



**COUNCIL OF
THE EUROPEAN UNION**

Brussels, 18 April 2013

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COVER NOTE

from:	Secretary-General of the European Commission, signed by Mr Jordi AYET PUIGARNAU, Director
date of receipt:	16 April 2013
to:	Mr Uwe CORSEPIUS, Secretary-General of the Council of the European Union

No Cion doc.:	SWD(2013) 132 final
Subject:	Commission Staff Working Document Impact Assessment - Part 1 <i>accompanying the document</i> Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: An EU Strategy on adaptation to climate change

Delegations will find attached Commission document SWD(2013) 132 final - Part 1.

Encl.: SWD(2013) 132 final - Part 1



EUROPEAN
COMMISSION

Brussels, 16.4.2013
SWD(2013) 132 final

COMMISSION STAFF WORKING DOCUMENT

Impact Assessment - Part 1

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

An EU Strategy on adaptation to climate change

{COM(2013) 216 final}
{SWD(2013) 131 final}
{SWD(2013) 133 final}
{SWD(2013) 134 final}
{SWD(2013) 135 final}
{SWD(2013) 136 final}
{SWD(2013) 137 final}
{SWD(2013) 138 final}
{SWD(2013) 139 final}

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An EU Strategy on adaptation to climate change

This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission.

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1. PROCEDURAL ISSUES AND RESULTS FROM CONSULTATION OF INTERESTED PARTIES

This Impact Assessment (IA) report forms part of the Commission's proposal for an EU Strategy on Adaptation to climate change¹. This initiative builds upon the White Paper "Adapting to climate change: Towards a European framework for action"².

1.1. Organisation and timing

An Impact Assessment steering group (IASG) met 3 times between May 2012 and October 2012. This group was chaired by DG CLIMA and the following services participated: AGRI, BUDG, ECFIN, ECHO, EEA, EMPL, ENTR, ENV, JRC, MARE, MARKT, MOVE, REGIO, R&I, SANCO and SG.

1.2. Consultation and expertise

This IA report has been preceded by wide-ranging consultation and benefits from a broad spectrum of scientific and policy expertise. Both inputs from stakeholder and research results are included in this report.³ Its preparation included the following steps:

Consultation with the **Adaptation Steering Group**: This group was created in September 2010 to support the Commission in developing its approach to adaptation. The ASG consists of representatives from EU Member States and a wide range of stakeholders, including business organisations and NGOs. The Group met 7 times between September 2010 and January 2013.

Ad hoc online public consultation: It was launched on 21 May 2012⁴ and ran for 13 weeks until 20 August 2012. The Commission received a total of 175 replies from a broad range of stakeholders, including Member States, business organisations, environmental NGOs and citizens.

Thematic seminars: Various events to consult Member States and key stakeholder groups on specific dimensions of the Adaptation Strategy (e.g. standards, forestry) were held in 2012.

Overall, stakeholders were supportive of additional EU-promoted action on adaptation, while acknowledging that many of the climate change impacts are to be addressed at local level. They highlighted that the Strategy will be especially useful for actors that are less advanced on the issue of climate change adaptation. Mainstreaming adaptation into key EU initiatives is seen by all as a priority, as well as providing the right framework, information tools, and EU funds that allow for the effective integration of adaptation issues at all levels of government. Some Member States would oppose an EU legislative instrument for promoting the adoption of national adaptation strategies. Environmental NGOs put a stronger emphasis on environmental issues than government and private organisations. Respondents to the public consultation also felt that the EU should be more involved in funding adaptation projects. Furthermore, stakeholders at all meetings raised the issue of uncertainty and reported that the lack of dedicated research hinders the adaptation process. In addition, communicating relevant information to decision makers was named as a challenging task.

¹ COM(2011) 777 final VOL. 2/2

² COM(2009) 147 final

³ In addition, annex **Error! Reference source not found.** presents an overview of topics which arose in the dialogue with stakeholders and how they are addressed in this report.

⁴ http://ec.europa.eu/yourvoice/consultations/index_fr.htm

The preparation of this IA report was accompanied by a pool of external experts⁵ and additionally used scientific/research results from the EU's Seventh Framework Programme for Research and Technological Development (FP7).

1.3. Addressing the Impact Assessment Board's comments

The IA was discussed at a meeting of the IA Board (IAB) on the 7th of November 2012. The IAB in its first opinion, asked for a revision of the document. Based on this, the report was modified as follows: i/ the **intervention logic** was clarified, by better linking the identified problems to newly-defined policy objectives. In addition, the policy options were amended so as to focus on problems that need to be addressed in priority at EU level. The specific and operational objectives were also linked to progress indicators, so as to provide a sound base for future assessments of the policy achievements; ii/ the **baseline scenario** was reinforced, so as to provide as much quantitative evidence as possible on the expected consequences of no additional EU action; iii/ the **policy options** have been more clearly defined, providing additional detail on the necessary implementation stages. The discussion around the need for a legislative proposal, its potential content and nature has also been reinforced so as to facilitate decision-making; v/ the **analysis of the social, environmental and economic impacts** is more transparent, clearly presenting the available evidence as well as the areas still subject to uncertainty. In terms of **procedure and presentation**, additional efforts have been put to clarify the achievements of the 2009 White Paper on adaptation as well as the remaining gaps. The results of the stakeholders' dialogue are now better scattered across the report, which facilitates the understanding of stakeholders' opinion on the identified problems and on the assessed options.

In its **second opinion**, issued on December 20, the IAB asked first for further strengthening the case for EU action concerning adaptation at sub-EU level and by the private sector. This comment has been addressed by reinforcing the positive impacts to be expected by EU-promoted action in most vulnerable sectors and regions. Second, the IAB asked for further clarifications regarding operational objectives and progress indicators, which have been modified so as to facilitate the assessment of the actions foreseen in the EU Adaptation Strategy during the reviewing phase. Thirdly, as requested by the IAB, the description of options has been separated from its assessment, via the use of a dedicated section. Finally, in line with the IAB's comments, in view of the evidence provided, the revised IA report is more balanced regarding the conclusions on the respective impacts of a legislative proposal requiring adaptation strategies now versus later.

2. PROBLEM DEFINITION, POLICY CONTEXT, AND SUBSIDIARITY

2.1. Climate change and the need for adaptation

The increase in global surface temperature is the most obvious aspect of anthropogenic climate change. The average temperature for the European land area for the last decade (2002-2011) is **1.3°C above the preindustrial average**, which makes the increase over Europe faster than the global average. Moreover, significant economic losses⁶ and human fatalities associated with **extreme weather events**, such as heat waves, droughts and heavy precipitation, have been registered.

⁵ Contract CLIMA.C.3/SER/2011/0026: 'Support to the development of the EU strategy for adaptation to climate change'

⁶ Between 1980 and 2011, direct economic losses in the EU due to flooding alone amounted to more than €90 billion. (EEA, 2012b).

Climate change will continue for decades to come because of the delayed effect of past emissions. Even if all greenhouse-gas emissions were to stop today, we would still see major changes in the climate. Achieving the EU goal of limiting the rise of global mean temperature below 2°C above pre-industrial levels, which was agreed by Parties to the United Framework Convention on Climate Change (UNFCCC) in 2010 as part of the Cancun Agreements, would reduce the most serious risks of climate change. Yet, although international pledges help in reducing emissions to below a business-as-usual level in 2020, they are insufficient to ensure a “likely” chance of limiting global warming to 2°C⁷. **Global mean temperature increases may therefore go beyond 2°C by the end of this century.** We therefore have no choice but to deal with the unavoidable climate impacts and their economic, environmental and social costs.

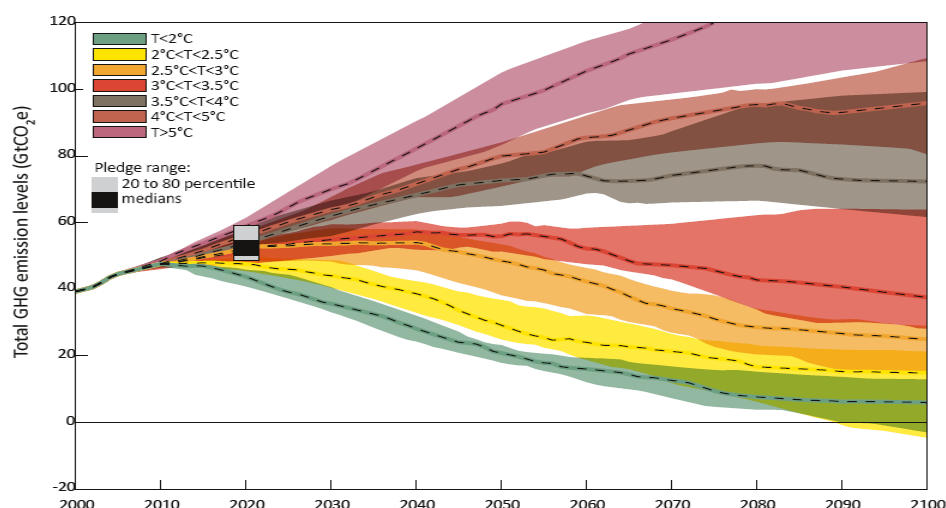


Figure 1: Likely (>66%) temperature increase (T) during 21st century associated with emission pathways. Source (UNEP, 2011)

Managing the risks of climate change implies **coupling mitigation efforts with adaptation to climate change**, since the success of each is linked to the other. The results of today's mitigation efforts will determine the degree of adaptation required in the future. At the same time, reaching levels of adverse impacts that will be impossible to address through adaptation must be prevented through mitigation. Early action will save on damage costs later. Examples of actions include using scarce water and energy more efficiently, adapting existing building codes to stand future climate conditions and extreme weather events⁸ or promoting green infrastructure, for instance in cities.

The recent EEA report on climate change impacts and vulnerability in Europe notably highlights that some studies estimate large economic costs for Europe. The minimum cost of not adapting to climate change is estimated to range from € 100 billion a year in 2020 to € 250 billion in 2050 for the EU as a whole⁹. Moreover, the PAGE09 Integrated Assessment Model¹⁰ reports total damage costs equivalent to almost 4 % of GDP for Europe by 2100 under a 3 to 4°C scenario, with a risk of extremely large costs at the tails of the distribution

⁷ UNEP (2011) The Emissions Gap Report: Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2° C or 1.5° C? A preliminary assessment.

⁸ This includes requirements under the Energy Performance of Buildings Directive (Directive 2010/31/) but not only.

⁹ EEA report No 12/2012 ‘Climate change, impacts and vulnerability in Europe’. Medium to high greenhouse gas emissions scenario, leading to temperature increases above the 2°C objective.

¹⁰ Watkiss, P. (ed.) (2011) *The ClimateCost Project. Final Report*, Vol. 1: Europe. Stockholm Environment Institute, Stockholm. <http://www.climatecost.cc/reportsandpublications.html>.

(in excess of 10 % of GDP equivalent). Under a scenario equivalent to the 2°C target, these fall to under 1 % of GDP equivalent and, more importantly, remove the tail of extreme values. Some other modelling approaches report lower values.¹¹

A recent study estimated the annual cost of adapting to global warming of modest level (+2°C compared to pre-industrial times) to between \$70 and 100 billion (approximately €55-75 billion) worldwide between 2010 and 2050¹².

2.2. Who is affected, in what ways, and to what extent?

The need for climate change adaptation is a horizontal issue, affecting all economic sectors, environmental systems and citizens, to varying degrees¹³.

2.2.1. Environmental challenges

Adaptation is particularly required to address climate impacts on water, soil, biodiversity and ecosystems. Challenges refer both to physical climate impacts and mutual dependencies across environmental systems, and to policy failures and knowledge gaps. On **soil**, climate change may aggravate erosion, decline in organic matter, salinization, soil biodiversity loss, landslides, and flooding. There is clear evidence to show that **biodiversity** is already responding to climate change and will continue to do so, though it is unclear how and whether biological systems will be able to adapt to an unprecedented combination of fast climate change, its associated disturbances and other human-induced negative drivers. Assessments show vulnerability primarily arises where species are constrained in colonising new areas with suitable climate. In the future, climate change is likely to affect **water** availability and quality and global warming will probably increase both the number and magnitude of hydrological extremes. In river basins under severe water stress, there will be strong competition for scarce water resources between households, industry, agriculture, and nature.

2.2.2. Sectoral challenges

Investments in **infrastructure or buildings** are increasingly put at risk by changing climatic conditions and extreme weather events. Buildings and infrastructure can be vulnerable to climate change because of their design (low resistance to storms) or location (e.g. in flood-prone areas, landslides, avalanches). Flooding is one of the most costly kinds of disasters and this is mainly due to floods in built-up areas. There is also a growing problem with overheating of the built environment being exposed to rising temperatures and extreme heat, which is not only an issue for the construction material but also affects the occupant's comfort and health.

Experiences of past catastrophes and research results show clearly that extreme weather events today are not sufficiently addressed by **transport** systems and in particular by risk or emergency management procedures within the transport sector¹⁴. More intense and frequent heat waves will shift **energy** supply and demand patterns, often in opposite direction. For instance, in the case of heat waves, supply will be lower due to decreased efficiency (for thermal plants), and decreased cooling water supply, while demand for air conditioning will

¹¹ In particular the JRC PESETA II project, presented in Annex 9.6.

¹² The World Bank 2010. The Economics of Adaptation to Climate Change: Synthesis Report. Washington DC, The World Bank

¹³ Details on the expected impacts of climate change and adaptation needs in Europe are provided in Annex **Error! Reference source not found.** It shows that climate change poses important environmental, economic and social challenges for adaptation, now and in the future.

¹⁴ Papanikolaou, A.; Mitsakis, V.; Chrysostomou, K.; Trinks, C.; Partzsch, I. (2011): Innovative emergency management strategies. Deliverable 3 of the research project WEATHER.

increase. Higher magnitude and frequency of extreme weather events will cause threats for physical energy infrastructure (explicitly overhead transmission/distribution, but also other infrastructure – e.g. substations, transformers or fragile supply infrastructure).

Climatic conditions affect **agriculture** and the water resources needed to maintain stable production levels in many areas of Europe and food security. Impacts of climate change and variability largely depend on farm characteristics (e.g. intensity, size, land use), as they influence management types and adaptation. Effects of climate change include increased risk of biotic (pests and diseases) and abiotic (droughts, storms and fires) disturbances to **forest** health. However, the exact effects of climate change on forests are complex and not yet well understood.

The frequency and intensity of most types of extreme event is expected to change significantly as a result of climate change (IPCC, 2012). In the short term, as long as due allowance is made for the underlying trend, premiums would rise gradually and the **insurance** market would absorb such changes without disruption. However, risk knowledge often advances in ‘steps’, which can lead to jumps in the price over a short period. In the longer term, particularly in sectors or areas where insurance has not been customary, climate change could create or exacerbate issues with correct pricing and availability.

2.2.3. *Social challenges*

Climate change is a significant threat to **health**. While the short- to medium-term impacts of climate change on health are mainly exacerbations of existing effects, projections for future impacts include an increase of heat-related mortality and illness as well as a higher burden from vector-, water- or food-borne diseases. Changes in weather/precipitation pattern and increases in extreme events are projected; therefore, more intense and frequent events are expected. Already in the past 20 years, 953 disasters killed nearly 88,671 people in Europe, affected more than 29 million others and caused approximately 250 billion Euros in economic losses¹⁵. Floods alone resulted in more than 2500 fatalities and affected more than 5.5. million people.

Europe's **ageing population**, disproportionately affected by reduced mobility or health impediments, will result in a higher share of the population being vulnerable to climate change impacts. **Displacement** of people due to climate change impacts presents a set of challenges including avoiding trapped populations, urbanisation, and managing free movement. Generally speaking, population groups with lower incomes and assets are more exposed to climate impacts but have less capacity to face them. For instance, women may be placed in a disadvantaged position when expensive adaptation measures are required.

Climate change will affect **labour markets** through the increase in adverse natural phenomena such as floods, heat waves, and variations in precipitation levels. On the labour market supply side, climate change may affect workforce availability due to a decrease in the health conditions of the population and additional occupational health constraints (higher temperature at work, more frequent and intense natural hazards keeping people from reaching their work place). On the demand side, several economic sectors are highly vulnerable because of their dependence on regular climate conditions. Sectoral production shifts – in agriculture and tourism for instance – are expected as a consequence of climate change¹⁶. Major investments in adaptation could offer employment and income opportunities in activities such as reinforcing coastal defences, buildings and (green) infrastructure, water

¹⁵ UNISDR (2009): Disaster statistics in Europe: available at http://www.unisdr.org/files/8867_pr200903DisasterStatisticsEurope.pdf

¹⁶ See for instance the discussion in Annex 9.2.3

management and relocation of exposed settlements¹⁷. Yet, great uncertainty remains regarding the possible net job creation effects of such investments. Skills upgrading will be necessary to grasp these opportunities.

2.2.4. Territorial challenges

Because of Europe's territorial diversity, **climate impacts vary from region to region** and are also very specific to the local situations. Some changes could provide time- and territorial-specific benefits (through better crop yields or increased tourism) while others will be detrimental to economic activities and the social fabric. This imbalance also holds on a broader level (see Figure 2).

Moreover, continuous changes in climatic conditions lead to widespread climate impacts, e.g. changes in species composition, damage to ecosystems and their services as well as to infrastructure associated with socio-economic consequences for European society and an increased need for disaster operations in many parts of Europe.

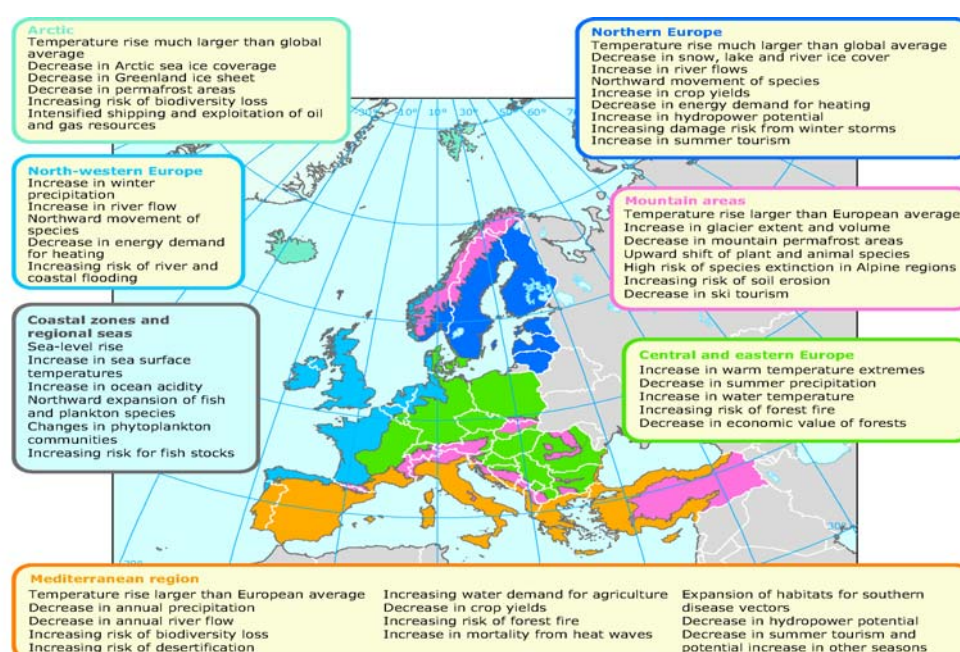


Figure 2: Impacts of climate change across Europe. Source: EEA 2012

Home to more than 70% of our population, **cities**¹⁸ play a crucial role for Europe's economy. Cities are exposed to a range of social and economic pressures which have the potential to worsen the impacts of climate change and increase the vulnerability of particular groups. For instance, soil sealing affects the vulnerability and resilience of cities and areas to climate change, as it is an important factor in the urban heat island effect. Similarly, climate change can magnify the pre-existing socio-economic challenges that cities face such as social exclusion or demographic change¹⁹.

