BASE

BOTTOM-UP CLIMATE
ADAPTATION STRATEGIES
TOWARDS A SUSTAINABLE EUROPE

Strategies for enhancing policy coherence: mainstreaming adaptation into key-sectoral and development policies

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under Grant Agreement No. 308337 (Project BASE). The contents of this document are the sole responsibility of BASE and can in no way be taken to reflect the views of the European Union.

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BOTTOM-UP CLIMATE ADAPTATION STRATEGIES TOWARDS A SUSTAINABLE EUROPE

Title: **Strategies for enhancing policy coherence: mainstreaming adaptation into key-sectoral and development policies**

Summary: This deliverable investigates and provides a comprehensive mapping of the processes and interactions linking climate change adaptation strategies to key-sectoral policies across Europe. Building upon analysis and outcomes from WP 2, findings from case studies (WP 5) and sectoral models assessment (WP 6), where strategies have been evaluated at different scale, the aim of this report is to identify and select measures and development options for enhancing policy coherence and effectiveness, especially in relation to the most relevant financial mechanisms supporting the Cohesion Policy and the Common Agricultural Policy. The aim of the study is to recommend ways and offer guidance to public bodies and managing authorities in Member States on how to mainstream adaptation through specific measures and expenditures eligible under the European sectoral legislation and critical development programs.

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SEVENTH FRAMEWORK PROGRAMME

BASE report

Contents

1 Introduction

This deliverable aims to address the objective 3 of the BASE project by identifying ways for improving adaptation policy coherence and effectiveness in a multi-level governance framework with policy interactions from the EU to the national level and down to site-specific municipalities' initiatives.

This deliverable provides operational guidance and recommendations to support policy-makers, public bodies and managing authorities in charge of policy implementation in pursuing synergies between adaptation and other relevant sectoral policies, so that the cross-cutting nature of adaptation policy may be recognized and constraints and potential conflicts may be overcome. Advice is provided for policy makers across sectors as policy can play a major role in facilitating or restricting different adaptation approaches from planned to autonomous strategies and ensure that adaptation is not undermined by non-adaptation policies. This may support initiatives on adaptation to move beyond the baseline of current policy as identified in WP2. *Implementation* represents a crucial stage when policy integration and better coherence need to be addressed and the analysis of the EU Adaptation Strategy in D2.1 suggests that the strategy's effectiveness may depend on how concrete actions will materialize in a wide range of policy areas that do not necessarily include adaptation to climate change in their primary objectives.

The operational objective of the report is to offer guidance on how to mainstream adaptation into the European sectoral legislation and critical development programs (mainly Common Agricultural Policy and Cohesion Policy) through the selection of measures and financial mechanisms under which the related expenditures may be eligible. Given the different levels of preparedness of managing authorities to deal with climate-proofed actions, the list of suggested measures is intended to provide a menu of solutions from which institutions and private stakeholders may better orient their own decisions. Consequently the measures should be considered as supporting decisions around spending priorities at national and local level to better enhance coherence between adaptation policy and actions taken in other sectors. The options for action suggested here may more likely meet the preference of countries where the knowledge base and policy frameworks are less developed, with a more top-down guidance approach potentially better fostering integration and coherence processes. Notwithstanding these factors, this deliverable may further be considered as an orientation tool also for those countries which tend to prefer a more flexible approach where priorities and funding allocations are based on accurate and site-specific risk assessments at regional and local level.
There is an increasing common need to share experiences and efficient climate change adaptation practices to ensure that adaptation considerations are taken consistently into account throughout all the stages of the policy cycle, particularly at the implementation stage, when they are not adequately explicit in the program design. Nevertheless portfolios of feasible, effective and socially accepted adaptation measures may also represent a useful instrument to be used for continuous upgrading of sectoral policies and development planning (e.g.: in the 2014-2020 programming period under the umbrella of Structural Funds, 2017 and 2019 annual implementation reports will represent a window of opportunity to take stock of the achievements in the first period and potentially act for improving integration in the second period).
Overall, this offers to institutions and decision-makers a map of the existing connections between climate change adaptation actions, key-sectoral policies (legislation and development programs) and typologies of intervention for pursuing adaptation and sectoral policies simultaneously. The identified good practices are built on robust assessments primarily carried out within the local case studies in the BASE project (WP5) and the Climate-ADAPT platform as another major source. There are also insights provided by sectoral models (WP6), along with some relevant scientific literature.

The options of interventions are deliberately multi-objective because they do not only address climate adaptation needs. Their main focus remains on sector-specific objectives which can be enhanced by pursuing climate adaptation goals and resilience to climate impacts. The degree to which measures will deliver climate adaptation benefits in practice depends to a large extent on their design, their consequent implementation and ultimately on their update by managing actors. Most of this success will very much rely on how Member States, regions and municipalities, where programming, implementation and monitoring take place and sectoral legislation through specific actions and procedures are enforced, will take action forward. In this regard institutions and managing authorities may take advantage of the flexibility and discretion allowed in programs and legislation implementation processes (e.g.: Directive enforcement, the setting out of Partnership Agreements, Operational Programs and rules for projects).

In Chapter 2, the theoretical rationale of the report is introduced, reminding that one of the pillars of the EU Adaptation Strategy is concerned with promoting adaptation in key vulnerable sectors. Chapter 3 addresses the issue of mainstreaming adaptation into relevant sectoral policies, starting with a review of scientific literature and followed up by a description of the analytical framework and methodological process adopted in the analysis of the relevant sectoral legislation and development policies. Empirical evidence from the BASE project's case studies and other important sources such as the Climate-ADAPT platform have been used to run the assessment and select the measures. Chapter 4 discusses the EU financial tools and mechanisms to support the implementation of adaptation measures under the umbrella of sectoral policies. Conclusions in Chapter 5 recall the main findings emerged over the report.

2 Mainstreaming Adaptation: a 'double dividend' in Sectoral Policies ?

The EU Adaptation Strategy (2013) addresses marginally mechanisms and procedures to promote policy integration and enhance cross-sectoral coherence. The EU approach to mainstreaming needs to some extent further development as it seems to be largely dependent on the willingness of relevant sectors to act individually. This flexible and not normative approach substantially gives Member States and underlying hierarchical levels the opportunities to pursue synergies in implementing adaptation strategies while developing EU policies. Even the majority of National Adaptation Strategies (NAS) in European countries currently use softer forms of coordination and integration with a lot of discretion allowed to the sectors.

Hence, policy integration from the EU to the local level is obviously crucial for a policy area such as adaptation and cannot be reasonably based on a detailed top-down regulation as adaptation requires sensitivity to local contexts.

Climate policy integration in form of 'sectoral mainstreaming' has already been a key pillar of the 2009 White Paper on Adaptation and few "mainstreaming initiatives", as stated in the EU Adaptation Strategy, took place in sectors such as marine water[1] and fisheries, forestry[2] and biodiversity, infrastructure[3], over the last decade. It should be highlighted that a number of initiatives were cross-

[1] Council Directive 2008/56/EC and EU Regulation No 1255/2011.

[2] Regulation (EC) 2152/2003.

[3] Decision 661/2010/EC.

sectoral and integrated policy initiatives such as Regional and Cohesion Policy, or the case of the Common Agricultural Policy (CAP). Inter-regional initiatives also exist, such as the 2012 Alpine Strategy for Adaptation to Climate Change in the field of natural hazards[4]. In addition, the Commission has planned to enact some legislative proposals to integrate more explicitly adaptation in agriculture and forestry[5], maritime spatial planning and integrated coastal management[6], energy, disaster risk prevention[7], transport[8], health[9].

The EU Adaptation Strategy has indicated some major directions or pillars for implementation and funding. The enclosed Impact Assessment in the Strategy has led to identify a so called 'preferred policy package' where the option of 'setting new calendar for revision of key EU legislation as part of the mainstreaming exercise' was discarded because of its political nature: the risk is that the adaptation agenda would conflict with the agenda of other sectoral issues. However there is still a risk that key information on adaptation will not be picked up by sectoral actors in their policy-making activities. Two remaining options are mentioned as more effective: 1.Giving guidance on how to mainstream adaptation into Cohesion Policy and the CAP and 2.Listing mainstreaming priorities in EU policies and engaging with key stakeholders.

However, important gaps still exist in adaptation uptake in key sectors when looking at the existing economic and social policies that do not explicitly address the likely impacts of climate change on their respective domains. In this regard, climate change considerations and adaptation policy objectives in particular, remain vague in the way they should be planned and implemented. The importance of coordination is likely to increase. Thus enhancing climate adaptation capacities in key sectors is increasingly becoming a crucial objective[10]. More specifically, a comprehensive mainstreaming of adaptation in the EU policies would require either a more effective integration of climate change adaptation objectives into other policy areas, plans and programs at different levels of governance, or a more consistent adaptation-proofed process that may develop projects addressing climate change adaptation although remaining with a prominent sector-specific purpose (Medarova et al. 2011).

Mainstreaming into sectoral policies represents one of the most important tools for the EU Adaptation Strategy implementation, as it relies on existing and operating normative frameworks and consequently may have access to financial resources already budgeted, looking for synergies and convergences with EU, national and local planning processes. In this regard "mainstreaming adaptation" through better integration and coherence may represent a major source of funding for an extremely wide variety of interventions and measures to be adopted in different sectors. EU legislation allows wide margins of action to Member States in implementation, and within the boundaries of each sectoral policy it is often possible to find 'the entry point' (a proper measure) to enforce legislation while doing adaptation at the same time. Budget allocation choices towards synergic or mutually supportive measures represent the leverage to act within the existing and already working European Structural and Investment (ESI) Funds and National fundings, to get a 'double dividend' from a more aware implementation of sectoral policies, exploiting financial resources most of the time already allocated.

