and possible adaptation solutions. Involving different players enables uncertainties to be reduced to some degree, and residual uncertainties to be put in perspective.

The five countries of this report recognise the benefit of carrying out research to refine climate change impacts forecasts, assess local vulnerabilities and come up with new technical and organisational solutions. This approach also enables political decision-makers to gain a better understanding of the uncertainty at stake, by favouring flexible no-regrets measures, for example, and by seeking to adopt multiple approaches through inter-disciplinary initiatives involving all the players.

⁷ Estimating the economic cost of adapting to climate change is addressed in a number of research reports (for example, Agrawala and Frankhauser, 2008; Parry *et al.* 2009). Moreover, the UNFCCC (2009) offers a full review of published research on assessing the costs and benefits of adaptation options and underlines the variety of methodologies, the advantages of using multi-disciplinary approaches and the need to improve the way in which question relating to uncertainty, to economic assessment and fairness issues are handled.

⁸ Ouranos is a private non-profit organisation based in Quebec with a network of 250 scientists and professionals that aims to acquire and develop knowledge relating to climate change and vulnerabilities, in order to help decision-makers to implement adaptation strategies at the local and regional levels.

II. THE FRAMEWORK FOR ADAPTATION POLICIES AND INSTITUTIONAL PROCESSES

A. Intervention by the public authorities: involvement at every level, from regional governments to the European Union

Justifying intervention by public authorities

The aim of a public policy or a national adaptation plan is to guide and support the adaptation of natural and socio-economic systems to the impacts of climate change. Public intervention is necessary for the following reasons, as set out in the CEDD (French Economic Council for Sustainable Development) report (De Perthuis *et al.* (2010)):

- overcoming market imperfections: i) as the climate change information generated and circulated on a private basis is inadequate, while prices do not fully reflect the economic impacts of adaptation, especially over the long term, spontaneous adaptation measures may be ineffective, and even lead to maladaptation⁹; and ii) the major infrastructure networks that need to be adapted are assets pertaining to the public interest, which justify public intervention;
- coordinating the action taken: i) to overcome barriers to collective action at the local level; and ii) to guarantee the social equity of the measures;
- introducing legislation: some existing standards and regulations need to be reviewed in accordance with the new climate environment.

In order to meet these requirements, the role of public authorities is to:

- generate and circulate information;
- adapt the institutions involved, i.e. adapt or introduce governance processes so that those institutions take adapting to climate change into account;
- adapt standards, regulations and the tax system;
- adapt public investment.

The role of regional and local governments: enabling decentralised governance

Decentralising the governance of an adaptation policy, from the central authority to regional and local governments, companies, households and NGOs, is crucial at every stage, whether beforehand, when gathering information and defining adaptation measures, or at a later stage, when measures are implemented. There are four main reasons for this stance:

- the level of information at the local level will be higher;
- many powers have been devolved to local (or regional) governments, which is justified by the principle of subsidiarity or by more political considerations; many adaptation measures will therefore be entrusted to them on that basis;
- the direct benefits derived from many adaptation measures are often purely local, like building a dyke that protects only a limited area, for example. To a certain extent, it may be legitimate to finance these measures locally rather than at the national level;
- private players will be forced to adapt of their own accord. Although they may be governed by the laws and regulations in force, their proactive measures and their capacity for initiative should not be overlooked.

⁹ Maladaptation consists in introducing adaptation measures that turn out to be ineffective and even more damaging than inaction, once climate changes have materialised (OECD, 2009).

Our case studies show the major role played by sub-national governments. However, the involvement of local authorities varies according to the country's institutional framework (Mickwitz *et al.*, 2009): in Spain, Germany and the United Kingdom, sub-national government levels (the 17 autonomous Spanish regions, the 16 German Länder, or the four constituent countries of the United Kingdom) enjoy considerable autonomy; the Netherlands are culturally used to decentralisation and seeking a consensus with all the stakeholders involved, including provincial governments; France, meanwhile, is the most centralised country among those included in this report, and the involvement of local authorities in defining national strategy was only introduced rather late, once a general framework had been defined. Table 2 shows examples of adaptation policies that have been introduced at the sub-national level for each of the five countries.

Table 2 - Examples of adaptation policies introduced at the sub-national level

Country	Regional and/or local governments	Activities
Germany	Länder	Working on climate change scenarios and impact studies Drawing up adaptation strategies Partnering the Federal Government in the local "adaptation action plan"
Spain	Autonomous regions	Involved in the NCCAP Drawing up their own policies
France	Regions and municipalities	Defining regional climate, air quality and energy guidelines between now and July 2011 All local authorities: defining local climate & energy plans Some regions are already assessing their vulnerability
Netherlands	Local authorities (provinces and municipalities)	Assessing their vulnerability and drawing up action plans Involved in the national adaptation strategy
United Kingdom	Constituent countries	With the support of the UKCIP: - the regions are developing their own strategies and measures - municipalities are involved in case studies and measures

Source: CDC Climat Research based on the five official documents listed above.

This decentralisation of the adaptation process raises the question of the relationship between national and sub-national policies. Two questions arise at this point. Which entity, at the national or sub-national level raises the issue of adapting to climate change? What is the degree of coordination between these two policy levels?

On the first point, national policies in the five countries have usually been the driver for local policies, or at least the need to take action, even if we can sometimes notice that awareness of local issues linked to climate change did not wait for such awareness to emerge at the national level. Some local and regional governments have used their legal expertise to decide on the measures to take before the national government did so, for example, where reviewing local town and country planning guidelines were concerned.

In terms of the coordination between national and local policies, our case studies indicate that there are specific organisations that play such a role. In the United Kingdom, for example, the UKCIP, which works both with the national government and with regional and local governments, is a key player, allowing coordination between the various government levels (among other things). Likewise in Spain, the CCPC (Climate Change Policies Coordination Committee) is the link between the Central Government and the Autonomous Regions, which enjoy a wide range of powers. In contrast, there is no formal institutional structure in France that provides this level of coordination. Even if the so-called "Grenelle de l'Environnement" law (or Environnement Round Table) requires an "adaptation" section in regional climate, air quality and energy guidelines, neither the content of these measures, nor the way in which they should be coordinated have been made clear.

In the Netherlands, the national programme brings together representatives from various government levels (national, provincial and municipal) and from the *water boards* (local government bodies which are responsible for managing the flood defence infrastructure, water levels and water quality) as part of a highly participatory approach. An accurate breakdown of roles and responsibilities should be provided when the Netherlands' national strategy is reviewed.