¹⁷ ILO (2008). Global Challenges for Sustainable Development: Strategies for Green Jobs. ILO Background Note for G8 Labour and Employment Ministers Conference Niigata, Japan.

Available at: <http://www.ilo.org/public/english/bureau/dgo/speeches/somavia/2008/g8paper.pdf>

¹⁸ "Cities" here broadly stands for "cities and towns" including urban areas of less than 50.000 inhabitants, see http://ec.europa.eu/regional_policy/conferences/citiesoftomorrow/index_en.cfm

¹⁹ EEA (2012a): Urban adaptation to climate change in Europe. Challenges and opportunities for cities together with supportive national and European policies. EEA Report No 2/2012.

Available at: <http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change>

Climate risks in **coastal zones** include sea-level rise, changes in sea surface temperature leading to adverse weather anomalies, increased erosion or ocean acidification. In **drier areas**, drought and desertification are expected to increase. In the **mountainous regions**, temperatures are increasing at a faster rate than in other bio-geographical regions. Additionally, threats to local communities are expected to increase when avalanches, flash floods, landslides and rock falls become more common. Climatic risks are also likely to exacerbate the socio-economic challenges that **rural areas** face. Rural areas – which still make most of the EU's land area and represent an important share of employment – are exposed to a wide range of impacts such as those affecting agriculture, forestry, tourism, and infrastructure. The EU's **outermost regions** are particularly vulnerable to different types of extreme weather events (e.g. floods, drought and cyclones) and to sea-level rise.

2.2.5. Potential vulnerability to climate change in Europe

Exposure²⁰ to climate change and **sensitivity** to this exposure jointly determine climate change impacts, and impacts together with the **adaptive capacity** of a system determine climate change **vulnerability**. Exposure refers to the nature and degree to which a system is exposed to significant climatic variations, for example, the extent of warming observed. Sensitivity captures the degree to which the system is affected by changes in climate parameters, for example, the share of GDP of climate-sensitive sectors such as agriculture. Adaptive capacity refers to the ability of a system to deal with the potential impacts, for example, the quality of emergency services in a country.

Various methodologies are used to assess climate change vulnerability across the EU. Due to the uncertainty of climate projections and all subsequent analyses one may only speak of 'potential vulnerability'. As an illustration, the potential vulnerability of Europe's regions to climate change is depicted in Figure 3. It shows potential negative impacts on the **territorial cohesion** objectives of the EU. Climate change will trigger a deepening of the existing socio-economic imbalances.

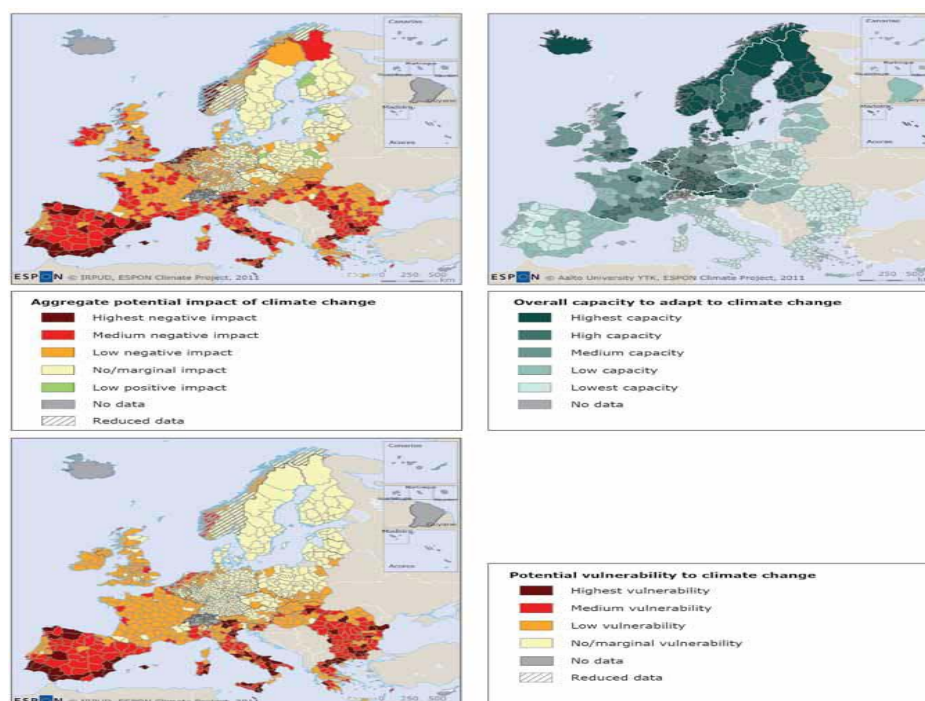


Figure 3: Potential aggregate impact, adaptive capacity and vulnerability to climate change. Source: ESPON Climate (2011), in *EEA: climate change impacts and vulnerability in Europe (2012)*

²⁰

See glossary for definitions

2.3. Policy context

2.3.1. EU initiatives

The **2009 White Paper** on adaptation to climate change called for a comprehensive EU Adaptation Strategy to be adopted by 2013. The 2009 White Paper included 33 actions to be implemented by end of 2012. Most actions announced in the 2009 White Paper have now been implemented or are in the process of being so. Yet, further action is needed along the main objectives identified in the White Paper. More specifically, **on knowledge gaps**, further EU-funded and national research is needed to fill gaps on methods, models, data sets and forecasting tools, in order to improve the understanding of current and expected climate impacts, vulnerabilities and adaptation options. On assessing the **cost and benefit of adaptation options**, some progress has been made at microeconomic level, but important gaps remain on the macroeconomic approach to model adaptation and assess their implications. No detailed assessment is available yet on the impacts of climate change and adaptation policies on **employment and on the well-being of vulnerable social groups**, though some progress has been made in the context of the recently adopted Employment package, especially through work on green jobs.²¹ **Mainstreaming** adaptation needs to be reinforced into some of the areas already highlighted as of key importance in the 2009 White Paper. This applies to the EU energy policy, for climate-proofing EU-funded infrastructure projects, and on the potential for insurance and other financial products to complement adaptation measures.

The 2011 Commission proposal for the next **Multiannual Financial Framework (MFF) 2014-2020** recognises mainstreaming as the MFF's favoured approach to facilitate the necessary contribution to a low-carbon economy and building resilience of sectors and policy domains²². It also includes a minimum contribution of 20% for climate related expenditure and that all EU funds will need to take climate change into account in their funding allocation decisions.

Contrary to the White Paper, the EU Adaptation Strategy will **not consider international issues**, that is, climate change adaptation in the rest of the world, as this is covered under the development and cooperation policy and through the UNFCCC negotiations.

2.3.2. Adaptation policies at Member State level

By **January 2013, 15 EU Member States have adopted an adaptation policy** (strategy and/or plan)²³:

²¹ SWD(2012) 92 final, Exploiting the employment potential of green growth

²² http://ec.europa.eu/budget/reform/commission-proposals-for-the-multiannual-financial-framework-2014-2020/index_en.htm

²³ The map considers all EEA Member States. This IA report concentrates on EU Member States. Note that Austria adopted its strategy in October 2012, which is not reflected on this map

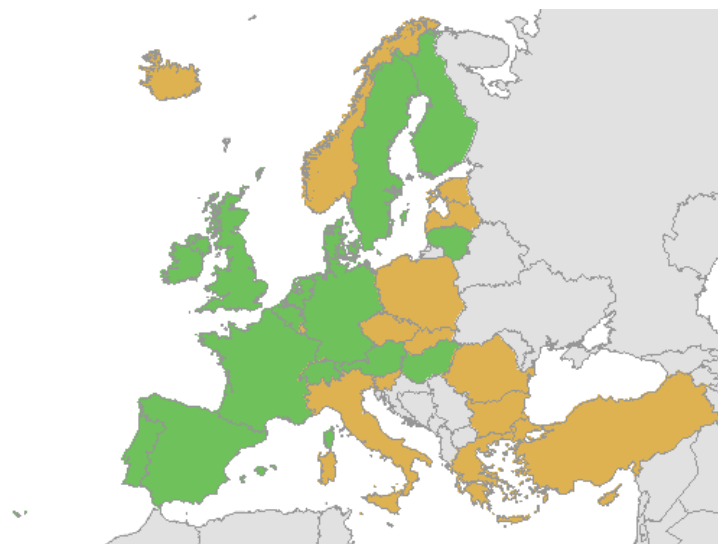


Figure 4: Member States with (in green) and without (in orange) an adapted adaptation strategy in March 2013.
Source: climate-adapt

Some of the adaptation strategies in place have **action plans** of varying levels of detail. Most adaptation strategies are being implemented (or will be implemented) by government / inter-ministerial committees or working groups. This approach confirms an acceptance of adaptation as something that must be implemented by **stakeholders** at all levels and in all areas of society, and not something to be pursued in isolation of other policy objectives, programmes and services.

Each of the adaptation strategies has been developed with **sectoral focus**. Integration and mainstreaming adaptation with existing national programmes and policies is central to all of them. **Communication and awareness raising** is another key principle of each of the adaptation strategy. Member States acknowledge that without effective communication and awareness raising, the adaptation strategy will not be successful.

Only one of the adaptation strategies in place considers **transboundary issues**, i.e. those issues affecting neighbouring countries: Belgium. In contrast, nine adaptation strategies consider **international issues**, that is the need to adapt to changes taking place in other parts of the world.

2.3.3. *Transnational, regional and local adaptation efforts*

No complete picture of adaptation efforts at regional or local level in the EU exists, though it is known that some regions have adopted regional climate change strategies in some cases dealing both with mitigation and adaptation, in others with adaptation only²⁴. There are some examples of joint adaptation projects between several European countries or cities in different countries. These are often partially financed by EU-funds such as the Life+ and programmes co-financed under the 'European Territorial Cooperation 2007-2013' objective. In addition, both transnational cooperation programmes 2007-2013 and macro-regional strategies have started working on transboundary adaptation challenges (e.g. Danube and Baltic Sea strategies²⁵, transnational cooperation programme 'Alpine Space'²⁶).

Cities are important drivers of adaptation activities at local and regional levels. Some cities in Europe have already adopted adaptation strategies or action plans or are in the process of

²⁴ E.g. in Germany, 10 out of 16 regions have a regional adaptation strategy, while in Spain, 6 out of 17

²⁵ <http://www.icpdr.org/main/activities-projects/climate-adaptation>

²⁶ <http://www.baltadapt.eu/>

<http://www.alpine-space.eu>

developing them. In several Member States, cities are cooperating with other cities on mitigation and adaptation issues, including sector-specific adaptation strategies and plans.²⁷

2.4. What are the specific problems that require additional action?

2.4.1. Knowledge and access to information gaps

What is the problem?

Adaptation to climate change is a relatively new policy area and the level of information is irregular. The **uncertainty** regarding the future impacts of climate change and related adaptation needs remains one of the most important cross-cutting challenges for policy making in this area. Global, EU and national research projects have improved our understanding of climate change impacts, vulnerabilities and adaptation over the past few years. However, data and knowledge gaps are still a major issue. The following topics represent relevant information barriers and **knowledge gaps** to adaptation activities:

- Information on projected damage and adaptation costs and benefits;
- Regional and local-level analyses and risk assessments;
- Frameworks, models and tools to support decision making within uncertainty and to assess the effectiveness of adaptation measures;
- Monitoring and evaluation of past adaptation efforts;
- Socio-economic trends that are interrelated with climatic changes;

As an example, Table 1 summarises the current knowledge on adaptation costs and benefits across sectors. Obvious gaps have been identified, for instance for business and industry.

Table 1: Coverage of adaptation studies in Europe (Selection). Source: ClimateCost project (www.climatecost.cc/).

Sector	Coverage	Cost estimates	Benefit estimates
Coastal zones	Very high coverage (infrastructure/erosion) for Europe, regions, several Member States as cities/local examples	+++	+++
Agriculture	High coverage of farm level adaptation benefits, as well as on costs of climate change, but less on adaptation	++	++
Health	Low – medium. Adaptation costs for heat alert and food-borne disease, but less coverage of other health risks	+	
Water	Low-medium. Limited number of national, river basin, or subnational studies on water supply	+	
Tourism	Low-medium. Studies on winter tourism (Alps) and some studies of autonomous adaptation from changing summer tourism flows.	++	+
Biodiversity / eco-system services	Low- limited number of quantitative studies	+	
Business and industry	Very low – no quantitative studies found		

Generating knowledge is only a first step. Once the information is available, it needs to be properly **disseminated**. Access to detailed data and reliable information is essential for a correct risk assessment. Knowledge of environmental issues improved over time, but according to a recent Eurobarometer survey, still around 40% of European citizens consider themselves badly-informed on environmental issues, indicating that considerable work is still needed to raise awareness and spread knowledge. To take a concrete sectoral example, a key challenge is to integrate findings from the physical and agronomic sciences with local knowledge from farmers, so as to develop robust and practical adaptation strategies, which,

²⁷ The 2012 EEA report on ‘Urban adaptation to climate change in Europe’ (EEA 2012c) provides examples from across the EU.

over a range of climate and socio-economic scenarios, can minimize the negative impacts of climate change.²⁸

The main tool for dissemination of knowledge on adaptation in the EU, the web portal **Climate-ADAPT**, already provides information from various sources, including observed and expected climate change in Europe, vulnerability of regions and sectors at present and in the future, disaster risk management, information on national and transnational adaptation strategies, case examples of adaptation and potential future adaptation options, tools that support adaptation planning, an overview of relevant EU policy processes. **Further work is however needed**, for instance for engaging platform users to upload relevant information. In particular, there is a lack of organised collection of data and information from the local and regional level, as well as of private sectors' initiatives. At national level, comprehensive adaptation portals exist in 6 Member States (AT, DE, DK, FI, SE, UK), while more limited adaptation portals are available in 8 more Member States.

Enabling societies to adapt to climate change will require establishing systems that transfer relevant information both from the national to the local level and vice versa²⁹. **Science-policy interfaces (SPIs)** aim to bridge relations between scientists and other actors in the policy process, which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making. Experience (e.g. in the Forestry sector) has shown that increased networking between scientists and policy-makers are important for improving communication in the science/policy interface. Given the relatively new nature of adaptation policies and the important knowledge gaps currently faced, the development of science-policy interfaces can contribute to better information dissemination and to increase **capacity-building**. At the EU level, a number of SPI research projects have been set up, in particular on agriculture, biodiversity, marine and water issues. In addition to the EU funded projects, there are some regional and national level initiatives taking place³⁰. However, most SPIs have not yet taken up the issues of climate change adaptation into their work.

What are the drivers?

In order to use synergies and decrease costs, comprehensive and most recent information on climate change impacts and adaptation with relevance for many European countries (e.g. EU-wide vulnerability assessment, compilation of adaptation options) needs to be generated, provided and disseminated centrally. However, an **insufficient level of cooperation** at EU level as well as with Member States and stakeholders does not allow identifying most pressing issues and avoiding overlaps and inefficiencies in defining and funding research projects. In addition, knowledge on adaptation remains an evolving problem which requires regular interactions to identify new priorities.

Climate-ADAPT, as well as other national portals, are still at an **early stage of development**. It initially focused on coverage of adaptation at EU level, as well as on relevant policies and good practice examples. Yet, time and political attention will be needed to improve the existing tool. Moreover, national adaptation platforms are costly to develop and financial and administrative barriers may hamper their effective development. One of the reasons for developing Climate-ADAPT was the lack of financial resources in Member States³¹. A lack of

²⁸ See section 9.2.1. on agriculture for more details

²⁹ <http://www.worldresourcesreport.org/expert-perspectives/question-five>

³⁰ BaltCICA (ed.) (2012): Climate Change Impacts, Costs and Adaptation in the Baltic Sea Region, Final Report, Version 1.0, May 2012.

Available at: http://www.baltcica.org/documents/BaltCICA_Final_Report_Version_1_080512.pdf

³¹ See http://ec.europa.eu/clima/tenders/2011/208209/clearinghouse_concept_note_en.pdf

institutions and working groups on adaptation also hampers the necessary science policy interfaces to maximise experience transfer.

Stakeholders' views:

Lack of knowledge, especially on the benefits of specific adaptation measures, has been identified as a major barrier by many stakeholders, both via meetings and via the online public consultation. In particular, research was considered as needing to be better integrated into EU policy making, making better use of EU funded research results. Although no formal assessment exists yet of the respective merits of Climate-ADAPT, stakeholders mentioned that the Adaptation Strategy should enhance the sharing of experiences and good practice on climate change adaptation, which can be provided by strengthening the European platform on climate change adaptation, Climate-ADAPT. It experienced a very high web use/traffic during and immediately after the launch, ranking high compared to launches of other EEA products

2.4.2. Gaps in adaptation action at sub-EU level

What is the problem?

Article 4.1 (b) and (e) of the UNFCCC recommend in a broad and non-prescriptive manner the formulation and implementation of programmes containing measures to facilitate adaptation to climate change, a recommendation not even followed by all Member States. Still, the UNFCCC "*affirms that enhanced action on adaptation should ... follow a **country-driven**, gender-sensitive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science, ..., with a view to integrating adaptation into relevant social, economic and environmental policies and actions*"³². National governments have an important stake in adaptation because climate change directly affects a wide range of services, operations, programmes, or assets (e.g., infrastructure, land). Moreover, climate change impacts will affect different regions differently and it is the role of the national authorities to provide a national response to these questions.

Adaptation strategies are the most effective instrument in preparing Member States to assess impacts, vulnerability and adaptation options and thus to face the projected impacts of climate change across sectors. Unlike mitigation, there is not a one size-fits-all solution for adaptation. Each Member State will experience different effects and impacts of climate change (e.g. precipitation could increase or decrease, depending on locations), vulnerability is also country-specific, derived from particular physical (environmental), social and economic features. And the way of planning and implementing adaptation is also specific to the particular governance system of each Member State. Effective adaptation to climate change requires mainstreaming it along a large number of policies. This needs to be coordinated or allowed by the executive or legislative powers.

Some Member States are active in the adaptation policy field but the **following gaps have been identified**: i/ almost half of Member States have not yet adopted an adaptation strategy; ii/ the level of efforts and the level of detail provided differs widely among Member States; iii/ almost none of the adaptation strategies in place deal with transboundary issues, or employment or social issues; iv/ the funding of adaptation options remains vague in many cases; v/ only a third of Member States have implemented an impacts, vulnerabilities and adaptation assessment to support policy; and vi/ only two Member States have made

³²

See http://unfccc.int/adaptation/cancun_adaptation_framework/items/5852.php

substantial progress in developing indicators and monitoring methodologies. The fact that a Member State has developed a strategy or an action plan does not necessarily imply that it is based on solid science and research, nor that the plan contains precise implementation measures or sufficient funding has been planned.