[4] BASE Deliverable 2.1 Policy integration and knowledge use in the EU adaptation strategy.

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

[6] COM(2013) 133 final.

[7] COM(2011)934 final.

[8] COM(2011) 650/2 final.

[9] http://ec.europa.eu/governance/impact/planned_ia/docs/2013_sanco_002_eu_plant_health_law_en.pdf

[10] BASE Deliverable 2.2 - Knowledge use, knowledge needs and policy integration in Member States.

3 Mainstreaming Adaptation into Key-Sectoral Policies

Over recent decades, climate change research has focused primarily on the climate system, impacts in general terms, and on mitigation. The emergence of climate change adaptation policies in Europe, however, raises new challenges and recognizes that the environmental, economic and social impacts of adaptation policies will be affected by and will affect many other policies. Although this makes climate policy integration and coherence essential, it must be pointed out that promoting policy integration instead of introducing dedicated policies and specific instruments may represent also a weaker policy implementation approach. Some policy assessments on general environmental policy integration that provide lessons also for the specific climate change adaptation context, have concluded that it is not surprising to see that EU has not performed efficiently so far: EU and the Member States themselves while setting jointly agreed political targets, have failed to put in place sufficient implementation actions and coordinating mechanisms to deliver them (Jordan et al. 2006, Jacob et al. 2008). Searching for climate policy integration and coherence in other policies starts from the awareness that changes cannot be achieved unless climate change is taken into consideration at the strategic level and extended also to sector-specific policies essential for economic activities and society. The increased emphasis on climate change is reflected in innovative policy instruments as well as in the revision of the existing ones, and climate policy integration is partially taking place within all types of policy instruments, among which regulations, economic instruments and information. The inclusion of climate change adaptation in governmental programs and strategies has substantially improved in recent years and adaptation actions are being increasingly perceived with a strategic role also in key sectoral policies. This has led to a search for wider and more efficient consistency between climate change and other aims in order, for the former, to be directly and more consciously addressed in other policy sectors. Notwithstanding the frequent lack of implementation plans, specific and stringent instruments and financial resources for adaptation indicates that, in practice, such aims are often still outweighed by other policy goals. Ambitious adaptation policy aims may remain merely symbolic, unless followed by a real enforcement or implementation and the recognition of the need for action results in specific measures.

Mainstreaming requires the integration of adaptation into existing decision cycles and the identification of suitable ‘entry points’ in the policy process that will usually differ across sectors and national contexts. Success often depends also on the timing of such mainstreaming measures and the stage at which they are considered during the decision-making process and project cycles. In the context of more general environmental mainstreaming, the OECD study (OECD 2012) on *greening development* highlighted specific interventions aimed at enhancing this process: using multi-year development planning, developing key actor’ technical skills, encouraging the participation of non-government actors and planning/targeting efforts carefully. Also it provided some recommendations on how developing support and harmonizing approaches among development support providers, or collaboration across domestic agencies, focusing on results, implementing best practice guidelines, reflecting on and learning from process, may deliver an overall better capacity to move effectively in this direction (OECD 2015).

There is no one-size-fits-all approach for mainstreaming climate into EU policies. This is partly because policy fields differ in nature and scope. EU agricultural and cohesion policies for instance are primarily distributive in the way they allocate funds to regions and farmers, while flood risk and water management policies are mainly regulatory in the way they set rules and standards. Beyond this, EU policies operate over different temporal and spatial scales (the farm is the relevant spatial unit for agriculture policy, while river basins play the same role in water policy), and employ different sets of policy instruments and measures. As a consequence, existing portfolios of governance tools should be used as climate policy instruments to a greater extent than in the past. Annual budgets, spatial

planning and impact assessments may represent examples with significant potential to be effective climate policy instruments. Spatial planning in particular is increasingly becoming a fundamental tool for implementing and integrating many climate policy aims, and this occurs because many adaptation measures have important spatial implications although they often are in conflict with other goals for land use. At the same time, there is a growing need to co-ordinate sectoral policies at different levels of decision-making more effectively and spatial planning is a promising instrument to address these challenges and provide integrated responses at the local level.

3.1 Enhancing coherence in sectoral policies

Policy integration may be defined as the embedding of climate change adaptation policy into all stages of the policy cycle in other policy sectors, complemented by an attempt to aggregate expected consequences for climate change adaptation into an overall evaluation of policy (Underdal, 1980).

When enhancing policy coherence, it is instead essential that different policy aims and instruments are consistent with each other or, as in the definition by Lafferty and Hovden (Lafferty at al. 2003), there should be ”a commitment to minimize contradictions between climate policies and other policies, and improve the consistency of the integrated climate change aspect in relation to other aspects”. In the presence of conflicts between different policy aims, environmental issues should be prioritized. This argument is based on the view that environmental concerns, in general, and adaptation to climate change, in our case, cannot be balanced with other objectives because they relate to preserving the carrying capacity of the nature (Lafferty et al. 2003).

When conflicting goals among different policies exist, a major weight may be attributed to climate aims to promote adaptation policy integration and the lack of consistency has to be sorted out by creating win-win options. Also, when policies result in market distortions (e.g. price or income subsidies), contradictions may arise and people may under- or over-adapt, depending on how their adaptation choices will translate into income changes (Fankhauser et al., 1999).

Many trade-offs and conflicts between climate policy and other policies are concerned with land use and spatial planning. Adaptation measures, in particular, claim more space for water management and dykes. In general, these claims compete with the space needed for agriculture, nature conservation, housing and other purposes. However, in some cases, these claims can be combined and a balanced mixture of different needs may be found: an example is water storage in nature conservation areas. In some areas this is clearly possible, while in other ones it would be threatening for the specific nature reserve. Conflicts may arise between different land use options, for example biofuel production versus restoring ecosystems or food production, or resettlements as a result of flood management give rise to potential conflicting needs among the population affected.

In order to tackle such circumstances, strategies should be built upon integrative approaches, including different sectors, scales and levels, involving a wide range of instruments (regulatory plans, fiscal incentives or sanctions, voluntary and soft measures) and considering future development. In most countries and sectors the trade-offs between the aims of climate policy and other aims are rarely openly assessed or are not fully known, and this applies in particular to adaptation.

Policy coherence, in this regard, should imply that incentives from different policies provide target groups with non-conflicting signals. Strategies designed to deal with inconsistencies are definitely intended to enhance cross-sectoral coherence and may lead to synergies and innovative win-win solutions capable to address simultaneously multi-objective purposes especially at lower levels of decision-making and implementation.

In other cases, however, where tradeoffs will remain and choices will have to be taken, the political weight that may be assigned to climate change, will be essential to set priorities of intervention. Thus while climate change is frequently not formally and explicitly recognized yet in programs and strategies, much more may be pursued looking at the implementation of specific measures. The weight given to climate change adaptation becomes crucial and weighting may represent therefore an important criterion for assessing the degree of policy integration, especially when decisions on specific measures are taken and resources are allocated. The current fiscal and economic austerity in public budget will increase the role of weighting since controversies, as to which issue should be given priority and how scarce resources should be allocated and distributed, will intensify. In this purpose also a better understanding of the economic and social processes involved in adaptation should provide new insights on selecting and developing the best measures: more recent assessments of adaptation actions have started to use iterative climate risk management and adaptation pathways (see also BASE project's case studies) in the scoping and initial prioritization phase. A key advantage of these methods is that they identify options with different time scales and levels of uncertainty, which can help with the phasing of responses and may suggest options that are beneficial, even without considering future climate change (e.g.: enhanced disaster risk management).

In this report we will not consider beneficial actions deriving from horizontal policy integration that refers mainly to objectives integration and cross-cutting procedures by governmental bodies, undertaken in order to mainstream a comprehensive integration of climate change adaptation aims into public policies. Typical means of this approach include broad strategies and the integration of climate policies into the preparation and adoption of new legislative frameworks and provisions as well as in development program. Other authors (Jacob et al., 2008) have already made interesting attempts in order to classify a variety of instruments used to enhance more in general environmental policy integration. Thus the report will not further address the importance and the clear effectiveness of communicative instruments (such as environmental and sustainable development strategies, obligations to report performance and external and independent reviews of performance), organizational instruments (such as combinations of departments, green cabinets, environmental units within sectoral departments and independent working groups) or procedural instruments (such as veto or obligatory consultation rights for environmental departments, green budgeting and impact assessment, etc).

The report will focus more on cross-sectoral coherence with adaptation policies that refers to the search for synergic measures in a specific sector, and partially on vertical policy integration, that is how implementation is pursued throughout the different governance levels from the European Commission to the local policy context. Hence the overall analysis includes sector-specific strategies and measures taken by different bodies acting in this multi-level governance approaches (Bache et al., 2004). Numerous researchers (Lenschow 2002, Jordan et al., 2008, Jordan et al., 2010) have studied environmental policy integration and developed methods to assess its extent. Organizations such as the OECD (OECD 2002) and the European Environmental Agency (2005a,b) have also developed criteria and checklists for assessing environmental policy integration. Nevertheless improving the efficiency of climate policy integration does not exclusively require its further inclusion in high-level strategies. More than this, it requires that the issue of consistency is more directly and openly addressed, that climate change is given more political weight, that systematic reporting is undertaken and that resources for integration - both in the form of know-how and funds – are made available (Mickwitz et al., 2009). Most practitioners are also convinced that even more effective than embedding climate policy goals deeply into policy strategies is ensuring that it is extended more fully to specific policy instruments such as spatial planning and governmental budgeting. Some authors (Jones 2002) argue that coherence may be described as a "systematic promotion of mutually reinforcing policy actions across government bodies creating synergies toward achieving the defined objective". Whinship (Whinship 2006) stresses that policy coherence is not primarily about choosing between conflicting aims, but rather about enabling a process by which both aims and actions can be designed so that win-win situations can be achieved.