Involving private players in the adaptation process

The involvement of private players guarantees the execution of adaptation measures and their acceptability at the local level. In most cases, this involvement will be spontaneous, depending on the singular interests of the companies or individuals concerned, who will see their conditions change in accordance with the climate environment (Mendelsohn, 2006). However, even in this case, the public authorities still have a role to play, at the very least in disseminating information and coordinating measures at the local level. They may, following the example of the UKCIP, provide technical support to private players through various tools; they also may introduce tools to involve private players in a variety of ways (regulatory and tax measures, incentives, or measures based on encouraging voluntary participation).

Meanwhile, future sector regulations may require companies to include adaptation measures within their business strategies. In addition, the public authorities introduce measures that are more global, restrictive, or inviting: for example, the British Government has already introduced a “reporting power”, which enables it to ask some business leaders, primarily those providing public goods and services like electricity, to draw up impacts studies for their businesses, specifying how they intend to respond to climate change. Voluntary measures are also encouraged, and the UKCIP is providing methodological support to companies that want to carry out impact studies.

Nonetheless, climate change will not be limited to creating restrictions for companies. For instance, the British departmental plans show that it could also create new opportunities and even new markets. In fact, companies will most likely have a major role to play in drawing up, funding and managing adaptation solutions.

Meanwhile, the involvement of private individuals in the five countries is still marginal at the present time, even if the UKCIP, for example, has designed tools intended for individuals (see Box 2).

Coordination by the European Union

Within the European Union, supranational institutions play a key role in coordinating climate change adaptation policies. In addition to carrying out adaptation research projects, like those of the JRC for example, the European Union (EU) began thinking about the adaptation issue as early as 2005, which resulted in the publication of two reports:

- in 2007, a European Commission Green Paper, entitled *Adapting to climate change in Europe - options for EU action*, was published, following the work carried out on adaptation by the second ECCP (European Climate Change Programme). This Green Paper outlines the main impacts of climate change expected in Europe, as well as the four pillars on which the European adaptation strategy will be based, i.e. swiftly including adaptation in all the EU's activities, including adaptation in the EU's external actions, developing an adaptation research programme at the Community level, and involving the other players in the adaptation field.
- 2009 saw the publication of a White Paper entitled *Adapting to climate change – towards a European framework for action* outlining the future “EU adaptation framework”, the way in which this framework will be implemented, its timetable and its contents. The EU has begun the process in 2009 by drawing up a Community adaptation strategy, which will be implemented from 2013 onwards. The White Paper also underlines the coordination role played by European institutions, particularly in the case of joint trans-border adaptation measures, where solidarity between Member States is required, or when it is necessary to amend other European policies on energy, agriculture, etc.

The adaptation measures taken by the European authorities appear belated compared with national policies, and do not seem to have played a driving role where those policies are concerned. Nonetheless, these measures are intended to become more extensive, in order to ensure the coordination of national policies, particularly the sharing of information and best practices between countries through a common dialogue platform. Additionally, the European adaptation strategy that will be designed from 2013 onwards is likely to be based on the work that is currently being carried out in various European countries: the national bodies involved have already been consulted about defining the policy.

B. Motivations for implementing an adaptation policy

A series of factors is prompting public authorities to become more concerned about adaptation and is determining the decisions taken regarding this issue. The *Europe adapts to Climate Change, Comparing national adaptation strategies* report (Swart *et al.*, 2009), suggests a classification for these determining factors. The factors are summarised in Table 3, which explains their respective roles in national adaptation policies.

This information matrix provides a partial explanation for the political choices that have been made regarding adaptation: there is a difference between the motivations and even the guidelines for adaptation policies depending on the country, and particularly on whether they have experienced extreme climate events.

Table 3 – The determining factors for adaptation policies

Motivating factors	Role in adaptation policies
International negotiations	Article 10 of the Kyoto Protocol (drawn up within the UNFCCC) provides that the Parties shall implement climate change adaptation programmes.
European policies	Community adaptation policies were belated; there were, however, prior discussions on the issue that may have prompted certain countries to take action. In addition, the policies create a common discussion platform for European countries, which may allow adaptation policies to be enhanced and properly coordinated.
Experience of extreme climate events	In some countries, the experience, or even the memory of extreme events, has been a major factor in encouraging adaptation. In the Netherlands, for example, most adaptation policies are based on flood defence. The 1953 floods were the catalyst for a proactive risk management policy.
Examples of adaptation policies in other countries	The policy watch process between countries influences national policies, even if discussions on the issue of adaptation do not seem to have made much progress so far.
Impact and adaptation research, assessment of the economic cost of inaction and expert opinions	Research that highlights certain impacts and assesses their cost has a crucial influence on the adaptation measures that will be taken. For instance, the ONERC <i>Climate change, impact cost and adaptation strategies</i> report provides food for thought when drawing up the NCCAP.
Identification of the opportunities to be seized	Identifying opportunities encourages public authorities to take measures in order to benefit from them. This is generally the case in the United Kingdom.
Social and interest group expectations	A need for adaptation may also arise from the expectations of society and certain interest groups. In the Netherlands, for instance, the public has high expectations in terms of flood protection.

Source: CDC Climat Research based on Swart *et al.*, 2009.

C. The different stages of defining an adaptation policy

General analysis

The analysis of the five countries studied shows that there are generally four major stages, which may coincide, in drawing up an adaptation policy:

- setting up a body or a public institution that coordinates information and/or adaptation policies;
- publishing the impacts assessment reports;
- creating a political adaptation framework;
- drawing up adaptation action plans and implementing measures.

Table 4 shows these four stages and the timetable for the main political events affecting the adaptation process at the European Community level and in the five countries examined.

This timetable demonstrates that adaptation has been a concern for around ten years in these countries, further expanding in the second half of the 2000s. The table also underlines the fact that the four stages mentioned may be rolled out on an ongoing basis and may overlap. However, each of the countries involved has adopted a varying degree of accuracy depending on the stage, which makes the progress status of their adaptation policies hard to compare simply by reading the table. If we take the detail of the reports mentioned into account, it would appear that the United Kingdom is very far ahead in terms of adaptation, thanks primarily to the UKCIP, which has conducted a large number of vulnerability studies involving many players (including local and private players), and also to the adaptation measures already in place. Given the extent of the adaptation measures implemented, primarily in the flood defence infrastructure field, the Netherlands is also very active.