In some Member States, regions have wide management and planning powers. Yet, regional adaptation strategies are not widespread and not very well communicated.

The same is true for adaptation across Europe's **cities**. Preliminary findings from the Adaptation Strategies for European Cities³³ show that around a quarter (24%) of the 100 cities or so surveyed so far report that an adaptation strategy has been adopted in their city. While a few cities believe they are well prepared (e.g. Rotterdam, Aalborg and Copenhagen), acting above and beyond their respective national governments, there are also cities that clearly need more support and guidance in order to adapt effectively (just under half the cities surveyed believe they are still in the very early stages of work on adaptation). Adaptation remains a **new policy area for many city administrations**.

What are the drivers?

Understanding of the concept of climate change adaptation by policy-makers still remains a barrier. Guidelines for developing regional climate change adaptation strategies are available³⁴, but a special focus on adaptation strategies at Member State level is still lacking. **Insufficient human and financial resources** at all levels are a major barrier, more so under the current economic climate. Financing is a particular issue for adaptation as specific studies need to be commissioned and budgets do not always allow for this. Even when research results exist, some Member States find it difficult to compile, collect and organize existing information with relevance for adaptation to climate change, notably in the absence of a national climate change adaptation portal.

Additional instruments are required to internalise the **cross-border externalities** of climate change adaptation. Some adaptation responses provide benefits or costs to other Member States. For example, activities such as defences against sea-level rise, building harbours, beach nourishment, dredging etc. do change coastal dynamics and can have an impact on neighbouring states. Coordinating instruments are therefore needed for a better integration of transboundary issues in national policy-making.

One key barrier for cities and governments trying to address adaptation is a **lack of cross-sectoral** collaboration within authorities and a prevailing "silo mentality". Whilst adaptation plans are developed by climate change departments, they do not filter into e.g. land use planning, and are not always mainstreamed in other sectoral policies, which may not see the links between adaptation and their own policy objectives.

Stakeholders' views:

A large majority of stakeholders see the need to enhance awareness of the actual and potential consequences of climate change and the need and possibilities for adaptation to climate change at regional/ local level. There is expectation from some Member States that the European Commission will deliver an external 'push' for action.

2.4.3. Gaps in adaptation uptake in key sectors

What is the problem?

³³ <http://eucities-adapt.eu/cms/>

³⁴ http://ec.europa.eu/clima/policies/adaptation/docs/ras_final_report_en.pdf

To favour synergies and decrease the costs of adaptation, the EU has recognised the need to foster **mainstreaming** into all EU sectoral policies:

Adaptation has already been mainstreamed in legislation in such sectors as marine waters³⁵, forestry³⁶, and transport³⁷; and in important policy instruments such as inland water³⁸, biodiversity³⁹ and migration and mobility⁴⁰.

In addition, the Commission has tabled legal proposals on integrating adaptation in agriculture and forestry⁴¹, maritime spatial planning and integrated coastal management⁴², energy⁴³, disaster risk prevention and management⁴⁴, transport⁴⁵, research, health⁴⁶, and the environment⁴⁷.

Forthcoming policy initiatives, in areas such as invasive alien species (2013), green infrastructure (2013), land as a resource (2014-15), and a new Forest Strategy (2013) are also expected to consider adaptation. Guidelines on adaptation and coastal zone management are being formulated (2014), and guidelines on adaptation and the Natura 2000 network are shortly to be issued (2013).

So far, European policies help address some of the transboundary issues associated with climate change. For instance, the Floods Directive and the Water Framework Directive promote transboundary cooperation in the water sector. Also, European and pan-European early warning and detection systems for weather-driven natural disasters exist such as the European Flood Awareness System, the European Forest Fire Information System and the European Drought Observatory.

Despite significant achievements, mainstreaming of climate adaptation is not yet recognised in policies dealing with social and education policies, tourism, fisheries, insurance and trade. In the case of energy, transport, disaster risk reduction or health additional efforts are needed. The 2009 White Paper proposed guidelines on adaptation and coastal zone management, which have not yet been developed.

Due to the long life spans of much of our energy, transport and buildings **infrastructure** and their great economic value, their preparedness for current and increasing future impacts of climate change is critical. For some EU policy areas, climate resilience has already been taken up as a parameter in cost-benefit analyses during the project development phase⁴⁸. However,

³⁵ Council Directive 2008/56/EC and EU Regulation No 1255/2011

³⁶ Regulation (EC) 2152/2003

³⁷ Decision 661/2010/EC

³⁸ COM(2012)673 final

³⁹ COM(2011)244 final

⁴⁰ COM(2011) 743 final

⁴¹ http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/index_en.htm

⁴² COM(2013) 133 final

⁴³ COM(2011) 665/3

⁴⁴ COM(2011)934 final

⁴⁵ COM(2011) 650/2 final

⁴⁶ http://ec.europa.eu/governance/impact/planned_ia/docs/2013_sanco_002_eu_plant_health_law_en.pdf

⁴⁷ COM(2012) 628 final

⁴⁸ For example, the proposal for 'guidelines for trans-European energy infrastructure' COM(2011)658 includes, in annex V, the 'system resilience, including disaster and climate resilience, and system security, notably for European critical infrastructure as defined in Directive 2008/114/EC' as an aspect to be considered for cost-benefit analyses for electricity transmission and storage. The majority of the Global 500 companies (81%) report physical risks from climate change and the percentage of companies that view these risks as current has nearly quadrupled from 10% in 2010 to 37% in 2012. In the UK the Carbon disclosure project surveyed members of the FTSE 100 group of companies finding more than 80% identify substantive risks to their business from climate change.

there is no general requirement to do so, neither in terms of assessing the costs and benefits of a project, nor when defining the technical characteristics of a project. In 2010, more than 1.5 million housing permits were issued in the EU, and construction started on close to 1 million homes. While some adaptive measures can be retrofitted cost-effectively (e.g. to save water), others are best incorporated into the design of the building. The IPCC identifies the enforcement of building codes as a low-regret measure that can reduce exposure and vulnerability to hazards and change. For municipal governments, adoption of building codes in disaster-prone areas reduces damages by US\$ 108 (84€) per square meter for homes built from 1996 to 2004 in Florida⁴⁹. In addition, **green infrastructure**, or ecosystem based approaches, can often be cost-effective options to increase resilience of a specific area, for instance green roofs in cities. **Strengthening the implementation of green infrastructure has just been taken up by the Communication on a Blueprint to Safeguard Europe's Water.**

In addition to the physical risks it brings, climate change will affect areas such as supply chains, logistics and raw materials costs, in turn impacting on **companies'** profits. The impacts from these risks are systemic (at the whole economy level), sector / industry-wide or company-specific. Climate-resilience of business operations and supply chains is therefore essential. Although there is evidence of on-the-ground adaptation⁵⁰ this is mainly from multinational corporations and there is little evidence of adaptation in SMEs outside those sectors most exposed to climate and current weather variability and extremes, e.g. the water sector or agriculture. Companies (and particularly SMEs) are discouraged by the often high initial costs of infrastructure changes as they focus on short-term returns, and ignore environmental risks. At the same time, SMEs are also discouraged to adopt a pro-active stance as autonomous providers of services and products for adaptation because of limited knowledge, information and technical support, expertise, time and resources⁵¹. A coherent framework of policies and regulations is necessary for effective decisions on adaptation, providing the right incentives and helping address potential barriers.

Climate adaptation is not only an instrument contributing to maintain the EU's macro-economic stability and growth, but it is also a growing market, with expected business opportunities for European firms on the EU and global markets. Thus, **adaptation will create new demand and market opportunities and increase need for innovation.** For instance, with increased water scarcity envisaged, the need for irrigation will continue. While innovations in irrigation appear to reduce downstream employment opportunities due to more efficient techniques, the European companies can grasp opportunities from selling water-efficient agricultural irrigation technologies worldwide. Approximately 28% of cropland is now under irrigation, with half of this located in Asia⁵². But European companies will need to improve their products and invest in R&D to compete to existing and forthcoming competitors from Asia.

What are the drivers?

⁴⁹ Kunreuther, H.C., E.O Michel-Kerjan, with N.A. Doherty, M.F. Grace, R.W. Klein, and M.V. Pauly, 2009: At War With the Weather: Managing Large-Scale Risks in a New Era of Catastrophes. MIT Press, Cambridge, MA.

⁵⁰ PWC (2010) Business leadership on climate change adaptation: Encouraging engagement and action; . OECD (2011) Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks; UK Trade & Investment (2011) Adapting to an uncertain climate: A world of commercial opportunities

⁵¹ Flash Eurobarometer 342, SMEs, Resource efficiency and Green Markets

⁵² See Commission study *The number of jobs dependent on environmental and resource efficiency improvements*, 2012.

First, some of the actions undertaken in the context of the implementation phase of the 2009 White Paper have not yet achieved their initial objectives, because the **initial knowledge gaps were too significant**. For instance, additional EU-funded projects have allowed a better understanding of adaptation costs and benefits for coastal zones and river floods, but not yet for forestry issues. Second, only a limited number of EU legislative acts are considering climate change, and **always following the normal revision** cycle of EU legislation. For instance, the EIA Directive is under revision and clearer provisions relevant for climate change have been proposed, but the Strategic Environmental Assessment Directive (which arguably also needs to include climate change adaptation considerations) has not been revised yet. Third, there are sometimes **inconsistencies between adaptation and some other EU policy objectives**, for instance when EU policies provide incentives for additional use of water resources in areas prone to an increase in the frequency of droughts.

There is **no common methodology or guidance** in place to systematically assess the **climate resilience of infrastructure projects** and improve their sustainability and liability in changing climate conditions. The work on **design standards** has remained uneven, in particular due to the coordination resources required to address the issue of climate change adaptation considerations in the thousands of design-standards potentially affected.

A number of **barriers prevent the private sector** from taking appropriate adaptation actions and future-proofing their business, among which the current economic conditions which are particularly unfavourable to long-term investments, especially for SMEs. The lack of accurate, reliable information, networking and exchange of experience also hinders the uptake of adaptation investment because of a lack of awareness of climate-change related risks. Moreover, almost none of the adaptation strategies currently in place at Member State level consider the explicit role and constraints faced by the private sector. Yet, as reiterated in the concluding remarks of the Informal Environment Council of 7-8 July in Cyprus,⁵³ Member States stressed the need for a balanced approach, so that adaptation is undertaken by a variety of actors, including individuals, communities, businesses and the private sector, civil society and governments. They also emphasised that reliable funding, both public and private, is a key for implementing any policies, plans or measures, and that the private sector had a key role to play in this context, both through private equity funds and the provision of technical expertise.

Stakeholders' views:

A consistent and comprehensive mainstreaming of adaptation is seen by all stakeholders as a priority. According to respondents, the sector with the highest relevance for improving Europe's resilience to the adverse impacts of climate change is water, followed by agriculture and rural development, nature conservation, energy and transport. Respondents identified the 'contradictory requirements from different EU policies' as a barrier. They also ranked improving the climate resilience of infrastructure investments as being very relevant. Financial constraints have been mentioned as barriers to the uptake of adaptation action. The business sectors' respondents to the online consultation rank the "short-term vs. long-term horizon" issue as the most important barrier to the uptake of adaptation action. In that respect, financial institutions and insurance companies are considered to have a key role to play in providing adequate incentives to companies.

⁵³

http://www.cy2012.eu/index.php/en/file/Y5RGhpLt8X_2nxXo9+AUZw==

2.5. How would the problems evolve by 2020 without further EU action?

2.5.1. Knowledge and access to information gaps

The EEA has just adopted a report on climate change impacts and vulnerability in Europe⁵⁴. At international level, the Intergovernmental Panel on Climate Change's (IPCC) 5th assessment report will be adopted in 2014 and will provide the state of the art on expected impacts, adaptation and vulnerability at global level. In addition, the Commission proposal for **Horizon 2020** includes ambitious research objectives on climate change in general, and climate change adaptation in particular. Moreover, the Commission's proposals for the next MFF allow for Member States to draw on the 2014-2020 Cohesion Policy and CAP to address the knowledge gap and invest in the needed analyses, risk assessment, tools and build up capacities for adaptation.

Yet, without additional efforts to identify knowledge gaps and coordinate research efforts among European and national institutions, some **overlaps in research projects** are expected, and knowledge gaps would not be addressed in the most effective way. To take one example, between 2009 and 2012, various projects have looked at the costs and benefits of adaptation at EU level, but limited progress has been made, as this information remains still mainly available for river floods and coastal areas. Even if funding is available, a lack of coordination in research activities would have indirect economic social and environmental implications, as not enough information would be made available for decision-making on resilience to climate change in the EU.

The Climate-ADAPT platform makes available information on adaptation to climate change in Europe. **Climate-ADAPT** already experienced a very high web use/traffic during and immediately after the launch, ranking high compared to launches of other EEA products. **Yet, no longer-term programme for the platform has been approved.** Without additional action, it is not expected that the coverage of Climate-ADAPT would change fundamentally, which would lead to significant gaps, in particular on local or regional issues. This is particularly problematic for stakeholders, in particular the private sector, in those Member States who have not developed yet a climate adaptation web-portal. Science-policy interfaces will continue addressing climate change adaptation on ad hoc basis and the **mainstreaming of adaptation in sectoral SPIs will remain limited.** Therefore, any progress on research in adaptation faces the risk of remaining unaccessible to decision makers, in particular in those sectors where no science policy interface could be detected, such as energy or transport. It will also be extremely difficult for practitioners to report to researchers on their adaptation expertise on the ground.

2.5.2. Gaps in adaptation action at sub-EU level

Some new developments at national, regional and local level are expected in the years to come. However, without additional action, **the barriers** currently preventing national, regional or local authorities from developing ambitious adaptation strategies are **likely to remain.** When there is no adaptation strategy, a lack of resources will prevent the necessary groundwork from being undertaken, potentially delaying the adoption of a strategy. This is in particular the case in Southern and Central European Countries in economic crisis. In most cases, precisely these counties are likely to face significant impacts of climate change earlier than elsewhere in Europe. From among these countries, Cyprus, Greece, Bulgaria, Slovenia and Romania appear to not have started yet the development of a comprehensive adaptation

⁵⁴ EEA (2012b): Climate change, impacts and vulnerability in Europe – An indicator-based report. EEA Report No 12/2012.

strategy, whereas Italy, Slovakia and Czech Republic are expected to finalise planning processes in 2013 or later in the next year(s).

An unprepared **Member State faces higher risks of significant economic, social and environmental losses**. To illustrate the above assertion, one can compare France's response to the 2003 heat wave compared with Greece's response to the 2007 wildfires. France subsequently set out to improve its ability to respond by developing an early warning system. Greece was much slower in addressing institutional shortcomings, and as a result found itself once again vulnerable when the problem reappeared in 2009.⁵⁵

For those Member States having already adopted an adaptation strategy, the lack of funding would mean that the strategies would not be translated into the necessary action plans. That is, even if an adaptation strategy is in place, the absence of concrete action, inadequate incentives or previous infrastructure investment decisions may leave some regions or Member States in vulnerable situations. For instance, in February 2010, the storm Xynthia hit the French Atlantic coast. In combination with the high tide and large waves, it caused the failure of flood defences, which led to the flooding of more than 50 000 ha. 53 people died because of the storm itself or the flooding and the cost of the damages is estimated around 2.5 billion €, a human and economic cost much higher than the impacts of Xynthia in Spain or Portugal.

Moreover, **climate change in one region can have repercussions elsewhere**. For instance, the summer 2010 heat-wave in Russia was one of the drivers leading⁵⁶ to an increase in the price of staple goods like pasta and bread all over Europe because Russia's wheat crops failed. It also contributed to inflation differentials across the Euro area, as Member States were diversely affected by an increase in import prices for agricultural products from Russia, the Baltic States being particularly sensitive to this increase.

Although the quantification of loss from a lack of strategy in each Member State is not possible, the risk is that effective adaptation actions would not take place across all Member States at similar pace, or that the approach followed and recommendations given would be inconsistent. An issue explored in the JRC PESETA II project is the extent to which climate impacts affecting part of Europe (because adaptation measures are not taken) could affect the rest of Europe due to **trade effects**. Two counterfactual situations were simulated, where it was assumed that only one EU region would face the impacts of climate change⁵⁷. In both cases, there appears to be **additional welfare loss in the rest of the EU**, equivalent to 20-30% of the welfare loss experienced in the region directly affected.

Transboundary issues have a broader scope and create interdependencies between countries (e.g. hydrological, social and economic ones in the case of water). For instance, ecological corridors and 'stepping stones' have to be planned and managed across national boundaries. Moreover, food security or global supply chain issues can require cross-border cooperation to diversify import sources.

Yet, under no policy change, **transboundary issues will remain a gap** in most of the strategies, which can lead to conflicting adaptation responses and would not provide for an effective approach to tackle common risks. Cross-border and transnational coordination will continue under the European Territorial Co-operation, but will remain mostly not linked with national and sub-national adaptation policy developments as having their focus on joint management of programmes and projects.

⁵⁵ Fankhauser, S. and Soare, R. (2012): Strategic Adaptation to Climate Change in Europe, Report prepared for the European Investment Bank, March 2012

⁵⁶ Other drivers notably include the Russian export ban, which increased the vulnerability of some EU Member States.

⁵⁷ The two cases are explained in detail in Annex 9.6

In addition, an inadequate level of preparedness at national, regional or local level would have implications on the effectiveness and sustainability of **EU Funding**. Investments made (e.g. in agriculture, infrastructure, biodiversity) in unprepared countries could lead to inefficient expenditure. Cohesion Policy contributed over the period 2007-2013 to more than 10% of public investments in Europe. Yet, out of the ten Member States having the higher share of EU funds to their public investments, only two have adopted an adaptation strategy (Portugal and Malta).⁵⁸ The risk is therefore that the EU would fund investments that are vulnerable to climate change.

In addition, national support and funding is necessary to finance adaptation action at local level. The absence of such support will increase existing disparities with respect to the potential vulnerabilities to climate change at **regional and local** level. Moreover, the impacts of climate change on cities are characterised by their interlinked, and often transboundary nature. Thus even those better prepared cities could be affected by other locations which suffer as a result of being poorly adapted.

2.5.3. *Gaps in adaptation uptake in key sectors*

Without additional mainstreaming, some of the **EU and Member States' policy objectives will become more difficult / costlier to achieve**. To take two examples, in addition to the discussion on infrastructure that follows, most of the existing social policies do not explicitly address the climatic change impacts on the social domain, which can be expected in the future, and which could hamper the achievements of the social pillar of the Europe 2020 Strategy. Moreover, recent analytical research shows that there is currently an overall low market penetration rate of disaster insurance in Member States,⁵⁹ which can have a negative impact on the sector itself, but also on the economic value of the insured and non-insured assets, and therefore on the competitiveness of European firms. By combining penetration rates with damages associated with extreme weather events, potential vulnerable Member States have been identified, such as BG, AT and SI in terms of flood risks or BG, GR, IT and RO in terms of storm risks.