Also some findings from research projects (FP7 Responses project[11]) confirm that successful mainstreaming needs a wide number of factors such as a shared sense of climate risks, high-level political commitment, cross-sectoral linkages, coordinating institutions, 'hard' instruments (mandates) in place. On top of that, 'win-win' opportunities between climate-related and other policy goals appear to be fundamental to achieve effective adaptation at a European scale and are mentioned to describe context and circumstances where mainstreaming is more likely to be successful. The Responses project has developed an attempt to map the interactions and opportunities for cross-sectoral adaptation actions and linkages to climate vulnerabilities and adaptation strategies (see figure 1 and 2). Notwithstanding one of the key findings is that potential synergies have not been fully exploited because cross-compliance among policies has not been aligned to the goal of increasing climate resilience.

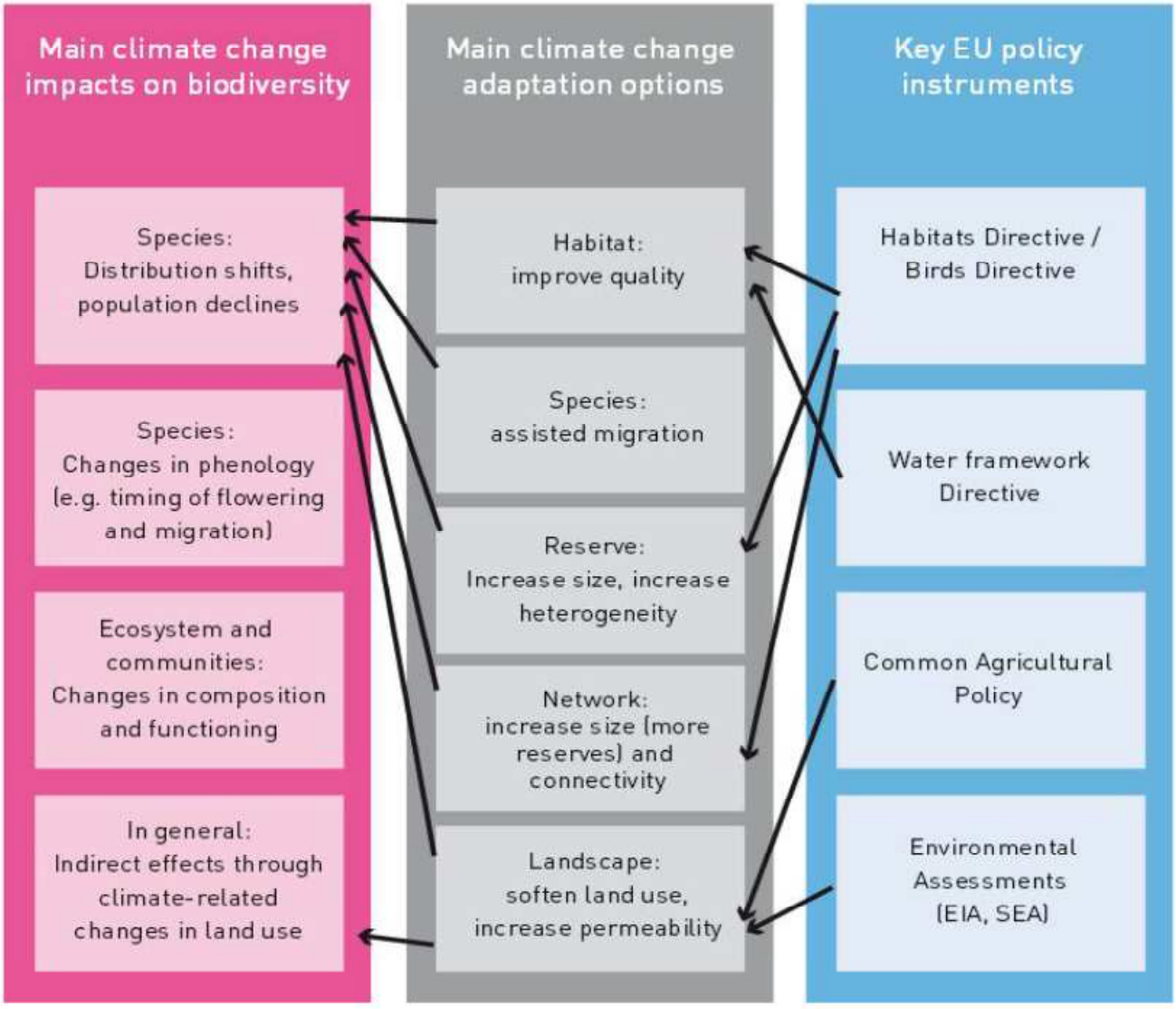

Figure 1: Interactions between impacts of climate change on biodiversity, strategies to alleviate these impacts and EU policy instruments/legislation frameworks available to implement these strategies in practice (Source: http://www.responsesproject.eu/)

[11] http://www.responsesproject.eu/.

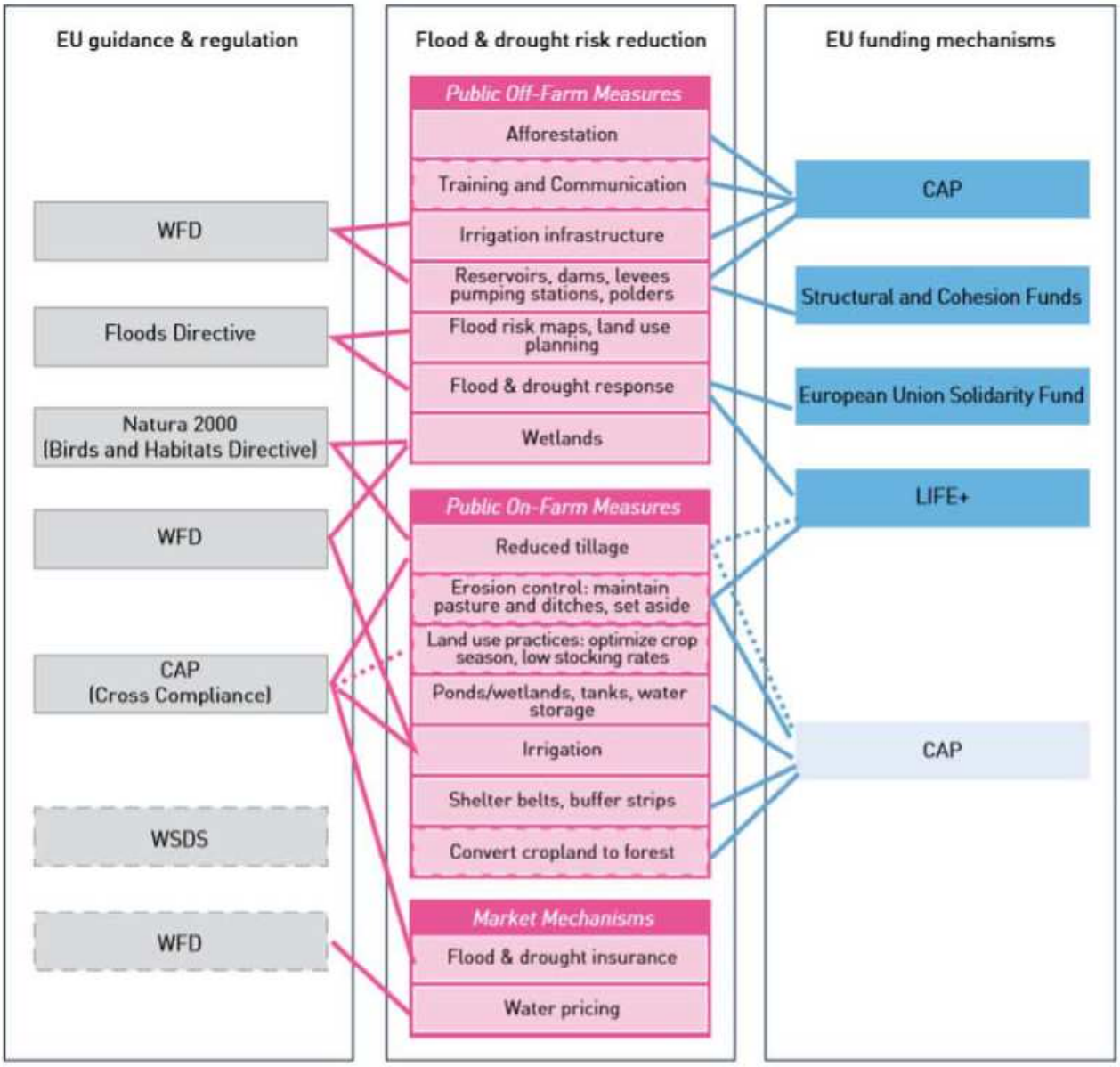

Figure 2: Interactions between EU policies, measures and EU funding mechanisms in flood and drought risk reduction. (Source: http://www.responsesproject.eu/)

An analysis of Member States' National Strategic Referential Frameworks (NSRFs), also mentioned in the Responses project, has showed that climate change adaptation has received little attention across most of the NSRFs: climate change adaptation considerations and actions have not been amongst the main priorities of EU Cohesion Policy in the 2007-2013 programming period, where there was no separate objective or priority action for climate change adaptation (Hanger et al., 2011[12]; Lunget al., 2011[13]).

[12] Hanger, S., Lung, T., Haug, C. and Bouwer, L.M. (2011) Catalogue of programs and policies related to regional development and infrastructure ('Baseline assessment'). RESPONSES project: Deliverable D6.1.IVM JRC and IIASA.