A few European studies attempt to compare adaptation strategies in various member states. Based on a study of the adaptation strategies of seven European countries (including the five strategies studied here), which was carried out as part of the Partnership for European Environmental Research, or PEER, Biesbroek *et al.* (2010) have also highlighted the similarities between these strategies (including the use of research, the similar sector issues, and the fact that the countries were early in considering the issue compared with the European Union), and have identified gaps that are often extensive, such as the lack of coordination with local governments, the lack of an economic analysis of the costs and benefits of adaptation, the lack of thought on how to fund measures, and the lack of a process for monitoring and assessing the policies. However, these gaps seem more due to the novelty of the issue than to any other factor. Pfenninger *et al.* (2010), primarily define the main difficulties encountered by national public authorities, based on interviews with those responsible for adaptation policies in eight European countries: namely multi-level governance involving sub-national entities, and taking decisions in an uncertain environment.

Where institutional aspects and the involvement of institutions are concerned, Termeer *et al.* (2009) describe the key conditions required for them to succeed in drawing up climate change adaptation policies: 1) the variety of players affected and the issues addressed by the institutions, 2) their ability to learn, 3) their ability to adapt spontaneously to new data, 4) their capacity to mobilise others, or "leadership" capacity, 5) their technical and financial resources, and 6) the overall governance system. The five countries included in the report also meet this description overall, although there are differences in their governance systems, their ability to mobilise people, and the financial resources available.

Table 4 – The stages and timetable for adaptation policies at the European Community level and in the five countries studied

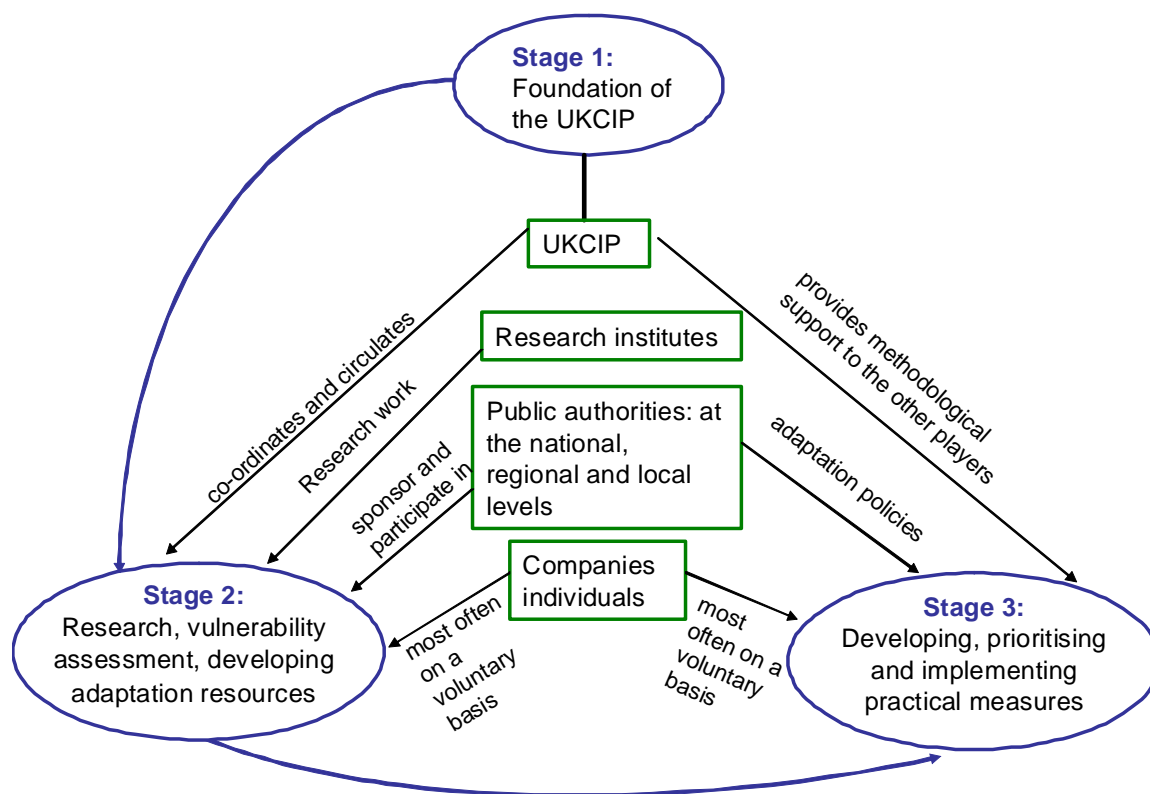
Country	European Union	Germany	Spain	France	Netherlands	United Kingdom
Stages						
Setting up a public body that coordinates information and/or adaptation policies		2006: Founding of KomPass	2001: Founding of the OECC	2001: Founding of the ONERC		1997: Founding of the UKCIP
Publishing the climate change impacts assessment reports	2007: Publication of the Green Paper on adaptation		2005: Publication of the ECCE report	2009: Publication of the ONERC report on <i>Climate change, impacts cost and adaptation strategies</i>		2000: Publication of the <i>Highlights Report</i> , including an assessment of the risks linked to climate change. 2008 (July) Publication of the report on <i>Adapting to Climate Change in England: a framework for action</i> , by DEFRA (UK Ministry for the Environment)
Creating a political adaptation framework	2009: Publication of the White Paper on adaptation	2008: Publication of the German climate change adaptation strategy 2009 : Creation of the first inter-ministerial adaptation strategy working group	2006-2009: 1 st work schedule for a National Climate Change Adaptation Plan (NCCAP) 2009-2012: 2 nd NCCAP work schedule	2006: Approval of the national adaptation strategy 2009-2010: Grenelle Roundtable Laws 1 and 2 2010: Organisation of a national consultation on the NCCAP	April 2007: Publication of the report on the national climate change adaptation plan (ARK)	November 2008: Adoption of the <i>Climate Change Act</i> , including a major adaptation section
Drawing up a schedule for adaptation measures and implementing them	2009-2012: Drawing up a Community adaptation strategy 2013: Implementation	2011: Presentation of the adaptation action plan (prepared by the working group)		2011: Drawing up and implementing a NCCAP	November 2007: Publication of the national adaptation strategy 2008: Publication of the Delta 2 Commission report, which resulted in a Delta programme (for flooding) 2015: Application of the first stage of the strategy ends	2008-2011: Defining the <i>Adapting to Climate Change Programme</i> 2010: Publication of the departmental adaptation plans (Ministries) 2012 and beyond: Implementation of the <i>National Adaptation Programme</i>

Source: CDC Climat Research based on official documents (see bibliography).