In addition, in order to meet the objective of a minimum contribution of 20% for climate related expenditure in EU Funds, additional attention must be given to the **implementing measures** accompanying broad policy objectives, for instance, on how to use the proposed Common Strategic Framework (now referred to as the European Structural and Investment) funds. Whereas some minimum guaranteed share of funding is proposed for cohesion policy to support mitigation measures such as energy efficiency and renewable energy, in particular in more developed and transitional regions, there is no similar earmarking of funds for adaptation, except for the overall objective of having at least 20% climate-related expenditure overall for the future EU budget. Where possible, priority should be given to options that realise important synergies with climate change mitigation or bring about co-benefits for other sectors such as industry, transport, water management and social inclusion. This would help to promote climate adaptation under different thematic objectives.

Without further EU action, **considerations about current and future impacts of climate change for new infrastructure investments will remain vague**. This is problematic as already now, climate hazards have an impact on buildings and infrastructure. For instance, the ClimateCost project estimates the expected annual damage of river floods at €20 billion annually by 2020. Analysis at the country level shows high climate-related costs in the UK,

⁵⁸ The ten Member States where Cohesion Policy represents the highest proportion of public investment are: HU, LT, SK, EE, MT, BG, LV, PL, PT, and RO.

⁵⁹ Joint Research Centre, European Commission (2012), *Natural Catastrophes: Risk relevance and Insurance Coverage in the EU*; OECD (2011), *Future Global Shocks, Improving risk governance*.

Ireland, Italy, the Netherlands and Belgium. The study also assessed the costs and benefits of adaptation. The benefits of these minimum protection levels are estimated at €9.2 billion/year by the 2020s. Moreover, the construction of new developments in flood-prone areas is likely to continue as room for settlements is limited in many European countries. The non-inclusion of climate change adaptation considerations could imply lower investment costs in the short term, but higher increasing maintenance/reconstruction costs in the medium to long term. To take one example, the FP7 WEATHER project provides estimates of costs associated with extreme weather events on transport (~2.2 billion €/yr.) largely explained by damages to road infrastructure (80%). Such costs are expected to increase by 24 to 47%, depending on the climate scenario, by 2040-2100. Moreover, negative interactions with 2020 climate change mitigation objectives would occur: the absence of retrofitting could mean that old buildings will need to be cooled with some use of fossil fuel, leading to additional emissions, thus further accelerating climate change and enhancing the need for adaptation.

Limited efforts have been made at national level to further climate-proof **design standards**, as reported in the context of a consultation of national standardisation bodies.⁶⁰ Climate change impacts are often local by nature, but the lack of harmonised approach on standards at EU level will create potential **technical barriers to trade**. Moreover, the IPCC (2012) recalls examples of highly variable enforcement of building codes by municipalities, becoming a limiting factor in disaster risk management and adaptation.

Some of the largest transnational corporations, and those in certain sectors, have begun to appreciate the potential threat and opportunity presented by climate change. However by 2020, in particular **many SMEs will be unable to make the necessary adaptation measures** making them increasingly vulnerable to the effects of unavoidable climate change. In the absence of measures from the EU to increase adaptive capacity, the **gap between large corporations and SMEs will widen** – possibly creating market obstacles for those left behind⁶¹. Without adequate public policy on adaptation, such changes would lead to unnecessary additional **frictions on the labour** market.

2.6. Does the EU have the right to act and is EU added-value evident for enhancing climate resilience?

The legal basis for adaptation action is Article 192(1) of the Treaty on the Functioning of the European Union. Combating climate change is now explicitly referred to in the Lisbon Treaty.

EU intervention in the field of climate change adaptation must respect the principles of subsidiarity and proportionality. While a “one-size-fits-all” approach to adaptation is clearly not appropriate, there is a key role for – and significant benefits to be gained from – integrated, coordinated EU adaptation action to complement national, regional and local efforts.

The EU can coordinate efforts to identify knowledge gaps and support specific **research** programmes on adaptation through focused project calls. EU-wide programmes promote economies of scale in research, data gathering, knowledge transfer and capacity-building. The

⁶⁰ DK seems to have done some pioneer work on this issue. Road regulations and railway standards are being/will be reviewed and revised with consideration of expected climate changes. Moreover, the UK's standardisation body has given a specific emphasis on climate change adaptation measures in standardization work with the construction sector and more recently, its biodiversity work. Other Member States active at national level include BE, DE and NL.

⁶¹ Lack of action can have negative implications on the right to fair and just working conditions (Title IV, art. 31 of the Charter of Fundamental rights) for employees due to additional occupational health constraints (higher temperature at work, more frequent and intense natural hazards keeping people from reaching their work place) not adequately addressed.

EU can also facilitate further science-policy interaction to facilitate the adoption of effective measures at national or subnational levels.

The EU can promote adaptation action **covering the whole EU territory**, since lack of preparedness or inaction in one Member State may have negative consequences for neighbouring countries. It is clear that climate change will impact everywhere, irrespective of administrative boundaries. Many of the adaptation measures required have cross-border dimensions (e.g. for river basins and bio-geographic regions). There is a role for the EU in promoting and coordinating such cross-border adaptation action.

At the same time, the EU has a responsibility to **integrate adaptation into its own policies** and financial programmes, given its competence in areas such as water, agriculture, biodiversity, health etc. and the implications this has for Member States policies. This includes ensuring that adaptation action is consistent with mitigation and vice versa.

Fundamental rights will also be affected by climate change and climate change adaptation policies. Climate change impacts such as sea-level rise, flooding or storm surges, threaten individuals' safety and security on a large scale and have effects on the right to life and the right to the integrity of the person (Title I, art. 2 and 3 of the Charter of Fundamental Rights), as well as on the right to property (Title II, art. 17). In particular, women are likely to be disproportionately affected by climate change as social exclusion has a strong gender bias that increases their vulnerability to climate change, as they have fewer means on average (Title III, art. 23). Elderly people and children are disadvantaged also in terms of health (greater exposition to injury, death and destitution as a result of extreme weather events) or ability to migrate (restrictions on mobility). In a global perspective, climate change will also jeopardise the fundamental right to an environment capable of supporting human society and the full enjoyment of human rights (Title IV, art. 37 of the Charter).

3. OBJECTIVES

3.1. What are the general and more specific/operational objectives?

3.1.1. General objective

The general aim of the EU Adaptation Strategy is to contribute effectively to a more climate resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change of the EU and its Member States, down to the local level. Particular attention is given to transboundary issues and sectors that are closely integrated at EU level through common policies.

3.1.2. Specific and operational objectives

To meet this general objective, and to address the problems listed above, three specific objectives have been identified, each one broken down into two operational objectives.

Better informed decision making: the EU Adaptation Strategy should further the understanding of adaptation, improve and widen the knowledge base where knowledge gaps have been identified and enhance dissemination of adaptation-related information.

Operational objective 1a: by 2020, priority knowledge gaps identified in 2013 have been closed

Operational objective 1b: by 2020, communication tools allow for available information on climate change adaptation to be more easily accessible for decision-makers, including Member States, local authorities and firms.

Increasing the resilience of the EU territory: the EU Adaptation Strategy should promote adaptation action at sub-EU level, and support and facilitate exchange and coordination. In doing so, the Strategy should address cross-border climate impacts and adaptation measures.

Operational objective 2a: by 2017, all Member States have adopted (an) Adaptation Strateg(y)ies, complemented by regional or local adaptation strategies when appropriate.

Operational objective 2b: by 2020, cities of more than 150,000 inhabitants have adopted an adaptation strategy

Increasing the resilience of key vulnerable sectors: The EU Adaptation Strategy should develop initiatives for a consistent and comprehensive integration of climate change adaptation considerations into sectors that are closely integrated at EU level through common policies.

Operational objective 3a: by 2020, adaptation considerations have been mainstreamed in a consistent and comprehensive way in key EU policies.

Operational objective 3b: by 2020, new major infrastructure investments are climate-proofed.

3.2. Consistency with EU policies and horizontal objectives of the European Union

The EU Adaptation Strategy supports the overarching EU objectives of a smart, sustainable and inclusive growth as stated in the **Europe 2020 – Europe's growth strategy**. The strategy falls under the Resource-Efficient Europe flagship initiative.

The EU Adaptation Strategy is part of a **broader climate change response strategy**, which includes mitigation efforts and adaptation actions. Mitigation aims at reducing GHG emissions, the ultimate cause of climatic change. Mitigation then implies interventions in order to avoid the most serious impacts associated with continuing, longer-term changes in the climate system as well as limiting the risks of large-scale discontinuities in that system. Adaptation aims particularly at reducing unavoidable negative impacts already in the shorter term, reducing vulnerability to present, near and far future climate variability, and exploiting opportunities provided by climate change. Moreover, in several cases, adaptation activities can simultaneously produce mitigation benefits, while sustaining production and growth. This is the case of a number of sustainable agricultural practices or of energy efficiency measures for instance.

Adaptation to climate change is a **crosscutting** issue and will affect **key EU policies** such as Cohesion policy, Common agricultural policy, policies related to disaster risk management, or environmental policies. For instance, ecosystem-based approaches both contribute to biodiversity protection and climate change adaptation. Better managing water shortages or biodiversity loss would also contribute to the main objectives of EU Agricultural policy. Synergies exist between energy efficiency and adaptation objectives. Furthermore, adaptation is building on the existing EU risk management approach, including the EU's disaster risk prevention objectives and actions⁶² which is also a cross-cutting issue. This requires close coordination and cooperation to maximise synergies and strengthen the links between the two policies and communities.

⁶² COM(2009) 82 Commission's Communication on 'A Community approach on the prevention of natural and man-made disasters '

4. POLICY OPTIONS

4.1. What are the policy options?

Adaptation is such a cross-cutting issue that a wide range of policy initiatives are conceivable to meet the objectives identified above. This IA report assesses the impacts of alternative new policy options per problem identified. The following table summarises the individual policy options considered. **Options should be compared horizontally**, to the no policy change scenario. They cover a wide array of potential intervention tools, from **soft measures to legislation, and including direct intervention**. The description of the options will specify whether they should be combined or considered mutually exclusive.

Table 2: List of options considered for this IA report

Problem	Drivers	Specific objective	Operational objective	Options			
				No policy change	Providing information and guidelines	Direct intervention	Regulatory approach
Knowledge and access to information gaps	Uncoordinated research activities	Better INFORMED decision-making	By 2020, priority KNOWLEDGE GAPS identified in 2013 have been closed	Horizon 2020 developed with no specific approach on adaptation	1A: Developing a common climate vulnerability assessment in the EU	1B: Developing a knowledge gap strategy	
	Incomplete instruments for knowledge dissemination		By 2020, COMMUNICATION TOOLS allow for available information on climate change adaptation to be accessible for decision-makers, including Member States, local authorities and firms	Climate-ADAPT follows a business-as-usual development	1C: Promoting interactions between Climate-ADAPT and other services;	1D: Supporting exchange between science and policy in the field of adaptation	1E: Proposing the mandatory setup of national information platforms on adaptation
Gaps in adaptation action at sub-EU level	Knowledge, financial, and political reluctance barriers	Increasing the resilience of THE EU TERRITORY	By 2017, all MEMBER STATES have adopted (an) Adaptation Strateg(y)ies, complemented by regional or local adaptation strategies when appropriate.	National, regional and local adaptation strategies are developed following a similar trend than in the past	2A: EU guidelines for adaptation strategies	2B: Using Life+ funding for supporting the preparation of adaptation strategies and for lighthouse projects on adaptation	2C: Commission's proposal on the adoption of national adaptation strategies. Three sub-options: i/ non-legal; ii/ legislation later; iii/ legislation now
	Absence of internalisation of cross-border considerations		By 2020, CITIES of more than 150,000 inhabitants have adopted an adaptation strategy		2D: Supporting UNISDR "Making Cities Resilient" campaign among EU cities	2E: Inclusion of adaptation into the Covenant of Mayors Framework	
Gaps in adaptation uptake in key sectors	Incomplete and Inconsistent mainstreaming	Increasing the resilience of key VULNERABLE SECTORS	By 2020, a comprehensive and consistent MAINSTREAMING of adaptation in EU policies is achieved	Commission's proposals on MFF; Piece-meal approach to mainstreaming	3A: Guidance on how to mainstream adaptation into Cohesion Policy and the CAP	3B: Listing mainstreaming priorities in EU policies and engaging with key stakeholders	3C: Setting new calendar for revision of key EU legislation as part of the mainstreaming exercise;
	Financial and information barriers to resilient investment and business decisions		By 2020, major INFRASTRUCTURE investments are	Revision of EIA and guidelines	3D: Guidelines for project	3E: Promote inclusion of climate	3F: Proposal on mandatory requirements

			climate-proofed	under TEN-E and TEN-T	developers for climate proofing vulnerable investments	change adaptation considerations in relevant infrastructure standards	for climate resilience of infrastructure projects
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4.2. Description of each option

4.2.1. Options aiming at better informed decision making

Option	Description
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Option 1A: Developing a common climate vulnerability assessment	<i>This option envisages the adoption of a common European-wide approach for climate vulnerability assessments, to be agreed by Member States and the Commission. This approach would be used to assess vulnerabilities across Europe and would serve as a basis for the identification of most vulnerable areas and sectors.</i>
Option 1B: Adopting a knowledge gap strategy	<i>This initiative envisages the creation of a working group, composed of representatives of Member States and key stakeholders, aiming at a systematic collection of knowledge and data gaps. In 2013, the Commission will make a proposal on some preliminary identified knowledge gaps, with in view of achieving a common agreement on a list of priority knowledge gaps with the members of the working group. The knowledge gaps could be clustered into thematic areas and prioritized. The findings will be integrated into Horizon 2020 and other research schemes. This exercise is to be regularly repeated, for instance every three years.</i>
Option 1C: Promoting interactions between Climate-ADAPT and other services	<i>Option 1C envisages that the Commission, in collaboration with the EEA, will boost interactions between Climate-ADAPT and other relevant databases. First it identifies key databases on adaptation to develop a guidance document to explain how to link in practice these databases to Climate-ADAPT. Second, particular efforts would be made by the Commission and the EEA to link and provide additional interfaces with the currently existing platform on adaptation for European cities. Third, additional guidance would be developed by the Commission and the EEA to clarify how the future Copernicus Climate services should be integrated to climate-ADAPT and its results better disseminated.</i>
Option 1D: Supporting exchange between science and policy in the field of adaptation.	<i>under this option, the Commission promotes further interactions between researchers and policy makers about adaptation. The aim is to ensure that the most recent scientific knowledge is brought to policy makers and that the policy needs are expressed to the research community.</i>
Option 1E: Proposal for mandatory set-up of national adaptation platforms	<i>under this option, the Commission proposes to Member States the mandatory set up of national information platforms on climate change adaptation including specifications on minimum requirements (similar to Climate-ADAPT) and how to link these national platforms to Climate-ADAPT.</i>

4.2.2. Options aiming at increasing the resilience of the EU territory

Option	Description
Option 2A: EU Guidelines for adaptation strategies	<i>The guidelines aim to support EU countries in preparing their adaptation strategies. It intends to provide a framework for generating the information needed to prepare, implement and evaluate a national adaptation strategy.</i>
Option 2B: Using Life+ funding for supporting the preparation of adaptation strategies and for lighthouse projects on adaptation	<i>The newly proposed LIFE programme has a budgetary allocation dedicated specifically to climate change adaptation (€363 million). This option is composed of two complementary sub-options: 2Bi/ fostering the development of national and regional adaptation strategies via financial support to experience transfer; 2Bii/ promoting lighthouse projects set to develop, testing and demonstrate policy or management approaches, best practices, and solutions, for climate change adaptation.</i>
Option 2C: Commission's proposal on the adoption of	<p>The aim of this option is to provide additional steer towards some minimum requirements across the EU in terms of adaptation policy processes. It focuses on the following elements:</p> <ul style="list-style-type: none"> - Each Member State should adopt adaptation strategies covering its entire territory. - Such adaptation strategies should include a climate change vulnerability

adaptation strategies for all Member States by 2017	<p>assessment, considerations for transboundary issues, and propose indicators to monitor and evaluate progress.</p> <ul style="list-style-type: none"> - For those Member States who already have an adaptation strategy, they would need to adapt them in accordance with the requirements mentioned above once those strategies would be up for revision and no later than in 2020. <p>Regarding the nature of the Commission's initiative, three alternative sub-options are considered:</p> <ul style="list-style-type: none"> - non-legal request: Along the same line as the 2009 White Paper, the Commission would recommend Member States to establish an adaptation strategy by 2017 (time foreseen for the revision of the European Adaptation Strategy); - legislative proposal later: the Strategy would call all Member States to establish an adaptation strategy by a certain date, e.g. 2017, after which, if sufficient progress is not achieved, the Commission would adopt a legislative proposal; - legislative proposal now in the form of a Directive.
Option 2D: promoting the UNISDR cities campaign	<i>This option aims to promote bottom-up action by cities on adaptation. The “Making Cities Resilient” campaign is an initiative of the UN International Strategy for Disaster Reduction (UNISDR) to raise awareness of the need for cities, towns and their local governments to become resilient to natural hazards, which include those arising from the changing climate, that result in disasters. Under this policy option, the Commission would increase its efforts to promote engagement by EU cities with the UNISDR campaign. This would initially focus on communication about the campaign both via Member States and existing urban networks and events, and could step up to include hosting campaign events and fora in collaboration with UNISDR.</i>
Option 2E: Inclusion of adaptation into the framework of the Covenant of Mayors	<i>This option aims to incentivise local government commitment to tackle climate change adaptation. This option aims at an extension of the framework of the Covenant of Mayors to include adaptation and a voluntary commitment of the signatories (cities) to adopt local adaptation strategies as well as to inform about their implementation.⁶³</i>

4.2.3. Options aiming at increasing the resilience of most vulnerable sectors

Option	Description
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⁶³ Two administratively different processes could be considered: i/ fully integrating adaptation tasks into the contract services for the Covenant of Mayors Office; ii/ Replicating the approach, but under a separate structure, could also be considered. Both administrative arrangements have similar impacts

Option 3A: Guidance on how to mainstream adaptation into Cohesion Policy and the Common Agricultural Policy	<i>It provides additional guidance to facilitate the integration of climate change adaptation considerations into operational and rural development programmes and projects, in line with the Commission's proposals for the next MFF.</i>
Option 3B: Listing mainstreaming priorities in EU policies and engaging with key stakeholders	<i>Under this option, the Commission provides a list of priority initiatives for mainstreaming adaptation into EU legislation by 2020. In addition to the above, the Commission seeks to engage with key stakeholders to anticipate and prepare the need for potential revision of legislation.</i>
Option 3C: Setting new calendar for revision of key EU legislation as part of the mainstreaming exercise	<i>This option considers a Commission's proposal to amend the calendar of revision of key EU legislations which would need to integrate climate change adaptation.</i>
Option 3D: Guidelines for project developers for climate proofing vulnerable investments	<i>This option considers guidelines developed by the Commission for project promoters of physical assets and infrastructure on how to incorporate resilience to current climate variability and future climate change within their projects. An alternative would be for the guidelines to be made mandatory for all EU-funded infrastructure projects receiving EU funding of €5 million or more and having an operational period of at least 20 years. Both voluntary and mandatory guidelines are discussed below.</i>
Option 3E: Promote inclusion of climate change adaptation considerations in relevant infrastructure standards	<i>Under this option, the Commission formally asks European standardisation organisations to map and prioritise relevant design standards that would need to be modified so as to take account of current and future impacts of climate change. Concretely, this option is two-fold: first, the Commission would issue an official request (Mandate) to map and prioritise relevant standards for transport infrastructure, energy infrastructure and buildings. Second, the Commission would support standardisation organisations in their efforts to update their environmental guide to include climate change adaptation considerations.</i>
Option 3F: Proposal on	<i>Under this option, the Commission proposes the elaboration of legally binding requirements on the resilience to climate change of existing and future infrastructure. That is, Member States would have to set up minimum climate resilience requirements for new infrastructure investments and for large existing ones that undergo major renovation.</i>

mandatory requirements for climate resilience of infrastructure projects	
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4.3. Which options have been discarded at an early stage and why?