[13] Lung, T., Lavalle, C. and Bouwer, L. (2011) Digital map of investment in the EU. European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation. RESPONSES project. Deliverable D6.2. December 2011.

Although adaptation measures are applied locally and local decision-makers take a large number of decisions that directly or indirectly affect adaptation approaches and its consequent success, this does not mean that other levels are irrelevant. Adaptation to climate change is not just a local issue. It concerns all levels from the local to the global and the other way round and all these interactions among governance levels are complex and multidirectional. As a matter of fact, incentives for adaptation measures are largely affected by resources and regulations (e.g. insurance laws and rules), and relevant decisions are made at the national or EU level. Water management and agriculture are just two examples of policy fields, crucial for adaptation, in which the general policy framework is largely decided by the European Union through relevant strategies, specific legislation provisions and a considerable number of guidance documents. In order to be successfully mainstreamed and implemented, adaptation policy would need to identify and improve the interconnections among these multiple levels of governance.

Assuming that there is a recognized political commitment that a policy objective on adaptation should be integrated into other policies, this needs to be reflected in policy strategies and government programs (in sector-specific ones) as well as in the measures and policy instruments (e.g. laws, taxes, supporting schemes, information material etc.) by which they are implemented. Policy makers need to place greater emphasis on adaptation-related issues than is currently the case, especially in implementation, when planning is not adequately designed to support adaptation. The degree to which climate change adaptation issues are pursued in existing policy areas is therefore a key issue, along with specific dedicated strategies.

Policy measures that will affect adaptation are often implemented for non-climate reasons, with multiple objectives and ancillary costs and benefits that are strictly dependent on the choice of the measures. Consequently it is important to understand the context for an intervention and decision, including the existing policy and objectives, non-climatic drivers, and the current decision-making process. As an example, resilience may be mainstreamed as part of an urban regeneration program, but the design of such a program may be driven by local economic development objectives and other variables, such as demographic and land use change. Mainstreaming requires a good knowledge and understanding of normative provisions, individual organizations, institutional networks and processes making relevant decisions. Critically, all of these variables will differ with each specific adaptation context.

When adaptation policy is integrated into or is consistent with sectoral policies, potential conflicts are addressed under new approaches and action is reformulated: same measures such as extended use of hydropower, construction of infrastructure, new waterways are promoted as topics related to adaptation and not exclusively to the water management sector.

There is a growing awareness that successful adaptation to climate change will depend on how adaptation will be ‘embedded’ into other sectoral policies in the relevant fields (water, risk management, spatial planning, infrastructure, etc) and the extent to which they will find concrete implementation. Not surprisingly, most countries focus mostly on addressing adaptation policy within sectors that have already been affected by extreme weather events. The risk here is that climate change adaptation tends to focus primarily on the more tangible events – floodings, water and drought – and other adaptation issues for example related to forestry, impacts on ecosystems, and natural habitats are to be neglected.

3.2 Analyzing the European sectoral policies to identify the key 'entry points'

3.2.1 Analytical framework and methodological process

In the present report, policy coherence will not be assessed with respect to a specific target group (industries, energy producers, etc.) or a geographic area as already addressed in other studies (May et al. 2006). Instead it will be analyzed with respect to key policy sectors (e.g. agriculture, water, coastal protection and flood risk management, health, etc).

An important component of the mainstreaming process is to find relevant 'entry points' (OECD, 2009), that allow to identify opportunities in the European sectoral legislation or planning policies where climate risk considerations can best be integrated. This includes an analysis for a number of key risks and requires an understanding of the linkages between climate change adaptation, sectoral legislation and development priorities. It is also important to consider how these linkages cascade through to implementation, as well as how they are placed within the institutional and political contexts.

For this purpose we have devised a process of analysis to understand how climate change adaptation can be more effectively mainstreamed into sectoral policies.

The methodological process adopted in this analysis is described in the following five steps and consists of:

1. an analysis of all the relevant EU legislation (Directives and Regulations in different sectors: agriculture, water, coastal protection, health, energy);
2. an analysis of all the relevant impacts related to climate change and somehow connected to the specific sectoral legislation;
3. the identification of the potential linkages of each specific legislation with adaptation to climate change;
4. the selection of a wide list of measures and/or typologies of measure, including the measures from BASE project's case studies, that may be adopted for the implementation of the EU legislation while pursuing at the same time adaptation;
5. a short explanation, where less intuitive, of what may justify and support the adoption of each measure under the specific sectoral legislation

The aforementioned process is also illustrated in figure 3.

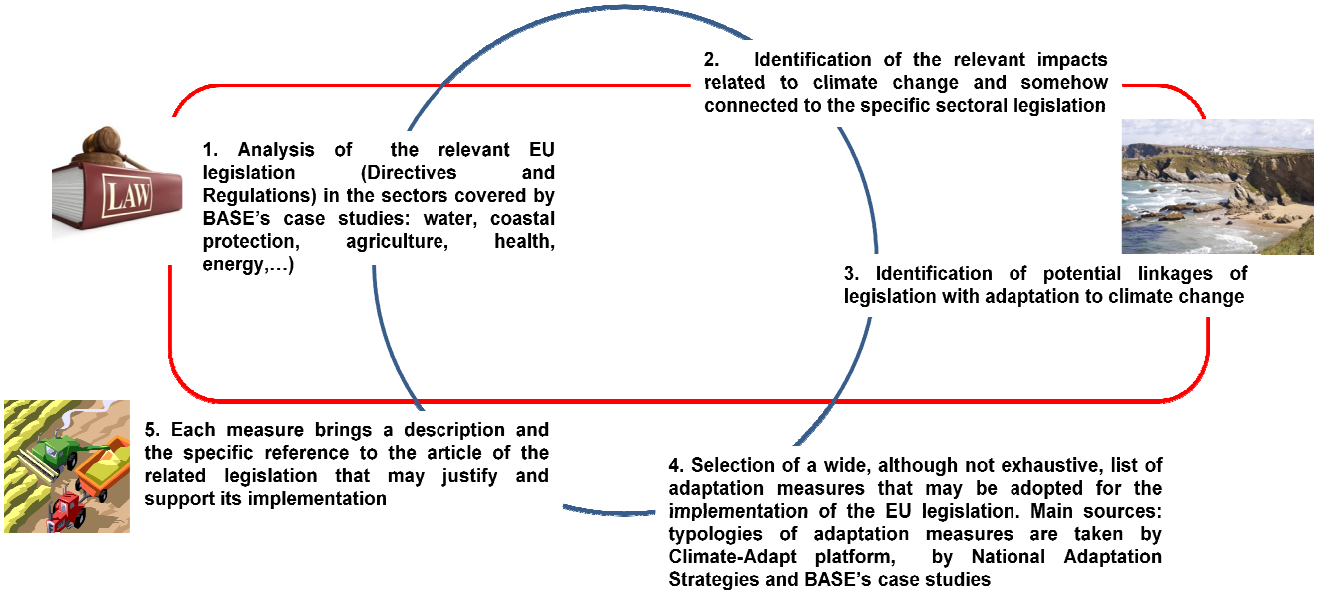

Figure 3: Methodological process.

Building on different sources such as national climate change adaptation strategies and action plans adopted by different countries (see also Mullan et al., 2013; Wilby, 2012; EEA, 2014), existing databases (Climate-ADAPT platform[14]), lists of adaptation options described already in scientific literature (Hjerp et al., 2012) and the research outcomes from the BASE project's case studies and sectoral models, where each measure and potential options of intervention has been tested and supported by a robust assessment[15] (cost/benefit appraisal, participatory cost/benefit analysis, cost-effectiveness, adaptation pathways and multicriteria analysis[16]), concrete options of intervention to foster climate change adaptation have been chosen on the basis of their potential to prevent significant climate threats and their urgency, and thus relevance under the specific sectoral policy.

Beyond the other sources, the BASE project's case studies taken into consideration in this analysis are the ones listed in the following table 1.

[14] The Climate-ADAPT platform was one of the most important source used for bringing in the report the widest universe of measure typology. Innovative tools, methodologies, processes and also good practices in implementation for integrating climate change adaptation across sectoral policies and programs need to keep on being collected and made available for all relevant actors in the Member States through this platform. http://climate-adapt.eea.europa.eu/.

[15] See Annex I.

[16] For more insights on different approaches to address uncertainty refer to MEDIATION project 2013 and Watkiss et al., 2014. For a detailed description and review of all these methods and their application to adaptation, see also ECONADAPT project.

BASE Case Study	Primary Climate Change Impacts
Alentejo	Heat stress, Water Scarcity, Droughts, Soil erosion
Holstebro & Lolland	Holstebro: Fluvial flooding, Pluvial flooding Lolland: Pluvial Flooding
Dartmoor	Droughts, Pluvial flooding
Jena	Heat stress, Pluvial flooding
Šumava (Green roof)	Ecosystem degradation
South Moravia	Water Scarcity, Droughts, Damages from extreme weather related events
Donãna	Water Scarcity, Droughts
Ústí	Water Scarcity, Droughts, Damages from extreme weather related events
Cascais	Heat stress, Water scarcity, Pluvial flooding, Coastal erosion, Damages from extreme weather related events
Copenhagen	Flooding (storm surge; urban heat islands) Coastal flooding, Coastal erosion, Damages from extreme weather related events Pluvial flooding
Ílhavo & Vagos	Coastal flooding, Coastal erosion, Damages from extreme weather related events
Kalundborg	Coastal flooding
Leeds	Fluvial flooding
Prague	Fluvial flooding, Heat Stress

Rotterdam	Coastal flooding, Fluvial flooding, Damages from extreme weather related events
South Devon	Coastal flooding Coastal erosion: Damages from extreme weather related events Fluvial flooding
Timmendorfer Strand	Coastal flooding, Coastal erosion
Venice	Coastal flooding
Cornwall	UV radiation
IJsselmeer	Water Scarcity, Flooding, Droughts
Kalajoki	Fluvial flooding, Water quality, Damages from extreme weather related events
England	Mental health
Madrid	Heat stress, Precipitations, Water Scarcity, Droughts, Damages from extreme weather related events
Health Assessment Model	Salmonella associated with increased average temperature
Agriculture Model	Negative impacts on agriculture productivity, Water scarcity, drought

Table 1: BASE case studies

In order to enrich the description of the measure typologies potentially 'eligible' under the specific sectoral legislation, a mix of “grey”, “green” and “soft” (as related to human capital and adaptive capacities) adaptation categories has been added and considered for classification[17]. The set of options may vary throughout EU, and will depend on the nature and severity of the climate change threats as well as on regional circumstances, including adaptive capacity.