One example: The adaptation policy elaboration process in the United Kingdom

The United Kingdom provides an interesting and relatively comprehensive example for drawing up adaptation policies. The country became concerned about climate change at a very early stage, has specialist research teams and is probably the European country that has made the most progress with its adaptation policy, in the widest sense. Its policy is used here, in order to illustrate the process for drawing up adaptation policies and the concept of stages, as described in the previous paragraph. Figure 2 represents the political process.

Figure 2 - The institutions involved in adaptation policies in the United Kingdom



Source: CDC Climat Research.

The three stages of the adaptation process were as follows:

1) The creation of institutional elements, including:

- creating a research coordination body, namely the UKCIP (*United Kingdom Climate Impacts Programme*), a programme created in 1997 with the aim of coordinating research on the impacts of climate change and helping public and private organisations to adapt. Unlike the OECC in Spain or the ONERC in France, for example, the UKCIP is independent of central government and does not coordinate policies, which is the role of DEFRA (the Department of the Environment, Food and Rural Affairs) and the DECC (Department of Energy and Climate Change). The UKCIP also plays a key role in coordinating the various players in the adaptation process, by setting up common dialogue platforms;
- drawing up an adaptation policy framework. The British government has launched a programme (covering 2008-2011, and even a second programme that is intended after 2012), which guides the work performed on adaptation and provides a framework for it, covering both the expansion of knowledge and the implementation of adaptation resources. In addition, the programme is responsible for launching an iterative process for assessing climate risk and reviewing adaptation policies.

2) Gathering and acquiring expertise in the three areas identified in Section 1:

- climate systems: the Met Office's Hadley Centre conducts research on climate systems that enable forecasts to be drawn up; the latest forecast is UKCP09 (United Kingdom Climate Projections 2009). These forecasts are then published by the UKCIP, including on its website.
- understanding the impacts: the UKCIP is responsible for coordinating and assessing impacts research. It works in partnership with various players: central government, research institutes, local authorities, companies and private individuals. It also provides tools that enable these players to conduct impacts risk assessments.
- adaptation resources: the UKCIP has worked on identifying adaptation resources in a collaborative manner and provides adaptation assistance tools, primarily intended for the English regions and independent authorities. Every department has worked on the adaptation strategies that needed to be envisaged at the central government level.

3) Defining, prioritising and implementing measures. Such measures are the remit of the public authorities responsible for the sector or topical policies concerned (flooding, transport, health, etc.), and are not entrusted to a central body. This is an integrated, *mainstreaming*-type approach (see next paragraph). As part of the adaptation programme, measures are suggested by every central government ministry, based on consultation with their partners and the sectoral data at their disposal. Overall coordination is provided by DEFRA. Some government agencies, such as the Environment Agency, which handles flood defences, also factor adaptation into their work. Finally bodies, and even individuals, may ask the UKCIP for methodological support in their adaptation measures at all other sub-national levels (regions, independent authorities, companies, etc.).

D. Links between adaptation policies and existing policies

Adaptation policies often interact with other existing policies, which can result in clashes or synergies. How then can we ensure that adaptation policies are properly integrated, and how do we rank the various adaptation and non-adaptation policies?

Consistency between policies

The consistency between the aims of adaptation policies and those of other existing policies is sometimes a matter for specific comment in adaptation programmes. In fact, in the United Kingdom, the *Adapting to Climate Change Programme* report specifies that sustainable development principles must be adhered to, which means, for example, that adaptation resources must be low-carbon. Likewise, the German strategy explicitly states that adaptation measures must look for synergies and avoid clashes with mitigation policies aimed at reducing greenhouse gas emissions. However, nothing is usually mentioned about the exact weighting to take into consideration in the event of clashes.

Actually, there is implicit coordination between the policies, since adaptation measures are often drawn up in collaboration with sectoral players, which generally ensures that specific sector features other than adaptation are taken into account. This enables decisions to be taken based on a good level of information, and as closely as possible with the realities on the ground, while also allowing the different players to express their concerns. Such a decision process generally ensures the emergence of synergies and enables a clash of outcomes to be avoided. Interactions with existing policies are then implicitly taken into account by all players, but on a case-by-case basis and with no strict rules on prioritisation measures between adaptation and other priorities. This so-called *mainstreaming* approach (see Box 3) promotes the inclusion of adaptation policy in usual policies, but does not prejudice its ranking in relation to those policies.

Box 3 – The *mainstreaming* concept

The *mainstreaming* concept was put forward for the first time at the Global Sustainable Development Summit in Johannesburg in 2002, and referred to the idea of including considerations linked to climate change in development policies. Since then the concept has been extended to any inclusion in sectoral policies and institutional mechanisms (see CEPS, 2008).

For instance, as part of the national consultation process on the NCCAP, a suggestion was made in France that “the benchmark values used in public service contracts should remain appropriately adapted within the context of climate change (Recommendation 111)”, that “the impact of climate change should be taken into account in urban planning documents (Recommendation 133)”, or again that “including adaptation to climate change in the eligibility criteria for investments in public and private funding projects, in order to exclude “poorly adapted” projects (Recommendation 139)” (MEEDDM, 2010).

Piecemeal integration or separate policies?

There is a growing trend in policy-making towards including adaptation issues in existing sectoral policies, or “mainstreaming”, which is recognised as a success factor (Mickwitz, 2009). This trend can be observed in all the countries included in this report, from the Netherlands, which seems to include adaptation in its sectoral policy to the greatest degree, as part of its regional development policy, to France, which is beginning to do so (see Box 3). However, conditions for inclusion vary depending on the case. The example of flood risk management enables us to illustrate this issue. In fact, in the case of an existing climate risk that would only be aggravated by climate change, like flooding, all that is necessary is to adapt the existing risk management system; this is what the Netherlands is doing, for instance, when it updates its flood risk management process and reviews dyke construction standards according to new climate forecasts. This is an integrated, *mainstreaming* approach. In contrast, in the event of a new climate risk (forest fires in Northern France, for instance), a new system, or even a new policy, will have to be created. Likewise, it might be appropriate to abolish systems or policies that have become obsolete.

A *mainstreaming* approach in drawing up and implementing policies does not imply that there are no specialist adaptation institutions: some specialist institutions responsible for drawing up and implementing policies have been created, like the ONERC in France and the OECC in Spain. Their precise role also depends on the cultural and political context of the country, which may be centralised to a greater or lesser degree.