Options that would legally require the development of adaptation strategies at regional and local level have been discarded at an early stage for subsidiarity reasons. In fact, the legal basis for imposing at EU level specific adaptation policies at local level would not have allowed discussing prescriptive measures.

Regarding the mainstreaming of adaptation in specific EU legislations, the level of details needed to assess the expected impacts of a change in each EU legislation can only be provided by a dedicated impact assessment. This was for instance necessary when revising the EIA Directive. The current report does not go into such detail and stays at the level of identifying key priority areas and comparing various approaches for further mainstreaming.

Options that require additional EU financial instruments have also been discarded. In fact, the Commission's proposal for the next MFF already makes available a range of policies and instruments for promoting adaptation actions in various sectors, and this report focuses on a discussion of potential measures aiming at achieving an optimal use of existing instruments. Finally, prescriptive approaches for European companies, such as the obligation to undertake climate risk assessment along their supply chains, have also been ruled out.

5. ANALYSIS OF IMPACTS

The impacts of no further EU action have been presented in section 2.5. The expected impacts of each considered option are presented below, in comparison to the baseline scenario. Note that the impacts being assessed are those of **EU-promoted actions**, which represents only the 'tip of the iceberg' when it comes to adaptation action. The costs of implementing such measures as well as their benefits are necessarily of a different magnitude than the overall costs and benefits of adaptation action across the EU.

5.1. Expected impacts of options aiming at better informed decision making

5.1.1. No policy change

5.1.1.1. No policy change

Major research efforts on climate change have been promoted and financed at the European level within the 7th Framework Programme and its predecessors. Such activities would continue and further expand, in line with the Commission's proposals on research under Horizon 2020. Although all the details have not been clarified yet, Horizon 2020 is expected to improve the coordination of research activities. However as no systematic mechanism of mapping knowledge gaps, screening of on-going research and support activities and prioritising along policy needs is proposed, some limitations in coordination and targeted close of knowledge gaps can be expected.

The Commission developed in the context of the PESETA and the JRC PESETA II projects⁶⁴ a multi-sectoral assessment of the impacts of climate change in Europe for the 2011-2040 and 2071-2100 time horizons. However, to get to a harmonized and agreed approach across the EU in modelling climate impacts would require further efforts. An important recent global initiative is ISI-MIP Inter-Sectoral Impact Model Intercomparison Project⁶⁵. This is the first global activity aimed at providing cross-sectoral global impact assessments, based on the newly developed climate Representative Concentration Pathways (RCPs) and socio-economic Shared Socio-Economic Pathways (SSPs).

It is considered that Climate-ADAPT will be further financed and that the EEA (supported by the European Topic Centre on Climate Change adaptation⁶⁶) will ensure regular maintenance and updating of Climate-ADAPT. This includes ensuring inclusion of this work within the EEA annual management plans and in the annual ETC CCA implementation plans. EEA (with ETC CCA) will organise regular training sessions and meetings but also develop information and publicity material such as a newsletter and a tutorial video. Beyond 2014 it remains unclear how Climate-ADAPT will further develop and which dissemination activities will be carried out.

An important additional element which is now being implemented is the obligation for EU-funded projects under the last FP7 Call to report to Climate-ADAPT on any climate change adaptation related findings from the research project. Under the no-policy change scenario, it is expected that these requirements will be included to EU-funded projects under Horizon 2020. This could entail some costs, both on the project side – to prepare reporting – and on the Climate-ADAPT management side – to ensure quality assurance and quality control.

In relation to data sets some progress has been made,⁶⁷ which is concurring in creating a wider and more reliable data and information base. Their linkage and an integrated use of the data stored however remains an unsolved issue.

While there are some science-policy interface (SPI) research projects and expert groups that include climate change adaptation as one of the main fields to focus on, many SPIs have not yet taken up the issues of climate change adaptation into their work. It is not expected that the situation would change dramatically without further EU intervention.

Annex 9.3.1. also provides a first assessment of identified knowledge gaps, in particular compared to a previous exercise ran just before the adoption of the 2009 White Paper on adaptation to climate change.

5.1.2. Options aiming at increasing knowledge generation

Options 1A and option 1B, discussed below, could potentially be combined.

5.1.2.1. Option 1A: Developing a common climate vulnerability assessment

Implementing this approach means developing in a centralised manner a climate risk assessment sufficiently robust to provide relevant information at local and sectoral level. At EU level, some projects look at vulnerability assessments in specific sectors (e.g. SCENES, on water, or MOTIVE on forests) or in specific areas (e.g. CECILIA for Central and Eastern

⁶⁴ Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis: <http://peseta.jrc.ec.europa.eu/>

⁶⁵ http://www.pik-potsdam.de/research/climate-impacts-and-vulnerabilities/projects/Externally_RD2/isi-mip

⁶⁶ <http://cca.eionet.europa.eu/>

⁶⁷ Data bases such as Climate-ADAPT, INSPIRE, WISE, CORDIS, OURCOAST Copernicus services, WSDiS, EEA WQ Waterbase, JRC EDO, Water Accounts, Research and Regional programmes have been further developed or new ones have been set up.

Europe). At national level, in particular the UK and Germany have undertaken comprehensive national climate vulnerability assessments. The **costs** of similar exercises at national level have been estimated by national authorities themselves to be between €40-45 million each.⁶⁸ It can be expected that a similar exercise at EU level would cost at least as much.

Such an exercise, which could build on the approach of the JRC PESETA II project, described in Annex 9.6., would close some knowledge gaps on the impacts of climate change and the potential benefits of adaptation at sectoral and local level, for instance in line with those mentioned in Table 1. It could allow identifying, quantifying and prioritizing vulnerabilities across the EU in a consistent way. However, imposing the use of one common climate vulnerability assessment in the EU has some limitations: i/ current activities, such as the recent global initiative ISI-MIP Inter-Sectoral Impact Model Intercomparison Project can already help achieve a better understanding of differences between impact model results relevant globally and for Europe; ii/ Both scenarios and models are continuously improved by a dedicated science community. Proposing one standard would **lock the state-of-the-art**, and might hinder improvements and unconventional solutions. Moreover, different models can be better suited to answer different sets of questions. Accordingly, it would be important to exploit rather than limit this richness.

5.1.2.2. Option 1B: Adopting a knowledge gap strategy

Administrative costs, to be split between the members of the Working Group, would result from the organisation of the Working Group meetings, in 2013, as well as every three years, when the knowledge gaps strategy needs to be updated. This initiative also implies some administrative costs for Member States and stakeholders for collecting the information, as they would need to prepare a questionnaire or dedicated meetings, analysing and assessing the results, so as to complement the initial proposal from the Commission. The administrative costs for Member States and stakeholders would differ depending on the format the information is collected and the fragmentation of information available at Member States level but no detailed estimate could be provided.

There is no need for additional EU funding per se, as this initiative only recommends a method for a **better streamlining** in EU-funded research projects, under Horizon 2020 and other research schemes, managed by EU institutions, such as the EEA's, the JRC's and service contracts by Commission services. A better coordination of research activities, at EU and Member States level, will result in a more efficient and transparent allocation of resources. It also provides additional political **commitment** at EU and Member States level, which notably facilitates transnationally coordinated research.

Economic, social and environmental benefits are expected in so far as the identification of priority research areas translates into the **closing of knowledge gaps** more quickly, among the ones identified in Annex 9.3.1. Priorities could be given in addressing the knowledge gaps identified in the more vulnerable regions or sectors within the EU so as to benefit in particular the private actors facing knowledge when implementing adaptation activities.

5.1.3. Options aiming at better knowledge dissemination

Option 1C and option 1E are seen as alternative options, while option 1D could be combined to one or the other.

5.1.3.1. Option 1C: Promoting interactions between Climate-ADAPT and other services

Identifying relevant databases and developing some **guidance** on how to link climate-ADAPT to such databases lead to some direct costs for the Commission and the EEA estimated at

⁶⁸ National authorities were informally consulted in the context of the preparation of this report.

50.000 to 100.000 Euros. The wider economic benefits of this initiative is clearly depending on the extent to which the guidance will be applied and therefore a quantification in monetary terms is currently not possible. Still, it will result in avoided costs for the EEA and other database managers for data integration into Climate-ADAPT, reduced costs for end users in compiling and processing data due to increased data availability (“**one-stop-shop**” principle). Using this guidance would reduce barriers and enhance cooperation between institutions (e.g. EEA and others).

As the section on urban adaptation in Climate-Adapt is currently rather limited, this option considers making additional **interlinkages with the cities platform** created under the Adaptation Strategies for European Cities project⁶⁹. The cost implications are therefore minimal (linking the two platforms) and the main benefit – although impossible to quantify – relates to additional coverage of adaptation actions at local level within Climate-ADAPT. This would address one of the key issues currently faced by information dissemination at EU level, namely the need to provide **downscaled information** on climate change and climate change adaptation.

Additional efforts, for the moment impossible to quantify, will also be required to link the results of the **Copernicus** (formally known as the Global Monitoring for Environment and Security) Climate Service to Climate-ADAPT. The Climate Service will be based on satellite and in-situ monitoring data, modelling of the entire Earth system, including model reanalysis and data assimilation. It will allow a better assessment of local and sectoral vulnerabilities, and therefore providing additional data for proper climate risk assessments. Making available this set of information to decision-makers via Climate-ADAPT would have positive economic, social and environmental impacts. Such impacts remain however impossible to quantify without knowing the detailed structure of the Copernicus Climate Service, currently under discussion.

5.1.3.2. Option 1D: Supporting exchange between science and policy in the field of adaptation.

Climate change adaptation topics can be included in upcoming science-policy interface (**SPi research projects**) under Horizon 2020. Two approaches could be considered: including specific work packages dedicated to climate change adaptation “climate checking” the results and recommendations ex-ante to identify where climate change adaptation would be needed.

An **alternative** approach is to set up an expert group with the sole objective of addressing specific climate change adaptation questions. Under this option, climate adaptation experts at national and sub-national level would meet via a **conference** (e.g. every 18 months) to continue to exchange ideas and experiences on climate change adaptation measures and/or programmes to ensure that across Europe stakeholders are working with the highest level and most up-to-date information. Organising such a conference on climate change adaptation in Europe would be between 50,000 Euro and 200,000 Euro based on past experiences.

This exercise can also be the opportunity to increase awareness raising and **business engagement** in adaptation policy making and planning. To date, business engagement has been focused on issues related to mitigation rather than on adaptation. A specific strategy for mobilising private sector strengths and assets is needed. There is some untapped data and knowledge potential in the private sector which should be maximised, and which an adequate science policy interface will help unfold.

The benefits this option would bring relate to **further stimulating research and development**, as well as innovation, in the field of climate change adaptation in a broad

⁶⁹ The completion of the project is scheduled for mid-2013. See <http://eucities-adapt.eu/cms/>

spectrum of sectors, thus placing the EU well on the international market. The bringing together of research and translating it in a way that policy makers can understand is essential for them to make the right choices in drawing up policies on adaptation; furthermore, it will make the public better informed on climate change adaptation issues as well, which fosters individual, collective and organisational learning, leading to changes in organisational practices and culture.

5.1.3.3. Option 1E: Proposal for mandatory set-up of national adaptation platforms

Developing national adaptation platforms is costly, in particular if it has to be preceded by research on climate change impacts. In Germany, the research costs were estimated at about €40 million. Another crucial issue is the agreement on common quality standards across Member States and ensuring that the national and EU level information is following them. The request from the EU to develop such platforms may therefore not be sufficient to ensure their effective implementation.

National adaptation platforms have a clear benefit in **bringing together national information** and providing it together with guidance for national, regional and local planners. Such platforms on the national level can also avoid competition and duplication of efforts and enhance complementarities between the various systems, strengthening national cooperation. Finally the information can be made available in the national language and therefore reach a broader range of stakeholders.

5.2. Expected impacts of options aiming at increasing the resilience of the EU territory

5.2.1. *No policy change*

Although most Member States are to some extent active in terms of adaptation, as of January 2013, almost half of Member States have not yet adopted an adaptation strategy. Without additional action, the barriers currently preventing national, regional or local authorities from developing their own adaptation strategies are likely to remain in place, be it in terms of human or financial resources. Moreover, adaptation strategies will likely vary in terms of scope, level of ambition and agreed financing of adaptation measures. Also the timeframe for adaptation will differ. Some countries might develop sectoral approaches only, covering a limited number of sectors.

The persistent financial and economic crisis makes it difficult to provide the necessary financial resources to develop adaptation strategies. A decentralised approach would increase already existing disparities within the EU with respect to the potential vulnerabilities to climate change. Communities, regions will develop their own approaches, leading to a heterogeneous pattern of adaptation efforts. This might lead to greater economic, social and territorial disparities counteracting with the Union objectives on cohesion.

Trans-boundary issues will remain a gap in most of the strategies. Trans-boundary issues are more complex than issues mainly affecting national and sub-national issues because procedures, laws, etc. might vary from country to country. A lack of coordination on trans-boundary issues could potentially lead to conflicting adaptation responses and would not provide for an effective approach to tackle common risks.

5.2.2. *Options aiming at promoting and facilitating adaptation policies at Member State and regional level*

Options 2A, 2B and 2C, discussed below, can be combined.

5.2.2.1. Option 2A: EU Guidelines for adaptation strategies

The development of the **guidelines** for adaptation strategies takes stock of on-going adaptation activities in EU Member States and beyond, draws on lessons learnt and experiences and specific exchange with stakeholders on certain issues of common interest. Recommendations are **relevant for all EU Member States**, independent from their state of adaptation efforts. Yet, they could benefit in priority those Member States less advanced in adaptation action, which, as shown in section 2.5.2., are often also the most vulnerable to the negative impacts of climate change.

Cost savings for each Member State are mainly to be expected by providing in the guidelines a comprehensive compilation of all issues needed to be addressed to prepare adaptation strategies complemented with various tools and information sources. Furthermore, if recommendations from the guidelines are taken up by Member States, **cost-efficiency** can also be expected by preparing for a range of risks that are to be anticipated with climatic changes. As such, the guidelines would not provide for recommendations at sectoral level, but the recommended climate change risk assessment, when implemented, would identify for each Member States most vulnerable sectors. Developing preventive response actions will increase coping capacity and reduce potential damage costs. Furthermore, more efforts invested in a comprehensive adaptation policy will ease the implementation thereof and prepare all necessary mechanisms for monitoring and evaluation in advance, thus reducing costs at a later stage of the policy process. The above highlighted savings for Member States and potentially further stakeholders that make use of the guidelines clearly outweighs the investment to develop these guidelines, which is estimated to be between 50.000 and 90.000 Euros⁷⁰ from the side of the Commission.

In terms of **social** implications, the guidelines can assist in enhancing the preparedness of Member States and the adaptive capacity of society, especially of those population groups that are most affected. Taking into account recommendations from the guidelines for stakeholder involvement can ensure that no potential risks will be overlooked and social implications of climate change are dealt with in a preventive manner.

Environmental impacts are to be expected merely positive. Climate change as a cross-cutting issue unfolds various effects on a number of environmental systems (such as water, soil, biodiversity). Dealing with all those issues in an integrated manner would ensure that cross-cutting issues and interdependencies are thoroughly assessed and that appropriate adaptation responses are developed.

5.2.2.2. Option 2B: Using Life+ funding for supporting the preparation of adaptation strategies and for lighthouse projects on adaptation

Building upon experience and knowledge from other countries where comprehensive adaptation strategies have already been adopted and are being implemented can reduce the time and resources needed and contribute to capacity building. Staff exchange schemes are beneficial both for outgoing- and incoming partner institutions. Projects under this scheme can be financed via Life+ and contribute to building new or strengthen existing networks and collaborations between Member States and associated countries and other third countries.

The eligibility of the LIFE funding for the development of adaptation strategies and action plans can include **obligation to apply good practices and guidance**. It can also cover important sectors and ensure compatibility with the EU environmental policies; and foster transnational collaboration and cooperative problem solving.

⁷⁰Figures are based on the contracts No ENV.G.1/ETU/2008/0093R and CLIMA.C.3/SER/2011/0026

Moreover, the LIFE proposal encourages **lighthouse projects** set to develop, test and demonstrate policy or management approaches, best practices, and solutions, for climate change adaptation in, but not limited to, *transboundary* areas. The development of such lighthouse cross-sectoral and cross-border projects can also make use of an innovation in the proposed Regulation, namely integrated projects (IP). A typical IP would receive funding from several sources – European, public and private – not only the LIFE programme. Among the topics that are suitable for lighthouse projects, the following ones have been identified as particularly relevant to address climate change adaptation issues. These suggestions are notably based on the identification of knowledge gaps discussed above and on issues that could help address vulnerabilities in sectors and regions most at risk: *Cross-border management of floods; Transboundary coastal management; Key infrastructure protection; Adaptation to climate change in urban areas; or Forest management.*

5.2.2.3. Option 2C: Commission's proposal on the adoption of adaptation strategies for all Member States by 2017

Developing a comprehensive Adaptation Strategy needs commitment. Its drafting alone entails efforts estimated as follows: some three full-time employees on average over the course of two years or more, supported by consultants, depending on the level of ambition of the vulnerability and risk assessments conducted. Total costs depend on how detailed the adaptation strategy/action plan is, how many sectors are addressed, whether concrete actions are specified or not and the number of conducted stakeholder consultations. Experience in the EU Member States and regions puts the cost of developing an adaptation strategy between 1 million euro and 48 million euro, depending on the number of studies commissioned, modelling done, etc.

Based on the scope of existing strategies and their estimated cost by Member States, rough **cost estimates suggest that around €3 million would be needed** for the development of an adaptation strategy in line with the considered EU guidelines (**option 2A**, assessed above), not counting the elaboration of implementation action plans where these are not included already in the adaptation strategies. The cost implications for those Member States who need to revise their adaptation strategies will not be higher than €3 million, as they can still build on their existing framework and mechanisms.

Although not easily quantifiable, there are benefits to be expected from the adoption of an adaptation strategy, whose type relates to the ones **described in detail in the assessment of policy option 2A – guidelines on preparing adaptation strategies**. The extent of the benefits would however vary. The main advantage in an additional stimulus is in the use of the suggestions made in the guidelines, which would translate in a consistent and comprehensive treatment of climate change adaptation considerations by 2020 in all Member States, taking account of local and sectoral differences.