'Soft' approaches correspond to 'design and application of policies and procedures and employing, inter alia, land-use controls, information dissemination and economic incentives to reduce vulnerability, encourage adaptive behaviour or avoid maladaptations. They require careful management of the underlying human systems'. Some of these measures can facilitate the implementation of grey or green measures (e.g. funding, integration of climate change into regulations).

'Green' infrastructure approaches contribute to the increase of ecosystems resilience and can halt biodiversity loss, degradation of ecosystem and restore water cycles. At the same time, green infrastructure uses the functions and services provided by the ecosystems to achieve a more cost effective and sometimes more feasible adaptation solution than grey infrastructure.

'Grey' infrastructure approaches correspond to 'physical interventions or construction measures and using engineering services to make buildings and infrastructure essential for the social and economic well-being of society more capable of withstanding extreme events'.

Typologies of measure have been selected by the different sources on the basis of the following set of additional criteria.

EU relevance: options which might impact sectoral legislation enacted at the EU level and however binding, no matter what kind of procedure and time constraints are subject to, and unlikely to be delivered as private autonomous implementation.

Coherence: options that might result in synergies with other policy field options.

Effectiveness: degree to which adaptation options effectively reach their intended objectives in terms of preventing climate change damage. As effectiveness related to climate change adaptation depends crucially on any assumptions related to projected climate change, the uncertainty around climate change scenarios needs to be considered. An assessment of options under different climate scenarios (including the extremes) is required to determine their robustness.

Efficiency: adaptation options that are considered to reach their objectives in the most efficient way (least cost). As climate change threats and impacts will differ across the EU, it needs to be assessed whether efficiency is given for the whole EU or only for specific regions or Member States.

The specific measures adopted in BASE project’s case studies are highlighted **in bold** (and clearly mentioned with the name of the case study) in each table associated to the legal provision analyzed.

[17] EEA Report, N. 2/2012 Urban adaptation to climate change in Europe – Challenges and opportunities for cities together with supportive national and European policies.

3.2.2 Agriculture

Climate change and agriculture: relevant impacts

Agriculture is highly exposed to climate change, as farming activities directly depend on climatic conditions. Climate change affects agricultural production as it modifies the main climate variables regulating crops cycles: increasing temperature, reduced precipitation, increasing frequency of extreme events (i.e. heat-waves, heavy rainfall, etc). Climate change also affects timing of growth stages (i.e. phenological changes), especially the earlier onset of spring events, and extension of the growing season

Long-term data reveal that the two most relevant factors that generally delimit species boundaries, temperature and humidity, are already affecting a wide variety of flora and fauna organisms in many parts of the world. The observed impacts include northward and altitudinal shifts of flora, decrease in productivity and organoleptic quality of products, drop in soil quality and decrease in water resources for agriculture. Changes in abundance of certain species, including limited evidence of a few local disappearances, and changes in community composition have been attributed to climate change over the last few decades.

The extension of the growing season has contributed to an observed increase in forest net primary productivity (NPP) in temperate regions, while warmer and drier conditions are partly responsible for reduced forest productivity, increased forest fires and pests and pathogens resulting in uncertain phytosanitary conditions in the Mediterranean Basin.

The area dedicated to agricultural land in coastal areas might decrease significantly in the future due to the potential increase of flooding events. Furthermore, the intrusion of saltwater into the groundwater could have an adverse impact on water quality for irrigation and consequently on crop yield.

Legal framework and objectives

Table 2 provides a scheme with the most relevant European legal provisions (i.e. Regulations, Directives, etc) for adaptation to climate change. For further insights see ANNEX II to this report.

Table 2: Legal framework on agriculture

Legal reference	Year	General objectives
Council Regulation (EC) No 74/2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)	19.01.2009	This Regulation lays down the general rules governing Community support for rural development, financed by the EAFRD. It outlines the rural development programs intended to implement the national strategy plan.
Regulation (EU) No 1303/2013 of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the	17.12.2013	This Regulation lays down the common rules applicable to the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund, the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF), which operate under the common framework of the 'European Structural and Investment ESI

European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/200		Funds'.
Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005	17.12.2013	This Regulation lays down the general rules governing Union support for rural development, financed by the European Agricultural Fund for Rural Development ("the EAFRD"). It sets out the objectives to which rural development policy is to contribute and the relevant Union priorities for rural development. It outlines the strategic context for rural development policy and defines the measures to be adopted in order to implement rural development policy. In addition, it lays down rules on programming, networking, management, monitoring and evaluation on the basis of responsibilities shared between the Member States and the Commission and rules to ensure coordination of the EAFRD with other Union instruments.
Regulation (EU) No 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008	17.12.2013	This Regulation lays down the rules on: (a) the financing of expenditure under the Common Agricultural Policy (CAP), including expenditure on rural development; (b) the farm advisory system; (c) the management and control systems to be put in place by the Member States; (d) the cross-compliance system; (e) clearance of accounts.
Regulation (EU) No 1307/2013 of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009.	17.12.2013	This Regulation establishes: (a) common rules on payments granted directly to farmers under the support schemes listed in Annex I ("direct payments"); (b) specific rules concerning: (i) a basic payment for farmers ((iv) a payment for farmers observing agricultural practices beneficial for the climate and the environment (in example, crop diversification, maintenance of existing permanent grassland, the constitution of an area of ecological interest on agricultural area).
Regulation (EU) No 1308/2013 of the European Parliament and of the Council establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007	17.12.2013	This Regulation establishes a common organization of the markets for agricultural products, which means all the products listed in Annex I to the Treaties with the exception of the fishery and aquaculture products as defined in Union legislative acts on the common organization of the markets in fishery and aquaculture products. Within the single common organization of agricultural markets established by this regulation, the Regulation (EU) 1370/2013 which provides measures for prices fixing, levies, aid and quantitative limitations is applied.

Regulation (EU) No 1310/2013 of the European Parliament and of the Council laying down certain transitional provisions on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), amending Regulation (EU) No 1305/2013 of the European Parliament and of the Council as regards resources and their distribution in respect of the year 2014 and amending Council Regulation (EC) No 73/2009 and Regulations (EU) No 1307/2013, (EU) No 1306/2013 and (EU) No 1308/2013of the European Parliament and of the Council as regards their application in the year 2014	17.12.2013	The aim of this Regulation is to facilitate the transition from existing support schemes under Regulation (EC) No 1698/2005 to the new legal framework which covers the programming period starting on 1 January 2014 ("the new programming period"), transitional rules should be adopted to avoid any difficulties or delays in the implementation of rural development support which may be caused as a result of the date of adoption of the new rural development programs.

Relevance of the legal framework with respect to adaptation and potential adaptation measures

Council Regulation (EC) No 74/2009

The Regulation 74/2009 amends the Regulation 1698/2005 (now repealed) on the financing operations to meet the new challenges and opportunities established following the assessment of the health state of the Common Agricultural Policy ("CAP Health Check"). After the assessment ("Health Check") of the CAP reform implementation in 2003, the Regulation identifies climate change among the "new challenges" for the European agriculture and set outs a priority for climate change adaptation and mitigation. Annex II provides a list of measures that are also potentially effective for adapting to climate change.

Table 3 provides the indicative list of operations explicitly mentioned within the Regulation (Annex II).

Table 3: ANNEX II - indicative list with types of operations referred to in Article 16a

	Grey, green or soft option		
Priority: Climate change adaptation and mitigation	**Grey**	**Green**	**Soft**
Types of operation			
Improve efficiency of nitrogen fertilizer use (e.g. reduced use, equipment, precision agriculture), improvement of manure storage (Art. 26: modernization of agricultural holdings, Art. 39: agri-environment payments)	• (modernization of agricultural holdings)	• (Improve efficiency of nitrogen fertilizer use)	• (precision agriculture)
Improvement of energy efficiency (e.g. use of construction materials which reduce heat loss) (Art. 26: modernization of agricultural	•		

holdings, Art. 28: adding value to agricultural and forestry products, Art. 29: cooperation for new products, processes and technologies)			
Preventive mechanisms against adverse effects of climate-related extreme events (e.g. setting up of hail nets) (Art. 26: Modernization of agricultural holdings)	•		
Soil management practices (e.g. tillage methods, catch crops, diversified crop rotations) (Art. 39: agri-environment payments)		•	
Land use change (e.g. conversion of arable land to pastures, permanent set-aside) (Art. 39: agri-environment payments ,Art. 41: non-productive investments)		•	
Extensification of livestock (e.g. reduction of stocking density) and grassland management. (Art. 39: agri-environment payments)		•	
Afforestation, establishment of agro-forestry systems (Art. 43 and 45: first afforestation of agricultural and non-agricultural land, Art. 44: first establishment of agro-forestry systems on agricultural land)		•	
Flood prevention and management measures (e.g. projects related to coastal and interior flood protection) (Art. 20: restoring agricultural production potential damaged by natural disaster and introducing appropriate prevention actions)		•	
Training and use of farm advisory services in relation to climate change (Art. 21: vocational training and information actions, Art. 24: use of advisory services, Art. 58: training and information)			•
Prevention actions against forest fires and climate-related natural disasters (Art. 48: restoring forestry potential and introducing prevention actions)		•	
Conversion to more resistant forest stand types (Art. 47: forest-environment, Art. 49: non-productive investments)		•	