III. DRAWING UP AND IMPLEMENTING ADAPTATION MEASURES

The analysis of the five case studies has shown that the political and institutional framework is fundamental, and determines the kind of adaptation policies that are possible. Nonetheless, many common points have emerged, including recourse to a coordinating body and the publication of reports, a concern to include adaptation in policies that already exist, and the involvement of all the players concerned to a greater or lesser extent. A more detailed analysis of the exact policies and measures envisaged allows the analysis to be extended, by detailing the key criteria for selecting and implementing measures in the different countries concerned.

A. Action and adaptation areas in the different countries concerned

The areas addressed differ depending on the country

Table 5 shows the issues and sectors addressed when defining practical adaptation measures that are either applied or envisaged, since many are actually still at a very early stage. The countries focus on the issues identified as vulnerable in the assessment reports (see Table 1) and suggest appropriate measures.

Table 5 – Content of adaptation policies and the issues addressed

	Germany	Spain	France	Netherlands	United Kingdom
Institutional framework	German strategy for Adapting to Climate Change	National Climate Change Adaptation Plan	National Climate Change Adaptation Plan (currently being drawn up)	National Adaptation Strategy and Delta Commission	National Climate Change Adaptation Programme
Operating content of the plans	Principles and criteria for prioritising actions, measures proposed at the Federal level, an overview of the measures for the other players, information on funding and proposals for monitoring progress	1 st programme: defining potential measures 2 nd programme: including adaptation in sector regulations, mobilising the players, putting monitoring indicators in place	Sector adaptation measures at the national level, proposals on funding and governance (currently being defined)	Virtually all adaptation measures concern land development. Between now and 2015, the strategy must amend laws and procedures in order to create suitable conditions for adaptation. The Delta 2 Commission provides for measures to adapt flood defence infrastructure (dams, dykes, etc.) including through lowering the level of acceptable risk	The departmental plans involve identifying the main risks created by climate change, and the action priorities, and suggest adaptation measures
Issues addressed	Human health, the construction sector, hydrological systems, agriculture, forests and forest management, fishing, energy, the finance, transport and transport infrastructure sectors, trade and industry, the tourism industry & cross-sectoral issues: regional development, public safety	1 st programme: water resources, biodiversity, coastal regions 2 nd programme: issues in the 1 st programme & health, tourism, agriculture, forests, soil and desertification	Health, water, biodiversity, natural risks, agriculture, forests, energy, transport infrastructure tourism & resources (other issues are also expected to be addressed)	Protection (against flooding), quality of life, biodiversity, the economy, agriculture, tourism and leisure, transport and energy The Delta 2 Commission suggests adaptation measures (including standardised measures) for flood defence infrastructure	Fairly exhaustive consideration of sectors and requirements thanks to departmental (ministerial plans)

Source: CDC Climat Research based on official documents listed above.

Some issues are shared by many countries: water management in the widest sense, i.e. flooding and water resources management, health, agriculture, forests, (transport and energy) infrastructure and tourism. This is explained by the fact that these sectors are particularly vulnerable to climate change.

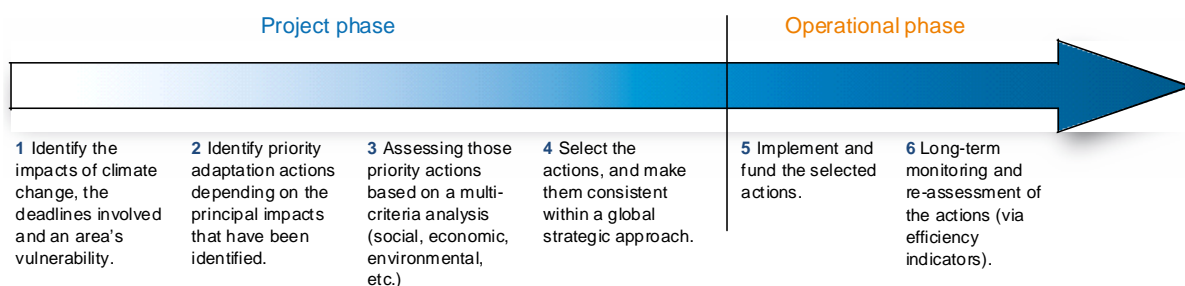
However, each country's adaptation policies have their own specific features in terms of the issues addressed or the way of addressing them. Two examples illustrate this point well: the Netherlands and Spain. The Netherlands' approach to adaptation involves regional development, as this is a crucial issue because of its high population density, which can reach up to 400 inhabitants per km², as well as water-related constraints. The Netherlands places significant emphasis on the last issue. This is not surprising for a country that is extremely vulnerable to flooding and that suffered catastrophic floods that left over 1,800 people dead in 1953. This event was the driver behind huge defence infrastructure works at the time (dykes, dams, etc.) that were carried out at the insistence of the Delta Commission. The same name, Delta, has been retained for the commission responsible for adapting defence infrastructures to climate change. In this case, adaptation has therefore been included in "traditional" risk management policy. In Spain, one of the priorities is water resources; soil and desertification issues have also been addressed. Spain was the only country in this report to be affected by desertification; it is therefore the only country to be concerned about it.

Ultimately, adaptation policies display a certain number of common points, such as the use of research and expertise and a supra-national policy or strategy framework, as well as individual features, which correspond to their political and institutional operating methods and to the impacts expected in each country. The stronger the impacts and the more cross-divisional effects it has, the more adaptation policies will be structured around it, as is the case for flooding in the Netherlands. Conversely, when no impact appears to be dominant, the adaptation approach is more general, like in France, for example.

The stages for drawing up and implementing adaptation measures

The process of defining and implementing the measures for an adaptation policy follows the six major stages detailed in Figure 3.

Figure 3 -The six stages in drawing up and implementing adaptation measures



Source: CDC Climat Research based on de Perthuis et al. (2010).

Adaptation measures: the example of flood defence

For illustration purposes, the practical adaptation measures that were adopted in the flood defence field are presented here. They form part of the first measures envisaged in any adaptation plan, and concern all the companies included in the report. Table 6 presents a series of adaptation measures that have been applied or are planned in this area for each country.