It would also ensure an adequate coverage of **transboundary** issues, currently overlooked. Cost-efficiency will be increased by sharing financial burdens of implementing adaptation measures as joint activities in a cross-border context. Furthermore, large-scale impacts caused e.g. through extreme events that would highly affect low-income groups can be reduced or even avoided. Further, potential un-coordinated responses could be avoided. Exchange of good practices in dealing with climate change impacts will be fostered. An inclusion of transboundary considerations in all adaptation strategies would enhance in the long-term the adaptive capacity of environmental systems, in particular with regard to water, biodiversity and soil.

Without a systematic overview of climate risks – which needs to be regularly adapted as more knowledge is obtained – the impacts of climate change will likely be addressed mostly

reactively and randomly, which would be significantly more costly than considering, in an orderly way, whether and how public authorities, the private sector and citizens should adapt. Moreover, this would prevent some of the negative impacts identified under the baseline scenario from unfolding and avoid the greater costs of inaction.

The main differences between the three options occur when discussing the effectiveness of each option and their political acceptance, presented in the following section of the report.

5.2.3. Options aiming at promoting and facilitating adaptation action for cities

Options 2D and 2E, discussed below, are seen as alternative options.

5.2.3.1. Option 2D: promoting the UNISDR cities campaign

Currently, 1067 cities worldwide are signed up and involved, including around 330 from the EU27, though most of these are from Austria (280) and Italy (34). All participants to the “Making Cities Resilient” campaign are expected to be self-supporting as they organize awareness-raising events, convene meetings and engage in planning on campaign objectives. It is not possible to put exact figures on this since the cost will be determined by the actions that each individual city chooses to take. The Commission is already advertising the existence of this campaign. The hosting campaign events, such as EU-based conferences, mentioned in the description of the option would result in additional costs of about 50,000 – 200,000 Euros, based on experience for similar types of events.

The wider economic benefits of this initiative are in terms of **stimulating adaptation and disaster risk reduction planning at city level**. While it may require some investment in the short term, it should result in the avoidance of much larger damage costs in the future, when extreme weather events are experienced. In addition, sharing of good practice and engagement in the international network could drive innovation in urban adaptation measures across a broad spectrum of sectors, potentially supporting creation of jobs and increasing EU market share in adaptation technologies. The opportunity to exchange learning experiences between cities might result in more efficient adaptation decision-making at city level.

5.2.3.2. Option 2E: Inclusion of adaptation into the framework of the Covenant of Mayors

The Covenant of Mayors was officially launched in January 2008. Since then, this initiative has met large international success: 2,108 European cities had signed political commitments by November 2012. The initiative addresses local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aim to meet and exceed the European Union's 20% CO2 reduction objective by 2020.

The approach of ensuring voluntary, local political commitment for EU policy objectives was replicated in two other cases: i/ enlargement of the approach to cities in the Eastern Partnership and Central Asia; ii/ the Green Digital Charter commits cities to work together to deliver on the EU climate objectives using digital technologies. Hence both projects are linked within the Covenant of Mayors framework, and in addition some of the same partners are in charge of the operative support. However, these initiatives are run through separate service contracts.

Implementing climate change adaptation related actions alongside existing initiatives can help meet the objectives and reach cost-effectiveness. For example, in the UK, the Nottingham

Declaration⁷¹ was successfully extended from covering only climate mitigation to include adaptation, and then further developed to provide action packs and supporting guidance.

Synergies with the Covenant of Mayors and related initiatives within its framework, via a common interface and common activities, can help increasing the effectiveness.

Establishing a supporting structure to deal with adaptation actions, like the **Covenant of Mayors Office** for climate mitigation, would require EU funding to administrate and steer the initiative. This has been estimated at around **500.000 Euro a year**, with a one-off additional investment required to launch the new area of action. The monitoring and evaluation of the municipalities' activities on adaptation can be supported by elaborating a methodology and related guidelines and through enhanced cooperation with the EEA. . In addition, an estimated budget of around 200.000 Euro should be foreseen to design and promote such an initiative, based on a bottom-up approach and involving existing city networks and cities directly. The pledge for climate adaptation actions, similarly to the Covenant of Mayors, will be a voluntary commitment. Hence the adhesion is fully free of charge for the cities. However there are costs to cities to follow up on pledges they sign up for. Using evidence from the study on Adaptation Strategies for European Cities, the **cost for each city** can be estimated at about **€50,000**⁷², to be considered as the higher range of potential costs since above described supporting structure will have some resources to provide support to cities engaging in such activities. Such estimated costs do not include the costs of implementing actions following the adoption of the adaptation strategies.

Given the role cities have to play in increasing Europe's resilience to climate change, positive economic, social and environmental impacts would stem from ensuring cities are still good places to live. This could be reinforced by prioritising adaptation action in cities located in vulnerable areas, such as, flood- or drought-prone areas, coastal zones, mountain areas and outermost regions. Establishing strong spatial planning which stops placing homes, businesses and infrastructure into current but also future risk-prone areas or providing more room for rivers can be an effective and sustainable way to deal with risks complementary to building higher dikes. For instance, the potential for promoting green infrastructures within cities would be enhanced, which creates multiple benefits. Green roofs and walls, for example, facilitate shading and evaporation and help to cope with hot weather. Increasing tree cover by 25% was estimated to reduce afternoon air temperatures by 5 to 10°C.⁷³ Adaptation to climate change at local level also offers the opportunity for developing new jobs and promoting innovation.

5.3. Expected impacts of options aiming at increasing resilience in key sectors

5.3.1. No policy change

The implementation phase of the 2009 White Paper can be considered as successful. Most actions have been implemented and in some cases, EU initiatives went beyond the White Paper's recommendations (see Annex 9.4.1 for details). Yet, among the number of EU policies that are or will gradually be affected by the adverse effects of climate change, some still do not sufficiently take into consideration the need to adapt to those negative effects. Moreover, in some cases (e.g. energy policy), a lot of attention has been paid to the

⁷¹ The Nottingham Declaration has been succeeded in 2012 by the Climate Local initiative which supports carbon reduction and climate resilience. See http://www.local.gov.uk/web/guest/the-lga-and-climate-change/-/journal_content/56/10171/3574359/ARTICLE-TEMPLATE

⁷² Based on a daily average cost of €500 for 40 days for the cities time plus potential consultancy cost of €27.000 (the figure would be reduced if the city administration were able to do the work in-house).

⁷³ Zipperer et al. (1997): Urban tree cover: an ecological perspective, *Urban Ecosystems*, Vol 1, 4°, pp 229-246.

greenhouse gas mitigation objectives while not necessarily integrating in the EU policy discussions vulnerability to climate change or adaptation options to reduce vulnerability. In addition, in many sectors, adaptation considerations have been addressed on ad hoc basis, and insufficient attention has been given to the implementing measures accompanying broad policy objectives. In particular, clear requirements in the Commission's proposals allow for serious consideration of climate change impacts in Cohesion Policy and Common Agricultural Policy for 2014-2020. At the same time, these requirements are flexible in nature, and allow for a great deal of interpretation by both the Member States and the Commission in their practical implementation.

The EU is a major investor in public infrastructure projects. European, investment-based development policies such as EU cohesion policy, TEN-T and TEN-E, help overcoming gaps in infrastructure needs, especially in Convergence regions. Due to the long life spans of infrastructure and their great economic value, their preparedness for current and future impacts of climate change is critical. Hence, an assessment of a project's risk-exposure and vulnerability to climate change impacts is vital to guarantee its long-term sustainability. Accordingly, for some EU policy areas, climate resilience has already been taken up as a parameter in obligatory cost-benefit analyses during the project development phase.⁷⁴

However, there is no common requirement to do so. There is also no common methodology or guidelines in place which could help project promoters to systematically assess the climate resilience of infrastructure projects and improve their sustainability and liability in changing climate conditions. Evidence⁷⁵ also suggests that there is a certain lack of awareness of project promoters for climate issues and insufficient knowledge on how to conduct the climate resilience checks for projects, especially private sector-driven projects.

At EU level, the inclusion of climate change adaptation considerations in the design of buildings has just started. As already announced in the 2009 White Paper, a mandate has been adopted which would require standardisation organisations to consider, in the context of their work to update Eurocodes, developing a technical report analysing and providing guidance for potential amendments for Eurocodes with regard relevant impacts of future climate change. Eurocodes are a set of harmonized technical rules developed by the European Committee for Standardisation for the structural design of construction works in the European Union. The Eurocodes therefore replace the existing national technical standards, published by national standard bodies, although many countries had a period of co-existence. They provide a common approach for the design of buildings and other civil engineering works. They cover earthquake resistance, but not yet climate proofing. Since March 2010 the Eurocodes have to be accepted in all public tenders as means of calculating structural design and are de-facto standard for the private sector.

A consultation among national standardisation bodies showed that only limited efforts have been undertaken at national level to further climate-proof design standards. Denmark seems to have done some pioneer work on this issue. Road regulations and railway standards are being/will be reviewed and revised with consideration of expected climate changes. The

⁷⁴ For example, the proposal for 'guidelines for trans-European energy infrastructure' COM(2011)658 includes, in annex V, the 'system resilience, including disaster and climate resilience, and system security, notably for European critical infrastructure as defined in Directive 2008/114/EC' as an aspect to be considered for cost-benefit analyses for electricity transmission and storage.

⁷⁵ Agrawala, S.; Matus Kramer, A.; Prudent-Richard, G.; Sainsbury, M. (2010a): Incorporating climate change impacts and adaptation in Environmental Impact Assessments: Opportunities and Challenges. OECD Environmental Working Paper No. 24.
Available at: http://www.oecd-ilibrary.org/environment/incorporating-climate-change-impacts-and-adaptation-in-environmental-impact-assessments_5km959r3jcmw-en

standardisation body in the UK is also active, with specific emphasis on climate change adaptation measures in their standardization work with the construction sector (i.e. standards on water supply, flooding and the like); risk/resilience standardization (project underway to explore the role of risk/resilience standardization in the context of climate change adaptation), and more recently, their biodiversity work (where climate change adaptation is currently considered within the context of the UK planning regime). Other national standardisation bodies active include the ones in BE, DE and NL.

5.3.2. *Options aiming at a more consistent and comprehensive mainstreaming of adaptation*

Options 3B and 3C are alternatives. Option 3A could be combined to either or.

5.3.2.1. Option 3A: Guidance on how to mainstream adaptation into Cohesion Policy and the Common Agricultural Policy

The guidance document will provide advice, methods, and examples aiming at ensuring that climate adaptation objectives are understood, fully addressed, and integrated into Member States' Rural Development Programmes (RDP) and Operational Programmes for the next programming period (2014-2020). The guidance is intended to be used by Managing Authorities as well as other actors participating in programme development, consultation, and evaluation including climate experts and external stakeholders involved in the process. The costs of developing the guidance are estimated at **€200,000, to be supported by the Commission**⁷⁶.

A mix of “grey” (as related to infrastructure), “green” (as related to the environment/ecosystems/green infrastructure), and “soft” (as related to human capital and adaptive capacities) **adaptation options** need to be promoted in future Cohesion Policy and the CAP. The set of implemented options will yet vary throughout the EU. These will depend on the nature and severity of the climate change threats as well as on regional circumstances, including adaptive capacity.

Adaptation options can have high benefit-cost ratios, although the cost- benefit largely depend on the national and regional context and the assumed climate scenarios. Preliminary work has identified the following adaptation actions as potentially worth for funding by the European Agricultural Fund for Rural Development (EAFRD): buffer strips for agricultural land, storm retention reservoirs, on-farm water storage, measures to adapt to river and coastal flooding. Other cost-effective options include: floodplain management, the planting of winter cover to prevent soil erosion, improvement of animal rearing conditions and high-efficiency ventilation. As regards Cohesion Policy, cost-effective actions are: early warning systems, adapting rail tracks to higher temperatures and adapting electricity grids.

Of particular importance is the possibility to make use of EU funds, in the context of the “Enhancing the competitiveness of small and medium-sized enterprises (SMEs)” objective of the Cohesion Policy proposal. An **awareness raising campaign for SMEs** could for instance help disseminate the relevant information and facilitate the uptake of autonomous adaptation by the private sector. Increasing awareness in the private sector contributes to reducing the burden of climate change and climate change adaptation for public finances, both because the private sector will also invest in adaptation measures (direct effect) and also because the non-insured losses following natural disasters will be reduced⁷⁷. It also benefits the workers' right

⁷⁶ Figures are based on the contract CLIMA/C3/SER/2011/0011

⁷⁷ The fiscal implications of climate change adaptation: http://ec.europa.eu/economy_finance/publications/external_studies/pdf/fiscal_implications_1.pdf

to information and consultation within the undertaking⁷⁸ as additional information would be provided on the climatic risks faced by their company and its location. Existing instruments such as the Enterprise Europe Network, which is articulated across Europe on the basis of territorial entities, can be used to modulate the message according to local and regional specificities. EU Funds can also be used to promote training and skill upgrade for smaller companies. For instance, this could help undertake retro-fitting and maintenance of buildings to increase energy efficiency and resilience to climate change by promoting the use of adequate skills and "best available technology".

5.3.2.2. Option 3B: Listing mainstreaming priorities in EU policies and engaging with key stakeholders

This option proposes a strategic approach for mainstreaming climate change adaptation into EU legislation. So far, only a limited number of legislative acts are considering climate change. Based on the assessment described in the problem description the priority initiatives for mainstreaming adaptation in the following years should focus on the following areas and actions.

Climate resilience of the **transport, energy and construction** sectors: some specific options are discussed below (section 5.3.2). In the case of mainstreaming in the **health** sector, integration of future climate change risks is expected to result in fewer heat related deaths through improved surveillance mechanisms and contingency planning taking due account of potentially more frequent and extreme weather events due to climate change. Fostering preventive actions would reduce the risk of spreading of pests and diseases considering changes in certain disease carriers (e.g. by the Asian tiger mosquito). The mainstreaming of adaptation to climate change in **social** policies might not always involve direct additions or edits of the texts of current legislation and other policy documents, however, it certainly does provide additional reasoning and importance for the development of EU social policies due to the fact that successful achievement of social policy aims is inseparably linked to successful strengthening of the adaptive capacity of societies. **Coastal** zones are one of the high risk – but at the same time one of the most dynamic and developing areas – in the EU territory. Increased mainstreaming into this policy area could reduce this risk but could also contribute to a sustainable development in the future. Additional mainstreaming would also improve environmental protection, by integrating adaptation considerations in **environmental** policies, such as strategic environmental assessments.

Regarding disaster risk reduction, the Commission would prepare **guidelines** of a voluntary nature **on disaster prevention**, for a greater knowledge of good practices of disaster prevention by Member States. The provision of disaster prevention guidelines would have a limited cost on the EU budget (less than 400,000 Euro⁷⁹). Such guidelines are expected to promote the sharing of valuable experiences and the take up of good practices by Member States in areas such as governance, planning, disaster data, research etc. As supported by Member States in several Council conclusions, sharing experiences and good practices is an essential component of prevention policy, as well as developing a prevention culture that is shared by all actors.

Besides the direct benefits that further integration of climate change adaptation will create when EU legislations are being revised, listing priority initiatives for further mainstreaming would **raise awareness** of the need to integrate climate change considerations in key EU policy areas. It fosters a dialogue with respective Commission services, but also with Member

⁷⁸ Title IV, art. 27 of the Charter of Fundamental rights

⁷⁹ Figures are based on the contract 070401/2010/581708/SER/C4 Strengthening the EU Disaster Management Capacity - Good Practices on Disaster Prevention

States and other stakeholders and allows for greater transparency. Benefits relate to a **clear commitment** to act at EU level to integrate climate change considerations in all relevant EU policies in a coordinated and well-planned manner. Similarly, anticipatory policy making on Member States level can save costs, while avoiding potential overlaps in mainstreaming efforts at national level. In fact, Member States would ensure that the calendar of revisions of their national legislations to take account of adaptation is in line with what the EU has planned in the same policy fields.

In addition to mainstreaming activities, the Commission would engage with dedicated stakeholders all through the implementation phase of the Strategy. The main objective would be to prepare the ground for potential legislative revisions and to identify relevant actions to be implemented under the current legal context. First, it seems essential to start **engaging with insurance companies**. The Commission is preparing a paper on the prevention and insurance of disasters, foreseen for adoption in 2013. A stakeholders' involvement process would then follow, with the objective of identifying good practice in the EU and detailing the need for additional information at EU level. The objective is to ensure that insurance, both as a sector and as an instrument for adaptation, provides the adequate incentives for investments and business decisions so as to secure the long-term resilience and competitiveness of the EU's economy. Efficient market functioning would ensure that the potential costs associated with increased insurance premiums in vulnerable areas would be outweighed by the avoided losses in case of natural disasters.

Second, while there is evidence of the contribution of public investment banks (e.g. European Investment Bank) on adaptation to climate change, less is known about the role of commercial banks. **Engaging with commercial banks** would close knowledge gaps on the approach undertaken by the financial sector. The impacts of the option are impossible to quantify at this stage but it is not about imposing additional constraints on the sector⁸⁰. If effective, the policy would improve access to finance through a more adequate offer of financial instruments on the EU market, in relation to climate adaptation. Small businesses face the biggest constraints limiting the type and scale of adaptation actions they can take⁸¹. Engaging with financial institutions and the banking sector to promote climate resilient investments is likely to help SMEs to overcome financial barriers by allowing them to adapt their operations and/or respond to new market demands by investing in product / service development.

Third, engaging with stakeholders dealing with **social issues** would also be a priority of the Commission, in order to better identify how Member States currently protect their vulnerable groups and how existing EU instruments can be used to increase resilience. The first step is to engage with representatives from Member States and relevant stakeholders through, for instance, the existing Adaptation Steering Group, on how they approach the social issues associated with climate change adaptation. It will help identify good practice and potential gaps that could be filled by EU intervention as regards health or employment issues. On employment, a dedicated work programme would identify, based on on-the-ground experience, requested skills and potential shortages for adaptation activities. It could also help identify most vulnerable activities and good practice could be shared on how to address such vulnerabilities. On health issues, the first step would be to clarify the current achievements and the potential benefits of some of the initiatives now under discussion, such as the new plant and animal health Laws.

⁸⁰ Title II, art. 16 of the Charter of Fundamental Rights

⁸¹ PWC (2010) Business leadership on climate change adaptation: Encouraging engagement and action

5.3.2.3. Option 3C: Setting new calendar for revision of key EU legislation as part of the mainstreaming exercise

The main advantage would be that climate change adaptation issues would be brought to the **forefront sooner**. It may be advantageous to do so in the context of the Europe 2020 Strategy, where ambitious objectives have also been agreed regarding the current and future of the EU to climate change.

This initiative may be difficult to carry out given its political nature. Certain revision dates have been subject to long political negotiations between the EU, the Council and the Commission with input from the Member States. Changing this timing could cause political conflicts. Furthermore, there is a possibility that moving the legislative revision forward might result in the introduction of other (hidden) political agendas.

Moreover, as highlighted by the developments in water policy in the EU, **voluntary action can pre-empt the need for causing legislation to be revised** at an earlier stage. Climate change action is not required under the Water Framework Directive, but in 2009 the Water Directors agreed to follow a common implementation strategy guidance on how to climate check river basin management plans.