Regulation (EU) No 1303/2013 of the European Parliament and of the Council

The Regulation addresses the issue of climate change both in terms of adaptation and mitigation. In particular, the European Regional Development Fund considers some relevant thematic objectives: promoting climate change adaptation and resource efficiency, risk prevention and management, preserving and protecting the environment (Art. 9). On the basis of the new European policy on Structural and Investments funds (ESI), Member States should take into account the climate change mitigation and adaptation potential of investments carried out with the support of the ESI (in accordance with Art. 8) and ensure that they are resilient to the impact of climate change and natural disasters such as increased risks of flooding, droughts, heat waves, forest fires and extreme weather events. Climate change, which is among the main challenges of society that the EU is currently tackling, is relevant to the setting of Partnership Agreements at national level and might have different impacts in different regions. The Regulation does not mention any specific adaptation measures. However, it refers to issues and thematic objectives that should be taken into account and supported in the Partnership Agreements (Art. 8 and Art. 96).

The Common Agriculture Policy (CAP)

The CAP offers much stronger opportunities for supporting targeted adaptation options for agriculture, forestry, biodiversity and rural areas more generally, than it has been the case in the past. Pillar 2 of the CAP deals with Rural Development Policy and plays a major role in the development of rural climate adaptation measures. It includes measures that support the development of human capital in the form of capacity building and the provision of advice, measures that provide investment for farming infrastructure, forestry activities and measures that support environmentally beneficial land management activities. Therefore, future expenditures in these areas will need to ensure that the funded infrastructures (e.g. manure storage and anaerobic digesters to water harvesting and storage units, to equipment for food processing, to farm machinery, livestock housing etc) are able to withstand future climate impacts and ideally contribute to the adaptation needs of the sector.

In addition, under Pillar 1 (i.e. direct payments), greening payments could provide significant levels of funding for different options which could improve the resilience of agricultural land to climate impacts. These options may include diversified crop rotations, the promotion of permanent grassland and the promotion of ecological areas. The requirement for Member States to set up a Farm Advisory Service that covers climate adaptation is also a further important innovation.

CAP legislation is basically defined under four consecutive Regulations covering:

- Rural Development: Regulation 1305/2013
- "Horizontal" issues such as funding and controls: Regulation 1306/2013
- Direct payments for farmers: Regulation 1307/2013
- Market measures: Regulation 1308/2013

Regulation (EU) No 1305/2013 of the European Parliament and of the Council

The Regulation addresses the issue of climate change both in terms of adaptation and mitigation and explicitly identifies relevant adaptation measures. In particular, Annex IV lists measures of particular relevance for climate change mitigation, adaptation and biodiversity (Table 4).

Table 4: Annex IV: indicative list of measures and operations of particular relevance to thematic sub-programs referred to in Art. 7. Climate change mitigation and adaptation and biodiversity

Measures and operations of relevance	Grey, green or soft option		
	Grey	Green	Soft
Knowledge transfer and information actions			•
Advisory services, farm management and farm relief services			•
Investments in physical assets	•		
Restoring agricultural production potential damaged by natural disasters and catastrophic events and introduction of appropriate prevention action		•	
Basic services and village renewal in rural areas	•		
Investments in forest area development and improvement of the viability of forests		•	
Agri-environment-climate;**Agri-environmental landscape management: remove vegetation where needed to reduce potential of wildfires (Dartmoor)**		•	
Organic farming		•	
Payments to areas facing natural and other specific constraints (biodiversity)			•
Forest-environmental and climate services, forest conservation; **Sustainable forest management: choice of native tree species, promotion of diverse age classes, game regulation, selective thinning, etc. (Šumava)**		•	
Risk management			•
Water retention in the landscape: rainwater harvesting in farms, by farmers, through the creation of permanent lakes and small dams (Alentejo)	•		
Regeneration of soils, diversification of crops, species and varieties (Alentejo)		•	
Increase adaptive capacity of rural communities through local rural development (Alentejo)			•
The farmer as water manager (water retention, delaying, storing) (Holstebro & Lolland)	•		
Agricultural management practices - permanent set aside of arable land, adaptation measures related to changes in planted crop variety, shift in the timing of agricultural activities (e.g., time of planting, sowing, treatment) (South Moravia)		•	
	•		

Agri-environmental practices: water recirculation and reutilization, Increase of technical efficiency of the irrigation systems (Donãna)			
Buffer zones to reduce nutrient leakage from fields; constructed wetlands in agriculture to reduce nutrient leakage and partially for flood protection; winter time vegetation cover (different slopes); perennial grass (different slopes); controlled drainage; optimal fertilization; cultivation techniques and technologies for water and nutrient management (Kalajoki)		•	

Regulation (EU) No 1306/2013 of the European Parliament and of the Council

The Regulation (Annex I and Annex II) explicitly identifies typologies of information on climate change mitigation and adaptation (Table 5 and Table 6).

Table 5: Annex I - Information in the field of climate change mitigation and adaptation, biodiversity and the protection of water as laid down in point (d) of Article 12(3).

Information in the field of climate change mitigation and adaptation, biodiversity and the protection of water	Grey, green or soft option		
	Grey	Green	Soft
Information on the prospective impact of climate change in the relevant regions, the greenhouse gas emissions of the relevant farming practices and the contribution of the agricultural sector to mitigation through improved farming and agro-forestry practices and through the development of renewable energy projects on farm and energy efficiency improvement on farm.			•
Information helping farmers to plan how best to invest in "climate-proofing" their farm systems, which Union funds they can use to do so; and in particular, information on adapting farmland to climatic fluctuations and longer term changes and information on how to adopt practical agronomic measures to increase the resilience of farming systems to floods and droughts as well as information on how to improve and optimize soil carbon levels.			•
Information on the positive correlation between biodiversity and agro-ecosystem resilience, and the spreading of risk, and also the link between monocultures and susceptibility to crop failure/damage from pests and extreme climatic events;			•
Information on how to best prevent the spread of alien invasive species and why this is important for the effective functioning of the ecosystem and for its resilience to climate change, including			•

information on access to funding for eradication schemes where additional costs are implied.			
Information on sustainable, low-volume irrigation systems and how to optimize rain-fed systems, in order to promote efficient water use; *Information on reducing water use in agriculture, including crop choice, on improving soil humus to increase water retention and on reducing the need to irrigate*.			•
Information exchange of best practice, training and capacity building (applicable to climate change mitigation and adaptation, biodiversity and protection of water).			•
Farm Advisory System and dissemination of information on the prospective impact of climate change (South Moravia)			•

Table 6: Annex II – Rules on cross-compliance pursuant to Art. 93 (relevant issues)

Area	Main issue	Requirements and standards	Grey, green or soft option		
			Grey	Green	Soft
Environment, climate change, good agricultural condition of land	Water	Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (OJ L 375, 31.12.1991, p. 1)			
		Establishment of buffer strips along water courses		•	
		Where use of water for irrigation is subject to authorization, compliance with authorization procedures			•
		Protection of ground water against pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution of groundwater through discharge			•

		on the ground and percolation through the soil of dangerous substances, as listed in the Annex to Directive 80/68/EEC in its version in force on the last day of its validity, as far as it relates to agricultural activity			
	Soil and carbon stock	Minimum soil cover		•	
		Minimum land management reflecting site specific conditions to limit erosion		•	
		Maintenance of soil organic matter level through appropriate practices including ban on burning arable stubble, except for plant health reasons		•	
	Biodiversity	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (OJ L 20, 26.1.2010, p. 7)			•
		Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna (OJ L 206, 22.7.1992, p. 7)			•
	Landscape, minimum level of maintenance	Retention of landscape features, including where appropriate, hedges, ponds, ditches, trees in line, in group or isolated, field margins and		•	

		terraces, including a ban on cutting hedges and trees during the bird breeding and rearing season and, as an option, measures for avoiding invasive plant species			

The Regulation crosses other legal provisions for an integrated cross-cutting approach (i.e. Regulation n. 73/2009). Further sectors mentioned such as public health, animal and plant health, environment, animal welfare, biodiversity, are all directly affected by climate change. They are connected to each other and to the agricultural sector, so that an integrated approach contributes to a more effective adaptation action.

Regulation (EU) No 1307/2013 of the European Parliament and of the Council

The Regulation addresses the issue of climate change both in terms of mitigation and adaptation and identifies adaptation measures even though it does not label them explicitly. One of the objectives of the new CAP is the enhancement of environmental performance through a mandatory "greening" component of direct payments which will support agricultural practices beneficial for the environment.

A summary of potential adaptation measures, that are explicitly mentioned in the Regulation, is given below (Table 7). The measures listed in the Regulation are often measures that are also beneficial for climate. Those practices, addressed to achieve both climate and environment policy goals, represent simple, generalized, non-contractual and annual actions that are linked to agriculture, such as crop diversification, the maintenance of permanent grassland, including traditional orchards where fruit trees are grown in low density on grassland and the establishment of ecological focus areas. These measures contribute to reduce the impacts of climate change: a good soil management and maintenance could help reduce the effects of heavy rainfall or drought, i.e. landslides, groundwater contamination by percolation or crisis of crops.