Table 6 – The flood defence adaptation measures adopted

Country	Flood defence adaptation measures
Germany	<ul style="list-style-type: none"> - taking into account the effects of climate change in the integrated management of river basins (arising from the directive on flood risk management) - adapting the infrastructure: drains and water distribution systems, dams, reservoirs and retention ponds - supporting individual measures to protect the public against flooding (flood warnings and information)
Spain	<ul style="list-style-type: none"> - report outlining the 2nd National Adaptation Plan work programme: <ul style="list-style-type: none"> 2011: publication of a climate change atlas for coastal areas 2012: sector assessment report on coastal regions - initially applying the results to the tourism sector
France	<p>Examples of proposals made during the national consultation process:</p> <ul style="list-style-type: none"> - taking climate change into account for coastal risks immediately when preparing planning documents, - taking climate change into account when building or maintaining defence facilities, - maintaining natural areas where flooding will increase, - studying strategic withdrawal options
Netherlands	<p>The Delta 2 Commission makes 12 recommendations, including the two below:</p> <ul style="list-style-type: none"> - between now and 2050, the level of dyke protection must be increased by a factor of 10 (i.e. that corresponds to a flooding rate that is ten times higher). Building "giant" dams for the most vulnerable areas. - using cost-benefit studies to know where to build. The costs must be borne at the local level. <p>The Delta programme is designed to be applied throughout the century.</p>
United Kingdom	<ul style="list-style-type: none"> - coastal and flood risk management strategy: significant long-term anti-flooding infrastructure investment programme (2010-2035) - working on natural risk reduction processes, primarily to maintain the buffer zone capabilities of coastal and river areas - adapting regional development plans: significant research and pilot projects & a joint statement by the various players involved - helping communities to live with risk: <ul style="list-style-type: none"> - flood warning systems and reinforcing emergency management systems, information website working with the public in order to make them understand the risk and the adaptation options - ensuring that buildings in high-risk areas are designed to withstand flooding - enabling property owners to adapt: creating a fund to enable property owners to adapt in places where the defence infrastructure is deficient.

Source: CDC Climat Research based on the five official documents listed above.

This example of anti-flooding measures underlines the differences in progress made on this issue in the countries, the various kinds of complementary measures, and the crucial role of the public authorities. For example, simply building dykes is not enough to counter the risk of flooding: the process must be accompanied by the introduction of warning systems, regulatory changes and incentive-based measures. This example also demonstrates the benefits of a global approach, including pre-implementation risk studies, and subsequent studies on the measures to implement. Some countries, like the Netherlands, are continuing to refine their policy by including an economic cost-benefit analysis, in order to assess the opportunities linked to each solution, and funding proposals.

B. Which adaptation measures for which priorities?

Classification of adaptation measures

The practical details of anti-flooding adaptation policies illustrate the dual classification of adaptation measures depending on their action mode. In fact, it is possible to make a distinction between adaptation measures known as:

- soft measures, which involve all adaptation measures that do not require direct heavy investment like building or adapting the infrastructure, for example. These measures consist primarily in organisational, regulatory or institutional measures. In the case of flood defences, putting in place or improving a public flood warning system that takes climate change into account is a soft adaptation measure, albeit a very useful one.
- hard measures, which involve measures that require heavy investment. They mainly involve infrastructure and built-up areas in the widest sense of the term, when the process involves adapting them or building new ones that take climate change into account. These measures are often intended for the long term. They may be introduced directly by public authorities through public investment, or indirectly through changes to construction standards.

According to another classification used in the report issued by Perthuis *et al.* (2010) for the CEDD, it is possible to describe the measures taken by public authorities as follows:

- institutional adaptation measures: changing institutions so that they take climate change into account represents in itself a kind of adaptation measure, which is aimed at ensuring that public governance takes adaptation into account, including governance by local government. For example, European legislation requires that the management of flood risks resulting from climate change is included in river basin management.
- regulatory and tax measures: these measures enable both the public sphere in the widest sense and the private sphere to be reached.
 - regulatory measures: a good portion of adaptation policies involves regulatory change. In the present case, this may involve construction standards for all new buildings, or even adapting regional development plans.
 - tax measures: this process involves the taxes and subsidies used to change the behaviour of some players, usually in the private sector. For instance, the British Fund that provides assistance to households to help them adapt to increased flood risks can be classified as a tax-related adaptation measure.
- public investment adaptation measures: public authorities may play a direct role in the adaptation process (Holm, 2010) through the investments that they generate or structure. By taking climate change into account, they can decide on whether to build or change infrastructures or public built-up areas in the widest sense of the term, like building new flood defence dykes, for instance.

This classification of adaptation measures enables us to see that a good number of them, especially regulatory and tax measures, only operate indirectly, through the effect that they have on other players. This is hence a decentralised approach to adaptation.

The previous flood risk management example illustrates the effect of combining the various kinds of measures available, in order to ensure greater effectiveness and reduce costs (soft and hard measures, or adapting institutions and investments), an option that has, in fact, been selected in all the countries included in this report.

Ranking adaptation measures

Once climate change issues have been understood and adaptation measures have been envisaged, they need to be ranked in order to decide on which ones to implement as a priority. This ranking is all the more necessary in the current economic environment, where human and financial resources are limited.

Table 7 sets out a list of the main criteria used to rank the adaptation measures described in the main country reports. Different criteria have been selected depending on the examples: there is no single rule, even within the same country.

Table 7 – Criteria for ranking the measures, and examples

Main ranking criteria	Methodological comments	Examples observed
Specific features of the impact (magnitude, frequency, etc.)	The potential damage that an impact may cause and the associated frequency of the phenomenon will be a condition for prioritising the measures to counter it.	In the Netherlands, anti-flood measures are very clearly the highest priority, given the significant potential damage.
Cost of the measure (in the broad sense) and the difficulty of implementing it	The cost of the measures (in relation to the benefits that they create) and more generally the difficulty of implementing them, slow down their implementation. The corollary benefits of the measures should also be taken into account and deducted from the cost.	Withdrawing from, i.e. abandoning areas has been envisaged from a theoretical point of view (in Spain, for example); however, practical examples are rare given the political and financial cost of such measures.
Level of certainty of the impact	Measures that counter the most certain impacts must be prioritised	In fact, the German strategy recommends favouring no-regrets measures that will be beneficial across a wide spectrum of developments due to climate change
Time horizon for the impact to be countered	All impacts are not expected to occur at the same time and immediately; some measures can therefore wait.	In Spain, water management is considered as a medium term issue, while desertification is a longer term problem. As a result, the second issue has not received much attention.
Inclusion within other policies	An adaptation measure that generates synergies and avoids clashes may be a priority.	The British Government insists on the fact that adaptation creates new opportunities that need to be exploited through appropriate industrial and trade policies.

Source: CDC Climat Research based on the five official documents listed above.

An economic calculation may be used to formalise the use of these criteria, on condition that external factors – i.e. the implied positive or negative effects that are not monetised – and uncertainty are included (de Perthuis *et al.*, 2010).