5.3.3. Options aiming at increasing the resilience of major infrastructure investments

Options 3D, 3E and 3F, discussed below, could potentially be combined.

5.3.3.1. Option 3D: Guidelines for project developers for climate proofing vulnerable investments

This option would help developers of physical assets and infrastructure to incorporate resilience to current climate variability and future climate change within their projects. The estimated **cost** of developing these **guidelines** is slightly above €100.000⁸², to be supported by the Commission. The Climate-ADAPT platform as well as additional publicity measures can be used to increase the up-take.

The Guidelines may be usefully applied to any investment project with a lifetime of more than 15 to 20 years, depending on the sector, because it is on these timescales that climate change impacts will increasingly be felt. As such, they are not sector specific but do identify a range of practices that could be considered for each type of project. Specifically, the guidelines would help for the following: i/ 'Climate-influenced projects' – assets and infrastructure projects whose success may be affected if climate change is ignored; and ii/ 'Climate adaptation projects' – whose main aim is to reduce vulnerability to climate hazards, such as a flood management scheme.

Climate proofing can be expected to slightly **increase costs for infrastructure projects**. A World Bank study⁸³ found that the net cost of adapting infrastructure to climate change is no more than 1-2% of the total cost of providing that infrastructure, as additional preparatory work may be needed, and some technical choices would need to be amended. However, at the same time, climate resilience may decrease costs over a longer period as it helps preventing damages to and interruptions of infrastructure. The economic costs and benefits of certain adaptation options in the energy and transport sector have been assessed.⁸⁴ Net benefits are

⁸² Figures based on on-going consultancy contract for developing "Climate resilience guidelines for project managers" (DG CLIMA, 2011-2012)

⁸³ World Bank (2010a). The Costs of Adapting to Climate Change for Infrastructure, *Discussion Paper nr.2*, August. Available at http://siteresources.worldbank.org/EXTCC/Resources/407863-1229101582229/DCCDP_2Infrastructure.pdf

⁸⁴ Altawater et al. (2011a-c)

identified for adaptation measures due to electricity demand triggered by supplemental cooling or for better drainage systems. Conversely, the investment costs for better heat-resistant asphalt seem to outweigh the expected benefits. The high level of uncertainty suggests however that such assessment would have to be repeated on a case-by-case basis.

Major effects on **employment** would not be expected from the measure, if it is assumed that the upgrading of infrastructures (e.g. improved drainage capacity) is integrated into the regular reinvestment cycle. This would be different if existing infrastructure was retrofitted before the end of its economic life span; but this would also incur significantly higher cost than anticipated in this estimation.

The EU industry is a main producer of technologies for energy infrastructure. Many countries outside the EU are also facing the challenge of installing electricity networks that are better-adapted to climate change and that meet the needs of changing generation patterns, which potentially increases the demand for **European technologies** and expertise in the world market. The investment need in this sector would have also a positive impact on small and medium enterprises (SMEs) in the fields of construction, mechanical engineering and business services.

Environmental benefits relate to reduced CO₂ emissions, notably where mitigation measures directly and indirectly target adaptation (e.g. improved energy performance of buildings⁸⁵ helping to avoid energy demand peaks during heating/cooling periods) and avoiding contamination of land and natural resources, especially where infrastructure is resilient in case of extreme weather events (e.g. flooding of power generators or waste water treatment facilities).

To ensure a minimum up-take and application by project promoters, the European level could encourage Member States and regions to use it by including a reference into EU documents on cost-benefit-analysis and ex-ante project assessments for various policy areas, notably for projects under EU structural funds, TEN-T and TEN-E. However, the decision whether to apply the guidelines or not would remain with the project promoters or involved financial partners. The non-binding character of the guidelines means lower impact on project promoters, thus on infrastructure projects. However, it **avoids an 'over-regulation'** of projects as well as a reduced administrative burden.

In any case, access to finance for the private sector can be achieved through the direct provision of grants by the EU and other private funding mechanisms including traditional loan finance and equity finance. The existing suite of grant schemes are set out within the proposed 2014-2020 Multi-annual Financial Framework and future MFFs to 2050 are seen as an opportunity to embed finance for adaptation measures.

5.3.3.2. Option 3E: Promoting inclusion of climate change adaptation considerations in relevant infrastructure standards

Mapping relevant standards and identifying the ones to be revised is a work of 1-2 years for standardisation organisations, with direct cost implications to organise the coordination of this exercise. For instance, according to CEN/CENELEC, some 500-1000 relevant transport standards need to be mapped. A detailed cost estimate at EU and Member State level to carry out this work could not be undertaken but main costs would relate to working time for dozens of national experts from EU 27 to be involved over several years. Including adaptation

⁸⁵ This would draw on the current requirements under the Energy Performance of Buildings Directive (EPBD), which already allows for a regional diversification of energy performance on top of the minimum requirements of the Directive.

considerations in the environmental guide would have limited costs as this can be prepared centrally.

The Environmental guide supports the assessment of sustainability during the development and amendment of standards. It assesses the impact from a product/process on its environment following a life cycle approach. For adaptation/climate proofing to be covered by the guide, it should also assess the impact of the environment on a product/process. Life-cycle thinking currently applied would also be relevant for adaptation, as that would prescribe consideration of climate change risks in all product development cycles from initial product development to raw material sources, to production processes to use and disposal options. Due to the voluntary nature of the guidance, the application cannot be guaranteed, even if the current version of the guidance document is highly accepted by the sector.

This option is a **first and important step** in a longer process to engage with stakeholders and to make European infrastructure and buildings more climateresilient. It certainly contributes to closing some knowledge gaps on the potential impacts of climate change on infrastructure and on identifying technical solutions. On the other hand, standards factoring in climate change risks lead in some cases to increased resource consumption (e.g. thicker steel) for construction products. Research on change in construction and on new materials would reduce these negative environmental impacts⁸⁶.

Uncertainty in climate modelling and potential lack of data/information in climate impacts for specific regions will make the amendment of any standard a difficult exercise. There is a risk that certain amendments will lead to overshooting the target and therewith unnecessary costs.

5.3.3.3. Option 3F: Proposal on mandatory requirements for climate resilience of infrastructure projects

Given the important role of the EU in Europe's infrastructure investment, a **mandatory** consideration of climate resilience will not only help in ensuring greater sustainability of action but also in promoting climate change adaptation as a EU policy priority.

The implementation of this option may however be difficult. First, this may induce increased project costs (short-term) due to additional investment for adaptation solutions, which could have negative impacts on the **short-term competitiveness** of European firms. Second, the uncertainty in climate modelling and potential lack of data/information in climate impacts for specific project sites may make the guidelines difficult to apply in practice. Third, the climate proofing of projects would create additional administrative burden for project promoters and for financing institutions to include it in cost-benefit analysis, in particular when such institutions have already their own approaches for climate proofing vulnerable investments, as currently the case for the EIB.

6. COMPARING THE POLICY OPTIONS

6.1. Comparing options on promoting better-informed decision making

6.1.1. *Effectiveness, efficiency and coherence*

Option 1A – developing a common climate vulnerability assessment in the EU may not be as effective as other options to close knowledge gaps, as a single climate vulnerability assessment would not allow from benefitting of the interactions between approaches and varying circumstances they can cover. The impacts would also be more limited on the other two objectives.

⁸⁶ Title IV, art. 37 of the Charter of Fundamental Rights

In comparison to the baseline, **option 1B – adopting a knowledge gap strategy** will strengthen knowledge generation, in particular in relation to existing policy needs expressed at national and sectoral level, which indirectly contributes to the other two objectives of the Strategy. However, the effectiveness of the impacts on adaptation action will depend on other factors, as for example the political willingness or financial capacity.

In terms of efficiency, **option 1B** may seem much less costly than **option 1A**, but it is also due to the fact that it focuses mainly on a better streamlining of existing funds. In that respect, this will have positive implications on the use of EU funds as the identified and prioritised knowledge gaps will be mainstreamed into Horizon 2020, as well as in other research pathways (e.g. JRC, EEA, service contracts, Life+).

Option 1C – Promoting interactions between Climate-ADAPT and other services contributes to better decision-making by ensuring the dissemination of information, specifically targeting improved data management, data access, sharing, harmonization, interoperability as well as the integration of data and services. Efficiency gains are mainly expected for final users, who can benefit from a "one-stop-shop" principle when Climate-ADAPT becomes the focal point on adaptation information in Europe.

Option 1D – supporting exchange between science and policy makers is effective in contributing to better-informed decision-making by adding additional paths to knowledge dissemination. In particular, it allows a very direct exchange between Member States, the Commission and stakeholders, which can increase capacity-building and contribute to a better understanding of adaptation.

The assessment of past trends, as reported by the EEA, on the development of adaptation portals at national level, led us to conclude that there is no need for additional EU-promoted action in this area, **Option 1E – mandatory adaptation portals**, would only have limited impacts compared to business as usual.

All options discussed here are coherent with other EU policy objectives such as the ones set out in the Horizon 2020. The results of the public consultation of the EU Adaptation Strategy confirm enhanced support for research initiatives. When asked which actions could improve the use of EU funding for projects, respondents rated ‘coordination among research projects’ (**option 1B**) and ‘strengthening the science-policy interface’ (**option 1D**) as having medium to high potential (55% and 81% of respondents, respectively). Conversely, Member States may oppose, on subsidiarity grounds, a proposal for mandatory national adaptation platforms (**option 1E**).

6.1.2. Summary table⁸⁷

	Economic, social, and environmental impacts	Effectiveness			Efficiency	Coherence /acceptability
		Better informed decision-making	Increasing the resilience of the EU territory	Increasing the resilience of key sectors		
BAU		0	0	0	0	0
Option 1A: developing a common climate vulnerability assessment	At least 40 million Euros at EU level for a comprehensive vulnerability assessment; close knowledge gaps and increase resilience	+ closes knowledge gaps, but risks locking vulnerability assessment in an inadequate approach	+ / ≈ Closing knowledge gaps helps in facilitating adaptation action at sub-EU level but top-down approach can limit effectiveness	+ Would contribute to closing knowledge gaps per sector, provided sectoral assessments are conducted	Low cost-efficiency as does not allow benefitting from other methods or local assessments	Could be in contradiction with approach followed by MS who have already conducted national vulnerability assessment
Option 1B: adopting a knowledge gap	Limited administrative costs will arise for collecting	++ Common understanding of	+ Triggers interactions	+ Triggers interactions with stakeholders'	+ Better value for money for EU funded	+ in line with Horizon 2020

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The preferred options are highlighted in bold

strategy	information; indirect positive eco, soc. and env benefits via more effective efforts to close knowledge gaps	most pressing knowledge gaps and coordinated efforts to close them	with Member States' needs for adaptation action	needs for adaptation action	research, but additional administrative burden for MS and stakeholders	objectives
Option 1C: Promoting interactions between Climate-ADAPT and other services	- costs of guidance documents and efforts to link platforms (≈ 100,000 for EC and EEA) + 'one-stop shop' for end users, which facilitates decision- making; soc. benefits via enhanced cooperation among data holders	+ / ++ "One-stop-shop" concept	+ Additional information on adaptation at local level	≈	+ Limited cost but large benefits to be expected from interoperability	+ Promotes more efficient use of Climate- ADAPT
Option 1D: Supporting exchange between science and policy makers	- costs of conferences (between 50,000 and 200,000 annually for the EC); + integration of adaptation in research and innovation agenda at sectoral level	+ Feedback from experience on the ground; increase adaptive capacity	≈	+ Promotes cooperation in sectoral and/or adaptation specific fora	+ / ? Relative efficiency of integrating adaptation in existing SPIs vs. dedicated forum is uncertain	+ Stakeholders in favour of additional interactions between researchers and decision- makers
Option 1E: proposal for mandatory set-up of national climate adaptation platforms	- costs of setting up a platform for MS (can be as high as €40 million) + info disseminated in national languages; favours cooperation between regions within a MS	+ Provides additional information at national level	+ Improves EU coverage on information on adaptation actions	≈	≈ / - Costly to implement; no clear additional benefit compared to BAU	? Subsidiarity issues

Magnitude of impact as compared with the baseline scenario (the baseline is indicated as 0): ++ strongly positive; + positive; – – strongly negative; – negative; ≈ marginal/neutral; ? Uncertain

6.2. Comparing options on promoting adaptation at sub-EU level

6.2.1. Effectiveness, efficiency and coherence

The problem description identified three main barriers to the development of adaptation strategies at sub-EU level: lack of knowledge, be it in terms of the impacts of climate change or in terms of how to define adaptation policy processes, lack of financial resources, and political reluctance.

Option 2A – EU guidelines for national adaptation policies would not address by itself all the barriers to effective adaptation. For instance, they would not help overcome any financial constraints faced by Member States or regional authorities in developing adaptation strategies. Therefore, if adopted in isolation, the effectiveness of the measure would remain limited. This option would be coherent with the better regulation objectives of the EU, which aims at working more closely with Member States and reinforcing the constructive dialogue between stakeholders and all regulators at the EU and national levels. Representatives from Member States widely agreed that the development of guidelines for national adaptation policy making would be of added value.

Option 2B – Using Life+ will directly contribute to additional adaptation action in some EU Member States or at subnational level. Moreover, this option also ensures a better informed decision-making via the identification and implementation of relevant cross-sectoral and cross-border lighthouse projects, as long as the experience gained is appropriately disseminated, a precondition for increased capacity-building. It also contributes to increasing the resilience of key vulnerable sectors by promoting the uptake of cross-sectoral lighthouse projects. The net benefits of the current programming period LIFE+ (2007-2013) are estimated to be 600 million Euros/year. The transaction costs of LIFE+ (2007-2012) projects are typically low and did not exceed 2%. Both elements contribute to considering this option as efficient, which confirms the expected cost-effectiveness of this option.

Option 2C – Commission's proposal on the adoption of national adaptation strategies is composed of three alternative approaches. The effectiveness, efficiency, and coherence of the three approaches – no legal requirement, legislation later, and legislation now – must be considered in conjunction with the implementation of option 2A – guidelines and option 2B – presented above. In that respect, the positive impacts to be expected from option 2C mainly relate to the stimulus that the Commission would give for actions at national level.

The **non-legal approach** is a continuation of the approach presented in the 2009 White Paper. The additional effectiveness of this approach, compared to implementing options 2A and 2B alone, is expected to be small. Therefore, if the guidelines plus the availability of Life+ funding opportunities are not enough to provide the necessary political visibility to climate change adaptation, there is no guarantee that the second objective of the Strategy will be met. However, it would be uncontroversial, from a Member State's perspective.

Legislation later will give Member States the chance to make use of the guidelines and of LIFE+ funding in designing their adaptation strategy would be more acceptable than a 'legislation now' scenario by Member States reluctant to EU legislation on this issue. It would also provide additional political incentives for adaptation action, in particular to speed up the process in those Member States that are currently undertaking climate change adaptation action. The risk is that for those Member States who have not started any action on adaptation, the political incentive would be insufficient to undertake adaptation action now, de facto delaying the necessary action to meet the objectives of the Strategy to beyond 2017.

Combining a **legislative proposal now** with the adoption of the guidelines and the availability of Life+ funding opportunities could increase the likelihood that all Member States have developed an adaptation strategy by 2017, thus raising coherence of EU action and bringing Member States to a similar pace. The Commission could help deal with some of the compliance costs for Member States by providing funding opportunities and the necessary framework for experience transfer and capacity building.

However, some of the Member States which have already an Adaptation Strategy have expressed their **opposition** to the use of a legal instrument, arguing that legislative approaches would be premature, given that Member States are already in the process of developing programmes of work, and putting in place domestic programmes of action. This is also true for a minority of Member States which have not adopted an adaptation strategy and for a large part of the stakeholders that have answered the public consultation. Conversely, a large majority of **environmental NGOs** who answered the public consultation **support a legislative proposal**.

Option 2D – promoting the UNISDR cities resilience campaign, will only have limited effectiveness. First, the Commission has no control over the level of up-take by EU cities unwilling to commit budget to additional activities. In addition, a signature of commitment to the campaign is not a guarantee that cities will be actively involved or that their activities will result in enhanced climate resilience. From an EU perspective, there is also a potential lack of control by being involved in an independent UN campaign rather than supporting EU policy priorities directly. Finally, the campaign is only scheduled to last until 2015, although UNISDR expects to go beyond that date. It will not be sufficient to steadily contribute to the objective of increasing the resilience of the EU territory by 2020.

Option 2E – inclusion of adaptation into the Covenant of Mayors framework would contribute to increasing the resilience at local level, while mainstreaming adaptation in a context where both mitigation and adaptation objectives can be achieved. A risk is on the delivery side, as the signature to the pledge is voluntary and does not guarantee that cities will actually invest and implement in additional activities and that urban adaptation will be

enhanced. However, the effectiveness of the Covenant of Mayors' initiative has already been assessed when it comes to the greenhouse gas mitigation objectives. From the analysis of a sample of commitments, it is expected that the Covenant Signatories will reduce their Greenhouse Gas (GHG) emissions by 28% by 2020, well in line with the initial objective of reducing emissions by more than 20% by 2020. This confirms the potential effectiveness of the instrument.