Chapter 3 – Payment for agricultural practices beneficial for the climate and the environment identifies the agricultural practices beneficial for the climate and the environment (Art. 43 (2)):

a) crop diversification;
b) maintaining existing permanent grassland;
c) having ecological focus area on the agricultural area.

It also defines the *equivalent practices* as those measures that yield an equivalent or higher level of benefit for the climate and the environment compared to a reference one. The equivalent practices should be those ones that include […] national or regional environmental certification schemes aiming at meeting the objectives relating to soil and water quality, biodiversity, landscape preservation, and climate change mitigation and adaptation (Art. 43 (3)).

Table 7: Annex IX. List of equivalent practices referred to in Art. 43(3)

List of equivalent practices	Grey, green or soft option		
	Grey	Green	Soft
Practices equivalent to crop diversification			
Crop diversification Requirement: at least three crops, the main crop		•	

covering a maximum of 75%, and any one or more of the following applying: - there are at least four crops; - lower maximum thresholds apply; - there is a more appropriate selection of crops, such as, for example, leguminous, protein crops, crops not requiring irrigation or pesticide treatments, as appropriate; - regional varieties of old, traditional or endangered crop types are included on at least 5% of the rotated area			
Crop rotation Requirement: at least three crops, the main crop covering a maximum of 75%, and any one or both of the following applying: - a more environmentally beneficial multiannual sequence of crops and/or fallow is followed;		•	
Winter soil cover (*)		•	
Catch crops (*)		•	
Practices equivalent to maintenance of permanent grassland			
Management of meadows or pastures Requirements: maintenance of permanent grassland and any one or more of the following: - cutting regime or appropriate mowing (dates, methods, limits); - maintenance of landscape features on permanent grassland and control of scrub; - specified grass varieties and/or seeding regime for renewal depending on the grassland type, with no destruction of high nature value; - evacuation of forage of hay; - appropriate management for steep slopes; - fertilizer regime, pesticide restrictions		•	
Extensive grazing systems Requirement: maintenance of permanent grassland and any one or more of the following: - extensive grazing (timing, maximum stocking density) - shepherding or mountain pastoralism - using local or traditional breeds for grazing the permanent grassland		•	
Practices equivalent with ecological focus area			
Requirement: application of any of the following practices on at least the percentage of the arable land set pursuant to Art. 46(1): - ecological set-aside;		•	

- creation of “buffer zones” for high nature value areas, Natura 2000 or other biodiversity protection sites, including along hedgerows and water courses; - management of uncultivated buffer strips and field margins (cutting regime, local or specified grass varieties and/or seeding regime, re-seeding with regional varieties, no use of pesticides, no disposal of manure and/or mineral fertilizers, no irrigation, no soil sealing); - borders, in-field strips and patches managed for wildlife or specific fauna (herbaceous border, protection of nests, wildflower strips, local seed mix, unharvested crops); - management (pruning, trimming, dates, methods, restoration) of landscape features (trees, hedgerows, riparian woody vegetation, stone walls (terraces), ditches, ponds); - keeping arable peaty or wet soils under grass (with no use of fertilizers and no use of plant protection products); - production on arable land with no use of fertilizer (mineral fertilizer and manure) and/or plant protection products, and not irrigated, not sown with the same crop two years in a row and on a fixed place (*); - conversion of arable land into permanent grassland extensively used.			
Agri-environmental practices: Water recirculation and reutilization; Increase of technical efficiency of the irrigation systems (Donãna)	•		

Regulation (EU) No 1308/2013 of the European Parliament and of the Council

The types of measures listed in table 8 are aggregates of different options for action to be considered contiguous in an integrated intervention approach.

Table 8: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Awareness campaigns about potential impacts and behavioural change; **Awareness campaigns (South Moravia)**			•
Risk sharing tools (catastrophe bonds, insurance)/change in ad hoc compensation and assistance for extreme events and disasters; **Risk sharing tools (South Moravia)**			•
Water sensitive agricultural practices/ Integrated land use and water management/ Water recycling/ Improving irrigation efficiency/ Land use planning to reduce flood risks	• (Water recycling)	• (Water sensitive agricultural	• (Land use planning to reduce flood

		practices)	risks)
Integration of actions to improve soil and water management with actions aimed at the protection of biodiversity and landscape for an increase of sustainability of agricultural production/ change in land use/ introduction of practices aimed at improving the efficient management of water and soil		•	
Structural interventions aimed at improving animals conditions (decrease in temperatures of stables, orientation and insulation, ventilation, etc)	•		
Reduction in the use of pesticides and fertilizers, through the increase use of integrated pest management, fertilization management, monitoring of phytosanitary conditions, crop rotation		•	
Diversification of productive activities through the introduction of new crops and/or cropping systems; **Regeneration of soils, diversification of crops, species and varieties (Alentejo)**		•	
Crisis management			•
Increase adaptive capacity of rural communities through local rural development (Alentejo)			•
Agri-environmental practices: Water recirculation and reutilization; Increase of technical efficiency of the irrigation systems (Donãna)	•		
Buffer zones to reduce nutrient leakage from fields; constructed wetlands in agriculture to reduce nutrient leakage and partially for flood protection; winter time vegetation cover (different slopes); perennial grass (different slopes); controlled drainage; optimal fertilization; cultivation techniques and technologies for water and nutrient management (Kalajoki)		•	

The Regulation explicitly mentions climate change only in terms of mitigation (Art. 152 - viii).

Nevertheless, supporting actions for harvest insurance which helps to safeguarding producers' incomes where there are losses as a consequence of natural disasters, adverse climatic events, diseases or pest infestations, are constrained by the need to introduce or maintain farming practices that help mitigate the impacts of climate change and facilitate adaptation.

Awareness campaigns about potential impacts and behavioural change. As stated in Art. 33 "*crisis prevention and management*"[…] shall be related to avoiding and dealing with crises on the fruit and vegetable markets and shall cover […] c) promotion and communication, either for prevention or during a crisis period. Furthermore, as stated in Art. 38 the Commission may adopt implementing acts laying down measures concerning: […] i) promotion, communication and training measures in case of crisis prevention and management. Crisis in the agricultural sector may occur as a consequence of adverse climatic conditions (i.e. frost, drought, heavy rainfall) that may cause lower harvests, deterioration in the product quality with consequences on the market. Measures addressed to prevent or manage crises including measures of education and information certainly represent tools for adapting to climate change whenever crises occur as a consequence of climate change.

Risk sharing tools (catastrophe bonds, insurance); change in ad hoc compensation and assistance for extreme events and disasters. Measures may be related to crisis prevention and management aimed to avoid and deal with crises on fruit and vegetable markets. Art. 33 (h) includes, among other measures, harvest insurance in order to contribute to safeguarding producers' income where there are losses as a consequence of natural disasters, adverse climatic events, diseases or pest infestations. As climate change has a significant impact on both the quantity and the quality of crops, this type of measure contributes to protect the affiliated farmers also by economic losses due to adverse climatic events, enabling them to invest with more confidence in these activities. Insurance and loans require that beneficiaries undertake necessary risk prevention measures: in case of crises occurring as a consequence of frost, drought, heavy rainfall, attention shall be paid to measures which contribute to reduce the effects of climate change and promote adaptation.

Water sensitive agricultural practices; Integrated land use and water management; Water recycling; Improving irrigation efficiency; Land use planning to reduce flood risks. As stated in Art. 152 the objectives of producers organizations include among others […] iv) carrying out research and developing initiatives on sustainable production methods, innovative practices, economic competitiveness and market developments; v) promoting and providing technical assistance for the use of environmentally sound cultivation practices and production techniques and sound animal welfare practices and techniques; vii) management of by-products and of waste in particular to protect the quality of water, soil and landscape and preserving or encouraging biodiversity; viii) contributing to a sustainable use of natural resources and to climate change mitigation. Furthermore, as stated in Art. 157 inter-branch organizations in a specific sector aim at […] vii) providing the information and carrying out the research necessary to innovate, rationalize, improve and adjust production and, where applicable, the processing and marketing, towards products more suited to market requirements […] and protection of the environment; viii) seeking ways of restricting the use of animal-health or plant protection products, better managing other inputs, ensuring product quality and soil and water conservation, promoting food safety […] and improving animal health and welfare; x) taking all possible actions to uphold, protect and promote organic farming and designations of origin, quality labels and geographical indications; xi) promoting and carrying out research into integrated, sustainable production or other environmentally sound production methods. The Regulation does not define precisely which measures are to be adopted for an environmentally sound agricultural production. However, a production management aimed at achieving these objectives cannot ignore techniques addressed to reduce consumption, to safeguard the quality of water resources, to protect the quality of soils, which all promote implicitly adaptation to climate change. Innovation with infrastructural investments at firm level such as high efficiency irrigation systems or recovery, restoration and maintenance of hydraulic and agricultural interventions in particular on hilly areas, through a participatory planning at micro-basin scale (terraces, embankment, etc) might be an example.

Integration of actions to improve soil and water management with actions aimed at the protection of biodiversity and landscape for an increase of sustainability of agricultural production; change in land use/ introduction of practices aimed at improving the efficient management of water and soil. See what stated above in Art. 152 and Art. 157. The objectives established by the Regulation for producer organizations (environmental protection, water and soil conservation, landscape conservation, biodiversity protection) through i.e. sustainable agriculture, innovative practices, restriction in the use of animal-health or plant protection products, can be all considered adaptation measures. As climate change represents a threat to the quantity and quality of water resources, including those ones for agriculture and livestock, agricultural practices addressed to a more efficient water use, as well as measures aimed at protecting biodiversity, could provide support to better face climate change effects.