However, these criteria must not obscure the political aspects. Indeed, prioritising measures, even if based on results provided by experts, is ultimately the result of political decisions and compromises, made in a more or less participatory manner.

C. Implementing, funding and monitoring measures

Implementing and funding adaptation measures

The next stage consists in implementing and funding the measures. Very few measures have reached this development stage. Some measures that have been drawn up are being implemented by public authorities, either by the Government, sub-national governments or public operators. Funding these measures is then included in the budget of these authorities, or is a separate funding target, like the Delta Programme in the Netherlands, for example, which is financed by a special Delta Fund. The other measures are implemented by private players such as companies and private individuals, either on a voluntary or compulsory basis, due primarily to regulatory changes. Even if the measures are funded directly by private individuals, financial support may be available from the government. In fact, in the United Kingdom, a £5.5 million fund has been set up in order to enable private individuals to adapt to the increased frequency of flooding in areas where there is a lack of public flood defence infrastructure.

The cost of the measures will be heavily dependent on their specific features. So-called *soft* measures, like organisational measures, for example, are usually much less costly than so-called *hard* measures, like building infrastructures. Conversely, the cost of updating existing infrastructures or building new defence infrastructures is extremely costly: for instance, the Delta Programme (put together by the Delta 2 Commission) is expected to cost between €1.0 and €1.5 billion per year between 2010 and 2100; in France, meanwhile, the cost of renovating a one-kilometre long dyke in the wake of the 2010 Hurricane Xynthia has been estimated at around €1 million.

Another source of funding for adaptation measures is also available, namely insurance mechanisms. Taking out appropriate insurance against certain climate events is one way of adapting, which may, however, have a perverse effect if it overshadows prevention measures. In fact, this is one of the main criticisms regarding flat-rate systems, which are unconnected from real exposure to risk, as in France and Spain. Insurance systems for natural risk vary, depending on the country, particularly in terms of government involvement. Table 8 summarises the specific features of the various systems in terms of public and/or private involvement:

Table 8 – Natural disaster insurance systems

Country	Insurance system structure
Germany	Private insurance system, unregulated rates, relatively low coverage level. However, the public authorities intervene in the event of major and exceptional damages.
Spain	Private insurance and public reinsurance systems, financed by surcharges on other types of insurance, single rate structure, compulsory cover.
France	Private insurance and public reinsurance system (CatNat), which covers virtually all natural risks except storms, and acts as a guarantee for private property insurance. The system is financed via surcharges. Single rate structure, compulsory cover, variable exemptions, availability of the “Barrier Fund” for funding projects that reduce vulnerability, which is financed by a portion of the insurance premiums gathered.
Netherlands	The public <i>Calamities Compensation Act</i> provides for compensation for victims of natural disasters. Private insurance is available in some cases (damage resulting from heavy rainfall, for example).
United Kingdom	Private insurance system, unregulated rates, high coverage level, with the notable exception of low-income households.

Source: CDC Climat Research.

One should note that the coverage rate varies between countries. Countries where there is a public insurance system often make insurance against natural disasters compulsory, while in countries where there is a private system, the rate of coverage is lower, or even much lower. Conversely, the unregulated rate structure of private systems enables a pricing message to be sent to policyholders via premiums and exemptions, which encourages them to take climate change risk into account. In the case of climate change, a change in climate risk is expected to lead to changes in the rate structures and therefore to behavioural changes. These changes in climate risk are currently the subject of a great deal of research by insurance companies.

Monitoring and assessing adaptation measures

Adaptation policies and measures that have been implemented need to be assessed, so that they can be readjusted. The United Kingdom provides a good example in terms of assessing adaptation policies, while the other countries of the report do not explicitly mention the process. The political framework formed by the National Adaptation Programme, as well as the National Climate Change Risk Assessment on which it is based, must be reviewed every five years. This will enable both updated climate scenarios and what has been learned from experience to be taken into account.

The United Kingdom has introduced specific indicators for adaptation plans, as part of the methodology assessment process. There are six national indicators, which make up the Public Service Agreement 27 (PSA 27), that allow the performance of climate change policies to be evaluated; one of those indicators involves adapting to climate change. This indicator measures the proportional increase in areas equipped with a sustainable water management system, i.e. it assesses the efforts made in terms of reducing water demand and long-term planning to ensure the sustainability of the supply. Another indicator assesses the progress of the adaptation policies implemented by local governments: this is National Indicator 188 (NI 188), which awards each local government a progress level rating based on five variables:

- Level 0: beginning the assessment and launching the ensuing projects;
- Level 1: the authority has made a public commitment to identify and manage climate risk;
- Level 2: completing the risk assessment process and prioritising measures in certain areas;
- Level 3: full action plan and ranking of measures in all priority areas;
- Level 4: ongoing implementation, monitoring and review.

This type of indicator enables us to assess the policy's progress, but that progress must be boosted by more detailed monitoring of its execution and adaptation measures implemented on the ground. Another area of research has been opened up here in order to identify the indicators that are the most relevant for monitoring the measures implemented as closely as possible and a method for correcting them.

IV. CONCLUSION

Since the turn of the century, and more particularly since 2005, adaptation has been attracting increasing interest from political decision-makers in developed countries, and the number of public measures is growing. As they notice that their country has already been affected by the initial impacts of climate change (severe droughts, flooding, etc.), prompted by public opinion, and warned by scientists about the increasing gravity of developments, decision-makers are beginning to draw up and implement adaptation policies and measures at government levels, from the local to the international ones.

The five European countries we chose to include in this report are among the most advanced in terms of defining adaptation policies. A comparative analysis has enabled us to highlight not only the differences between them, but also their common features, thus providing us with an indication of the key points that apparently need to be included in all adaptation policies. Among those points, one can note the following: i) high-level research into both local climate change impacts and socio-techno-economic research; ii) an appropriate institutional framework, that includes the founding of institutes that are specifically dedicated to working on adaptation in order to coordinate research and/or define policy, and the involvement of stakeholders, which is institutionalised to a greater or lesser degree according to the country's economic and political environment, and iii) the identification of key issues and of potential measures that can be implemented, which are often linked to existing sectoral or local policies aimed at ensuring the effectiveness of such measures.

Indeed, the research work performed on climate change represents the stage that comes before drawing up and implementing practical adaptation measures, and the studied countries have developed their own issue-based research. The understanding of climate change adaptation has been considerably increased by the major research efforts made regarding the issue, but must be further expanded. Despite inherent uncertainty on this issue, adaptation policies have adopted various decision-making principles that enable

decisions to be made in this context (the selection of no-regrets or flexible measures, the use of probability calculations, recourse to multi-disciplinary and multi-player approaches, etc.).