6.2.2. Summary table⁸⁸

	Economic, social, and environmental impacts	Effectiveness			Efficiency	Coherence /acceptability
		Better informed decision-making	Increasing the resilience of the EU territory	Increasing the resilience of key sectors		
BAU		0	0	0		0
Option 2A ALONE : EU Guidelines for national adaption policies	- cost of €100,000 for developing the guidelines + favours cooperation and identifies good practices; helps address transboundary issues	+ Promoting climate risk assessment will increase knowledge and adaptive capacity at national level	+ Highlights main steps for developing adaptation strategies: addresses knowledge barriers	≈	≈ / + Limited impacts if option implemented on its own, as does not address all barriers to adaptation	+ Supported by MS
Option 2A + Option 2B: Using Life+ funding for supporting the preparation of adaptation strategies and for lighthouse projects on adaptation	- administrative cost of running the Life projects + eco. Soc and env. benefits from lighthouse projects; financial support to experience transfer and development adaptation strategies will increase uptake	+ Eases cooperation; facilitates the uptake of demonstration projects and dissemination of results	+ Addresses financial and knowledge barriers	+ lighthouse projects can unlock adaptation options at sectoral level	+ Draws on the benefits of an existing instrument	+ Makes use of existing instruments
Combining Option 2A, Option 2B, and 2C: Commission's proposal on the adoption of adaptation strategies for all Member States by 2017	Non-legal request	Very limited additional benefits compared to the options above alone				≈ / + would be supported by Member States but simply follows on the 2009 recommendations
	Legislation later	80 million € for 27 MS adopting adaptation strategies or updating existing ones	+ can speed up adoption processes for MS already preparing adaptation strategies and therefore increase the chances of benefitting from more adaptation strategies in Europe; unlikely to be effective when Member States have not started adaptation action		no compliance costs now, but may be less effective in the uptake of adaptation action	+ Draws on conclusions from 2009 White Paper's implementation phase; avoids opposition by MS but may postpone achievements of adaptation strategy objectives
	Legislation now	Provides for a coverage of the EU territory and ensures consideration of transboundary issues	++ Addresses most barriers to the uptake of adaptation action at MS level; Helps achieve the mainstreaming objectives at national level		Additional transposition and compliance costs; ensure effective uptake of adaptation action	- Acceptability by Member States would most likely be an issue
Option 2D – promoting the UNISDR cities campaign	Cost for cities participating to the programme; can increase resilience for participating cities	≈	+ / ≈ no committed budget	≈		- / ≈ Potential lack of coherence between EU and UN initiatives. Different timeframe
Option 2E: Inclusion of adaptation into the framework of the Covenant of Mayors	- costs: ~ 500,000 Euro/year for the EC; may cost overall, 100 million euros for participating cities, but on a voluntary basis + high benefits for adaptation at cities level; links	≈	+ / ++ Experience exchange Builds on success of the Covenant of Mayors	+ Links mitigation and adaptation efforts across sectors at local levels	+ / ++ Uses an existing network whose efficiency has been proven.	+ / ++ Links mitigation and adaptation; promotes action at the spatial level that is most relevant for climate change adaptation / builds on Covenant of Mayors' success

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The preferred options are highlighted in bold

	mitigation and adaptation					
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Magnitude of impact as compared with the baseline scenario (the baseline is indicated as 0): ++ strongly positive; + positive; -- strongly negative; - negative; ≈ marginal/neutral; ? Uncertain

6.3. Comparing options on promoting adaptation in key sectors

6.3.1. Effectiveness, efficiency and coherence

Option 3A – guidance on how to mainstream adaptation into CAP and Cohesion Policy, will help improving the contribution of these policies to promote the resilience of key vulnerable sectors, in particular agriculture and forestry as well as energy, transport and construction. This usefully complements policy objectives and instruments made available under the proposals for the next MFF and can increase cost-efficiency with respect to the use of EU funds. The risk is that the information that can be made available in guidance prepared at EU level is not specific enough for the needs of local actors. To be effective, this approach must be complemented by additional efforts both by managing authorities at regional or local level, and by the Commission, to increase capacity building, through, for instance, training events, at EU but also national and regional level, targeting the main actors involved in the rural development and operational programmes.

Option 3B – listing mainstreaming priorities and engaging with stakeholders, will have an impact on the resilience of key vulnerable sectors when concrete actions are proposed/taken. It can, for instance, prevent maladaptation. Increased engagement with the financial and insurance sectors will raise awareness of adaptation and there is likely to be a cascade effect with banks and insurance companies communicating adaptation-related information with their customers and supply chain partners. This will contribute to improved decision-making. Additional mainstreaming at EU level can also facilitate mainstreaming of national adaptation strategies in sectoral policies at Member State level, therefore contributing to the second objective of the Strategy.

It may be advantageous to propose a **new calendar for revision of some key EU legislation, option 3C**, in the context of the Europe 2020 Strategy, where ambitious objectives have also been agreed regarding the current and future of the EU's climate change policies and objectives. A risk is that the adaptation agenda would come in conflict with the agenda of the sectoral issues that would need to be addressed. For instance, Member States and stakeholders are only now starting to get familiar with the requirements under the Strategic Environmental Assessment Directive. Amending it now would mean also anticipating a new period of adjustments for Member States and stakeholders.

Option 3D – guidelines for project developers, and **3E – including adaptation considerations in design standards**, are a first important step for increasing the resilience of key infrastructure investments. By doing so, they will ensure that the resilience of those infrastructure sectors is increased. However, mainstreaming climate change into CEN-CENELEC standards will only bring effective impacts if finally standards are amended to reflect the potential impacts from climate change. This will require time and further interactions with stakeholders in the impacted sectors. This will clearly contribute to increasing knowledge and will allow for a better-informed decision making by 2020. Standardisation is seen as a significant contributor to the completion of the Internal Market in the context of 'New Approach' legislation⁸⁹, which refers to European standards developed by the European standards organisations. There is support from Member States and stakeholders in promoting more climate resilient infrastructure investments, the business sector putting the

⁸⁹ See http://ec.europa.eu/enterprise/policies/single-market-goods/regulatory-policies-common-rules-for-products/new-legislative-framework/index_en.htm

emphasis on traditional infrastructures while environmental NGOs highlighting the role of green infrastructures.

The time dimension and the uncertainties surrounding the impacts of climate change and the necessary technical options to address them are also an issue if **option 3F – mandatory approach** is followed and requirements are imposed for current and future infrastructure investments.

6.3.2. Summary table⁹⁰

	Economic, social, and environmental impacts	Effectiveness			Efficiency	Coherence /acceptability
		Better informed decision-making	Increasing the resilience of the EU territory	Increasing the resilience of key sectors		
BAU		0	0	0	0	0
Option 3A: Guidance on how to mainstream adaptation into Cohesion Policy and the CAP	Cost of developing the guidance Capacity building and increase resilience of key investments and sectors (SMEs in particular)	+ Contributes to increasing understanding and capacity of MA and related actors involved in all the stages of programming	+ Capacity building strategy calls for interactions with and between MS	+ Contributes to increasing resilience of agriculture, energy transport and water sectors + Triggers pro-active involvement of EU-funded project managers	+ Contributes to more cost-effective implementation of EU budget	+/ ++ In line with MFF objectives; Member States and regional authorities have expressed a need for this initiative
Option 3B: Listing mainstreaming priorities in EU policies and engaging with key stakeholders	+ fosters dialogue, allows for greater transparency; Detailed econ. social and envrtal impacts in line with mainstreamed areas	≈	+ eases decision-making at MS level for EU-related policies	≈ / + Allows for better understanding of the role for insurance and banking sectors	≈	+/ ++ Provides visibility for MS on Commission's activities; Mainstreaming seen by all stakeholders as a key component of the Strategy
Option 3C: Setting new calendar for revision of key EU legislation as part of the mainstreaming exercise	mainstreaming is achieved earlier, but risk of additional adjustment costs	≈	≈ / - Negatively influences existing priority setting	+ Ensures swift mainstreaming in key EU initiatives ≈	? Potentially problematic in terms of allocation of resources	+/ ≈ In line with past and current objectives on mainstreaming; Negatively influences existing priority setting
Option 3D: guidelines for project developers	Cost of 100,000 Euros for EC for developing the guidelines; initial costs but indirect eco.soc. and environmental benefits via more resilient infrastructure	+ Triggers additional research on climate proofing vulnerable investments	≈	+/ ++ in line with Commission's proposals for TEN-E and TEN-T; Triggers pro-active involvement of EU-funded project manager	+ Voluntary nature would allow providing adequate methodology without additional administrative burden	+/ ++ In line with Commission's proposals for TEN-E and TEN-T
Option 3E: Promote inclusion of climate change adaptation considerations in relevant infrastructure standards	- administrative cost of around 200,000 € a year for standardisation organisations; + first necessary step to provide for indirect benefits for more resilient infrastructure	+ Triggers research activities on standards	+ Triggers interactions among standardisation organisations at EU and MS level	+ Indirect impacts expected to be significant in energy / transport/construction	? Difficult to conclude at this stage	+/ ≈ Initiative well received by stakeholders
Option 3F: proposal for mandatory requirements for climate resilience of infrastructure projects	- additional costs, potentially high when adaptation technologies are not available yet	+ Triggers research needs	≈	- Difficult to implement in practice	- Long term technological lock-in may prove inefficient given uncertainties.	- Resistance from stakeholders to be expected because of increased administrative and financial burden.

Magnitude of impact as compared with the baseline scenario (the baseline is indicated as 0): ++ strongly positive; + positive; -- strongly negative; - negative; ≈ marginal/neutral; ? Uncertain

⁹⁰

The preferred policy options are highlighted in bold

7. IDENTIFICATION OF THE PREFERRED POLICY PACKAGE

On the basis of the above comparison of the different options, the preferred policy package would be summarised as follows:

Specific objective	Operational objective	Preferred Option		
		Information and guidelines	Direct intervention	Regulatory approach
Better INFORMED decision-making	By 2020, priority KNOWLEDGE GAPS identified in 2013 have been closed		1B: Developing a knowledge gap strategy	
	By 2020, COMMUNICATION TOOLS allow for available information on climate change adaptation to be accessible for decision-makers, including Member States, local authorities and firms	1C: Promoting interactions between Climate-ADAPT and other services	1D: Supporting exchange between science and policy in the field of adaptation	
Increasing the resilience of THE EU TERRITORY	By 2017, all MEMBER STATES have adopted (an) Adaptation Strateg(y)ies, complemented by regional or local adaptation strategies when appropriate.	2A: EU Guidelines for developing adaptation strategies	2B: Using Life+ funding for supporting the preparation of adaptation strategies and lighthouse projects	2Cii: Legislative proposal later
	By 2020, CITIES of more than 150,000 inhabitants have adopted an adaptation strategy		2E: Inclusion of adaptation into the Covenant of Mayors Framework	
Increasing the resilience of key VULNERABLE SECTORS	By 2020, a comprehensive and consistent MAINSTREAMING of adaptation in EU policies is achieved	3A: Guidance on how to climate proof Cohesion Policy and the Common Agricultural Policy;	3B: Listing mainstreaming priorities in EU legislation and policy initiatives by 2020, and engaging with key stakeholders in areas of particular importance	
	By 2020, major INFRASTRUCTURE investments are climate-proofed	3D: Guidelines for project developers for climate proofing vulnerable investments;	3E: Promote inclusion of climate change adaptation considerations in relevant infrastructure standards	

Implementing the preferred policy options identified in the above-table will ensure that by 2020, all decision makers in the field of adaptation will benefit from more accurate and more easily accessible information.

Adaptation needs massive input from R&D programmes and it needs it already now, to face the current impacts of climate change, but also to plan and make decisions for the short and medium term. Additional efforts to promote coordination for **knowledge generation and dissemination** will greatly increase the efficiency in the use of EU funds made available for research on climate change adaptation. It will close knowledge gaps faster and facilitate decision making. Climate-ADAPT will become the main source of information on adaptation in Europe. Information transfers between researchers and decision makers will be reinforced, increasing the adaptive capacity of decision-makers. In that respect, adaptation decisions will be more robust, with a positive impact on the resilience of economic, social and environmental systems.

Implementing the measures to meet the first specific objective of the Strategy would cost the European Commission approximately 350,000 Euros (for all the guidelines and conference events), mostly one-off costs. In addition, additional coordination costs are expected for Member States and stakeholders to collect relevant information.

Implementing the preferred policy options identified in the above-table will ensure that by 2020, adaptation strategies will be in place across the EU territory, providing an effective policy framework for adaptation action.

Giving a clear timeline by which **adaptation strategies will be completed in all Member States** means that the most basic tools needed to enhance Europe's resilience will be available, that a minimum assessment of risks and vulnerabilities will be undertaken and adaptation actions planned for the whole EU territory. In fact, national adaptation strategies

are the recommended instrument at global level in the UN Framework Convention on Climate Change context. These strategies are key analytical pieces of work to inform and prioritise actions and investments.

Acceptability issues may hamper the selection of a legislative proposal now. The combination of guidelines and Life+ funding opportunities can provide the necessary support to Member States willing to act on climate change adaptation, in particular those who already started to develop an adaptation framework. The reviewing phase of the Adaptation Strategy will help decide whether a legislative instrument should be used to facilitate compliance with overall Union objectives on climate policy, in case some Member States remain inactive and create the risk of spillovers and additional vulnerabilities within the EU.

Most vulnerable population groups will be identified and can therefore be better protected. Efficient stakeholder involvement can ensure that no potential risks will be overlooked and social implications of climate change are dealt with in a preventive manner. This will also provide better information for decision-making, therefore also contributing to the first objective of the Strategy.

It will also reduce the likelihood and frequency of maladaptation actions if all major adaptation decisions are screened for their potential adverse effects. Adaptation strategies at will help Member States to identify and justify the needs for adaptation financed under the EU budget, in particular on regional/cohesion policy and Common Agriculture Policy. This option will reduce the negative economic, social and environmental implications identified under the no policy change scenario in case of inadequate adaptation in some parts of Europe. Spillovers will also be minimised as Member States will address transboundary issues. In addition, building on the existing EU disaster management approach, better prevention and preparedness across the whole EU territory also helps to reduce the impact of extreme weather events and climate-related disasters (e.g. flooding in coastal areas, landslides in mountainous areas, heat waves). A strong signal will be sent to our international partners that adaptation to climate change is seriously addressed within the EU.

The EU will also support local and regional action and will facilitate experience transfer and the uptake of innovative solutions via cross-border and cross sectoral demonstration projects, in particular in the most vulnerable areas and sectors. The key roles that cities must play in adaptation to climate change is also acknowledged and the EU will contribute to promote and facilitate adaptation at local level.

The adoption or reviewing of adaptation strategies would cost for the EU 27 Member States around 80 million Euros. In addition, the Commission would prepare guidelines (100,000 Euros) and would make available some of the funds available under the proposed LIFE instrument for experience transfer or local lighthouse projects. Voluntarily complying with future pledges on adaptation via the Covenant of Mayors Framework has been estimated at a maximum of €50,000 per city.

Implementing the preferred policy options identified in the above-table will ensure that by 2020, most EU-led vulnerable sectors will integrate climate change adaptation considerations in their investment and business decisions.

By 2020, all relevant EU policies that will have been revised will include climate change adaptation considerations, and the Commission will engage with key stakeholders to ensure that even without revision, considerations on **adaptation will be mainstreamed**. Moreover, the use of EU funds will promote climate resilient investments, in particular in the area of energy, transport, and buildings infrastructure and will enhance the competitiveness of EU firms by reducing losses associated with climate-related disasters and by seizing business

opportunities that adaptation represents. The Strategy also contributes to a sustainable and resilient agriculture in Europe. Benefits are also expected from further interactions with actors in the insurance and financial sectors. This leads to more efficient market functioning, increasing the adaptive capacity and facilitating European firms' decision makings.

The direct cost of additional mainstreaming activities at EU level are uncertain but expected to be limited (the cost of adapting legislation when revised). The indirect impacts would be more significant but this will be the object of dedicated impact assessments. Mainstreaming would also be about making efficient use of the ambitious objectives under the next Multi-annual Financial Framework, funds already allocated in the MFF proposals to climate action.

The direct costs of promoting more resilient infrastructure investments are also limited, and would consist in preparing guidelines (€100,000) and engaging with standardisation organisations for reviewing current standards (€200,000). Even if uncertainty is high on the potential costs of actually making infrastructure investments more climate resilient, estimates from the World Bank mention that it could cost 1 to 2% of infrastructure investments. In addition, the potential benefits of concrete adaptation action have been estimated in the energy and transport sectors, showing that some options do provide net benefits with high confidence. Broader benefits from more resilient **infrastructures** are expected, such as additional employment in the construction sector when new projects are considered, and fewer disruptions to economic activities due to infrastructure failures following extreme weather events.

Although many of the measures discussed in this report have consequences for more than one objective of the Strategy, the identified problems are sufficiently independent from each other that no other combination of individual initiatives is expected to bring additional benefits at lower costs.

8. MONITORING AND EVALUATION

In the course of this impact assessment a series of actions have been evaluated which should improve the resilience of the EU to the impacts of climate change. Many of the actions are preparatory in nature and will only unfold their full effects in years to come. **Monitoring will be required not only to assess whether the actions defined in the Strategy are on track but also to review the evolution of the global context and to determine whether additional measures will be required.**

The EU Adaptation Strategy will run until 2020. **A review is scheduled by 2017/2018**, which will provide an assessment of what is achieved at EU and sub-EU level and whether additional actions would be needed to meet the objectives of the Strategy. **The Commission will present a report to the European Parliament and to the Council on the state of implementation of the Strategy.** This report will build on the reporting of adaptation activities provided by Member States following the proposed Monitoring Mechanism Regulation. This report will also build on information provided by the Member States in the annual implementation reports to be submitted in 2017 for programmes funded by the ESI funds in the period 2014-2020. The report will also make use of the indicators presented below to assess whether the Strategy is on track for achieving its objectives.

An important issue to consider is the relatively limited number of indicators currently available to allow an assessment of adaptation efforts and vulnerabilities across the EU. **The Commission will use available reports, from the EEA on impacts, vulnerability and adaptation, or from the 5th IPCC Report to be adopted in 2014 and new research and knowledge gathered in the meantime on future impacts.** These will be complemented by more specific indicators and assessments to follow the implementation of the measures adopted

with the Strategy. It will in particular use the following indicators specified in the Table⁹¹ below.

Specific objective	Operational objective	Core indicators	Score	Comment
Better INFORMED decision-making	By 2020, priority KNOWLEDGE GAPS identified in 2013 have been closed	List of knowledge gaps (initiated) now, in 2017 and in 2020.	2	New FP7 calls on adaptation now specify that information collected should be reported to Climate-ADAPT, which will ease information collection for the last indicator. The forthcoming IPCC's 5 th assessment report will also be used as a source of information.
		Horizon 2020 projects, JRC research (on-going): number of projects dealing with adaptation and budget allocated	1	
	By 2020, COMMUNICATION TOOLS allow for available information on climate change adaptation to be more easily accessible for decision-makers	Use of Climate-ADAPT (on-going): number of visitors, pages most visited, number of registered users, assessment of the content, databases and metadata	2	This information can easily be collected by slightly amending existing practices
		Number of conferences, workshops, adaptation events (registered in Climate-ADAPT)	2	
Increasing the resilience of THE EU TERRITORY	By 2017, all MEMBER STATES have adopted (an) Adaptation Strateg(y)ies, complemented by regional or local adaptation strategies when appropriate	Number of National Adaptation Strategies and Action Plans and national climate change risk assessments, as reported in Climate-ADAPT	3	
		Number and amount of Life+ grants used for experience transfer	3	
	By 2020, cities of more than 150,000 inhabitants have adopted an adaptation strategy	Number and amount of Life+ grants used for lighthouse projects on adaptation	1	Additional efforts will be required to monitor and assess adaptation at local level, which can be implemented by the Commission with the help of the EEA.
		Covenant of Mayors (on-going): number of cities pledging to develop an adaptation strategy	1	
		Number of cities of more than 150000 euros in vulnerable areas with an adaptation strategy (a follow-up in Climate-ADAPT could be organised)	2	
Increasing the resilience of key VULNERABLE SECTORS	By 2020, a comprehensive and consistent MAINSTREAMING of adaptation in EU policies is achieved	List of policies and legal acts where adaptation has been mainstreamed (available)	3	This will also make use of the reports by Member States on the implementation of programmes funded by the ESI funds about climate change action(2017)
		Adaptation activities by private organisations as reported in the Carbon Disclosure Project surveys	3	
	By 2020, major INFRASTRUCTURE investments are climate-proofed	Amount of adaptation infrastructure investments (co-)financed by EU funds and/or public financial institutions.	*	Tracking of adaptation in EU Funds is part of the Commission's proposal for the next MFF. Progress on the mapping of relevant standards in which to integrate adaptation considerations will be part of the normal cycle of interactions with standardisation organisations
		Progress on the mapping exercise by CEN/CENELEC	2	

⁹¹ Indicators are scored according to the progress already made for each of them: Not yet started = 0; Underway (limited progress) = 1; Underway (substantial progress) = 2; Complete (under review) = 3; Future report (after implementation) = *.