The various institutional organisations (federal government, centralised or non-centralised government, with or without powerful local authorities) also determine the institutional process followed in order to draw up an adaptation policy. All the countries have emphasised the local government level and have devolved the work on drawing up and/or implementing adaptation policies to sub-national governments to a greater or lesser degree. They have also underlined the need of coordination with private players, and the United Kingdom has even been developing specific tools intended for those players.

In most cases, the countries included in the report are only just beginning to draw up measures, except in the case of the Netherlands, which is at the forefront where country planning and flood risk management is concerned. Except in the case of flooding, where policies are usually quite advanced in most countries, the other issues are often still at the impacts analysis stage, and have not really reached the stage where operating measures can be defined. However, the countries are ready to consider the full range of possible measures ("hard", regulatory and organisational measures, etc.). The economic cost-benefit analysis of the measures and their funding has still not been significantly addressed. Likewise, the setting up of a committee to monitor measures in the medium-term and developing appropriate monitoring indicators are solutions that have not yet been widely envisaged, although they are an essential step for correcting policies on an ongoing basis.

These countries still need to improve the way in which they include adaptation considerations into existing policies, to continue their research on priority issues and improve the dissemination of tools that can be used by public and private players, to seek sources of funding and to reassess policies and measures on a regular basis. Operating measures are expected to be drawn up shortly, since most countries are setting themselves a 2012 target. Likewise, an EU Community adaptation strategy is also expected to be drawn up by 2013. The next three years will therefore be crucial for climate change adaptation in Europe. Faced with such a wide variety of issues and approaches in the Member States, the European Union organisations may not succeed in drawing up joint measures. However, the Community remains a key player in terms of ensuring trans-border coordination and at the very least, of disseminating information on best practices between the Member States, and of encouraging the remaining Members to draw up their own national adaptation policies. These points ought to be central factors in the new Community adaptation strategy.



APPENDIX 1 – NATIONAL INSTITUTIONS RESPONSIBLE FOR COORDINATING AND DISSEMINATING RESEARCH ON THE IMPACTS OF CLIMATE CHANGE IN SUPPORT OF ADAPTATION POLICIES

	Name of the body, date it was founded and annual intervention resources	Status of the body	Aims of the body (in terms of impact assessment)
Germany	KomPass (Centre of Expertise on Climate Change Impacts and Adaptation), founded in 2006; 9 people – €3 million for the <i>Climate Change Vulnerability, Impacts and Adaptation</i> programme	Centre founded by the Federal Environment Ministry within the Federal Environment Agency	<ul style="list-style-type: none"> - Processing data on climate change and climate impacts - Disseminating the information among decision-makers and the general public - Compiling and assessing adaptation projects and options
Spain	OECC (Spanish Climate Change Agency) founded in 2001 9 people – resources are not disclosed	General Department of the Ministry for the Environment, includes a Sub-Department dealing with impacts and adaptation	<ul style="list-style-type: none"> - Disseminating information (in the widest sense) - Analysing and promoting research on climate change and climate systems - Promoting impact assessments on vulnerability and adaptation to climate change - CCPCC Secretariat
	CCPCC (Climate Change Policy Coordination Committee)	Communication body between the central government and the autonomous regions	<ul style="list-style-type: none"> - Monitoring climate change and adaptation to its impacts at the political level
France	ONERC (National Observatory for the Effects of Global Warming) 5 people - €700,000	Department attached to the Energy and Climate Department at the Ministry of Ecology, Sustainable Development, Transport and Food	<ul style="list-style-type: none"> - Gathering and disseminating information on climate change (in the broad sense) - Currently in charge of drawing up the National Climate Change Adaptation Plan, following the national consultation process
Netherlands	Adaptation policies are generally handled by the Ministry of Housing, Regional Development and the Environment, except for the work performed by the Delta 2 Programme, which depends on the Ministry for Transport, Public Works and Water Management. Research work on climate change, primarily the recent <i>Knowledge for Climate</i> programme, is managed directly at the climate change research programme level.		
United Kingdom	UKCIP (<i>UK Climate Impacts Programme</i>) 15 people - €1.2 million	Programme based at the Oxford University Environmental Change Institute, and mostly funded by DEFRA (Ministry of the Environment)	<ul style="list-style-type: none"> - Coordinating scientific research on the impact of climate change - Helping organisations (governments, authorities, companies and individuals, etc.) to adapt to climate change

Source: CDC Climat Research.

APPENDIX 2 – REVIEW OF RESEARCH ON CLIMATE SYSTEMS AND THE EFFECTS OF CLIMATE CHANGE

Research area	Germany	Spain	France	Netherlands	United Kingdom	
Climate systems and drawing up scenarios	Information at the national level					
	Relatively reliable and user-friendly climate scenarios at the national (and European) level have been drawn up in the five countries, although there is possible room for improvement. A current research area in which there is significant activity involves 10-year forecasts, which ought to enable 5 to 30-year forecasts to be drawn up.					
Impact and vulnerability assessment	Degree of downscaling	Several methods and models are used for regionalisation. One of the methods used involves a 10 km grid.	Regional climate scenarios were drawn up as a priority during Phase 1 of the national adaptation plan. Work is ongoing as part of Phase 2.	Regional scenarios for 20 to 50 km grids. Below that level, the degree of uncertainty increases significantly. Better understanding of extreme climate events is required.	The <i>Knowledge for Climate</i> programme provides for the development of high-quality regional scenarios.	UKCP09 uses regional models for reducing the scale and sets out climate scenarios on a regional basis.
	Information at the national level	General sector studies have been conducted at the national level; in fact, some of the results are set out in the national adaptation strategy.	Sectoral studies have been conducted under the aegis and coordination of the ECCE and the national adaptation plan.	The ONERC has disseminated sector studies at the national level, various specific cases are being addressed in research programmes	Research programmes such as <i>Knowledge for Climate</i> or <i>Climate Changes Spatial Planning</i> have addressed the impact of climate change, often according to a local approach (linked to regional development)	A large number of sector or non-sector studies have already been conducted by the UKCIP, both at the national level and for each region. In addition, the UKCIP supports local authorities, companies and private individuals who want to assess their vulnerability, either on a voluntary or involuntary basis.
Climate systems and drawing up scenarios	Degree of downscaling	The Länder have conducted sectoral impact studies	The autonomous regions have drawn up their own adaptation strategies, which include an impact assessment section.	Case studies conducted at the local authority level are available.		

Source: CDC Climat Research.

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