Structural interventions aimed at improving animals conditions (decrease in temperatures of stables, orientation and insulation, ventilation, etc). As stated in Art. 152 the objectives of producer organizations are: […] v) promoting and providing technical assistance for the use of

environmentally sound cultivation practices and production techniques, and sound animal welfare practices and techniques. Climate change is not only responsible for damages to agricultural production, both in quality and quantity, but also for uncertain phytosanitary conditions (i.e. spreading of new pathogens, changes in the product life cycles) and the deterioration of animal conditions (i.e. frost, heat-waves, new pathogen vectors, etc). Thus, measures that are aimed at improving animal welfare should necessarily take into account possible adverse climatic conditions.

Reduction in the use of pesticides and fertilizers, through the increase use of integrated pest management, fertilization management, monitoring of phytosanitary conditions, crop rotation. The Regulation does not explicitly mention such specific measures, but it promotes a sustainable agriculture (i.e. environmentally sound agriculture, protection of biodiversity, water resources, landscape, etc) and organic farming (Art. 33). The achievement of these objectives requires necessarily a reduction in the use of pesticides and fertilizers, integrated pest management methods, crop rotation. The reduction in the use of pesticides and fertilizers allows for prevention and reduction of water pollution due to the frequent runoff events and the infiltration in the groundwater due to the increase in the frequency and the intensity of rainfall. System crops rotation will increase the natural soil fertility and improve the ability of pest management by contributing to limit the impacts of climate change in agriculture.

Diversification of productive activities through the introduction of new crops and/or cropping systems. As stated in Art. 49 the Regulation provides support for harvest insurance in order to safeguarding producers' income where there are losses as a consequence of natural disasters, adverse climatic events, diseases or pest infestations. There is not specific reference to the introduction of particular crop systems or new crops, however the financial support requires that producers take all the necessary measures to prevent crisis situations.

Crisis management. As stated in Art. 33 crisis prevention and management are included. Measures for crisis management act on the consequences arising from natural disasters (i.e. effects on the agricultural sector) and might be linked to economic investments, training and good practices exchange.

Regulation (EU) No 1310/2013 of the European Parliament and of the Council

The Regulation does not include any specific references to climate change or key-points with respect to climate change adaptation.

3.2.3 Water

Climate change and water: relevant impacts

Climate change is responsible for changes in climate variables, such as temperature, evaporation and precipitation with effects on outflows, soil moisture and aquifer recharge. The hydrological cycle is heavily impacted not only by the change in average values but also, and more importantly, by the variability and the occurrence of extreme events. The impacts of these changes are evident in many sectors, from agriculture to industry, and concern the quality of surface and ground water to public health. Extreme events can cause damages on exposed population with consequences in terms of human life, health costs, costs for temporary accommodation for displaced people, damages to infrastructure (energy, transport, sewerage, water, etc), buildings, production systems with the disruption of all kinds of services. Failure or losses in water distribution network and structural damages caused by extreme weather events and their consequences (i.e. landslides) may also increase the risk of water leakages and possible contaminations.

Heavy rains and subsequent flooding can cause overflow of untreated discharges, resulting in pollution of rivers and aquifers. In a relatively impermeable soil, rain may give rise to runoffs of nitrogenous waste to watercourses. In case soil is more permeable, percolation of such pollutants might occur more easily. The leaching of nitrogen in the soil in nitrate form can reach the deeper layers of soil and later underground aquifers, resulting in deterioration of the water/pollutants dilution ratio. Such kind of pollutant originates mainly from agricultural and breeding activities.

During drought periods, the water level that decreases in receptor bodies determines an increase in the level of pollutants concentration, and this might result in the intensification of eutrophication in water receptors. Climate change may also alter chemical processes in the soil through changed conditions in humidity and temperature. Changes in river flow (increasing erosion and the transport of nutrients and sediments) are expected to alter accordingly concentrations and total loads of dissolved substances, particularly evident during intense rainfall events that follow prolonged dry periods.

The infrastructure of the drainage system and the waste water treatment are highly stressed by both floods and droughts. The design of these systems should take into consideration the hydraulic load (the quantity of waste water treated in cubic meters per day, generally defined on the basis of the discharge flow trend). Peaks coincide with particularly intense weather events: in the case of treatment plants also the increased temperature affects the ability to reduce pollutants, and consequently the effectiveness of the treatment. River overflows can cause backflow in sewage systems, possibly aggravated by freezing due to drastic decreases in temperature.

Agricultural activities and livestock produce emissions of various substances, including ammonia (NH_3), which impact both on human health and the environment as they contribute to the process of soil acidification, eutrophication and ground-level ozone pollution.

The increase in water temperature and the occurrence of extreme events (floods and droughts) may increase pollution loads and reduce the availability of water (especially during drought periods) that could affect water supplies for drinking purposes. Sea level rise could have an impact on coastal aquifers through saltwater intrusion, and together with a regime of decreasing rainfall may determine additional reduction in water availability (exhaustion of the aquifers and risk of its gradual pollution caused either by the intrusion of salt wedge in coastal areas or the deterioration of the water/pollutants dilution ratio from industrial sources).

The increase in water temperature and water pollution connected to the occurrence of extreme weather events may also result in a reduction of the bathing water quality. The increasing risk of infectious diseases is strictly related to the environmental status of the water and to weather conditions more in general. Climate change can affect the toxicity of bathing water both in direct and

indirect way: floodings might contribute to water contamination while temperature increase also influences the level of toxicity through changes in marine pathogens distribution.

Legal framework and objectives

Table 9 provides a scheme of the most relevant European legal provisions (i.e. Regulations, Directives, etc) for adaptation to climate change. For further insights see ANNEX II to this report.

Table 9: Legal framework on water

Legal reference	Year	General objectives
Council Directive concerning urban waste water treatment (91/271/EEC)	21.05.1991	This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the above mentioned waste water discharges.
Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)	12.12.1991	This Directive has the objective of :reducing water pollution caused or induced by nitrates from agricultural. It is necessary for Member States to identify vulnerable zones and to establish and implement action programs (promoting the application of the code(s) of good agricultural practice, the adoption of restrictions, prohibitions, minimum structural requirements) in order to reduce water pollution from nitrogen compounds in vulnerable zone.
Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy	23.10.2000	The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater (prevents further deterioration and protects and enhances the status of aquatic ecosystem, promotes sustainable water use based on a long-term protection of available water resources, measures for the progressive reduction of discharges, emissions and losses of priority substances [...] contributes to mitigating the effects of floods and drought [...]).
Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration	12.12.2006	Art. 1 - Purpose 1. This Directive establishes specific measures as provided for in Article 17(1) and (2) of Directive 2000/60/EC in order to prevent and control groundwater pollution. These measures include in particular: (a) criteria for the assessment of good groundwater chemical status; and (b) criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversals
Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood	23.10.2007	The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse

risks		consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community.

Relevance of the legal framework with respect to adaptation and potential adaptation measures

Council Directive concerning urban waste water treatment (91/271/EEC)

The Directive does not include any specific reference to climate change adaptation. The types of measures listed in Table 10 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach.

Table 10: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Adapting the design factor for flood protection (proper scale of intervention, black and gray water separation, construction of reservoirs, etc)	•		
Programs to promote efficient water use; Water recycling; Water restrictions; Water saving measures	•		
Structural interventions for improving the efficiency and upgrade of networks to reduce losses	•		
Technological adaptation for a "climate-proofing" management of treatment plants (measurement instruments, remote control, etc.)			•

Adapting the design factor for flood protection (proper scale of intervention, black and gray water separation, construction of reservoirs, etc). Although treatment plant design is addressed to ensure the performance under normal weather conditions (Art. 10), design, building and maintenance of sewage systems should consider - inter alia - pollution due to overflows of heavy rains, the volume and characteristics of urban waste water, the prevention of leaks (Annex 1 A).

Climate change is responsible for extreme weather events (i.e., heavy rainfall) with consequences such as flooding, mudslides and landslides. These events can cause damages to technical infrastructure of waste water management, from the sewer system to the treatment plants. The sewer system should be dimensioned to cope with extreme weather events in order to prevent flooding from generating a water flow exceeding what the sewer system might dispose. Reservoirs, both online and offline, are conceived to address increases in flow rates and control the quantity and quality of pollutant discharges to the environment during system crisis. Treatment plants are not able, if not properly designed, to treat considerable increases of water loads that flow in, mainly caused by the presence of just a single sewer system for both black and white water. Therefore during the infrastructure and plants design, possible areas subject to flooding or abnormal rainfall intensity need to be identified. It is important to consider the design of water spillways for separation of black water

from the white ones, and allow only part of the effluent to get into the plant while letting the remaining part reaching water courses.

Programs to promote efficient water use; water recycling; water restrictions; water saving measures. Art. 12 suggests the reuse of treated wastewater whenever appropriate. The wastewater reuse for agricultural or industrial purposes is a measure that is aimed, together with the efficient use and water saving, to reduce water consumption. In this regard it may represent a measure of adaptation to climate change as drought and water shortages are stressors produced or aggravated by the climate change.

Structural interventions for improving the efficiency and upgrade of networks to reduce losses. Although the Directive does not provide explicit responses to climate change, it sets out to design, build and maintain sewage systems, considering inter alia pollution due to overflows of heavy rains, the volume and characteristics of urban waste water, the prevention of leaks (Annex 1 A). Climate change is responsible for extreme weather events with consequent flooding and hydraulic loads in excess with respect to the size of the receiving infrastructure. Therefore, the upgrading and the maintenance of these systems would eliminate the leaks from pipelines thus limiting damages from wastewater spills able to contaminate surrounding soil and groundwater.

Technological adaptation for a "climate-proofing" management of treatment plants (measurement instruments, remote control, etc.). Construction and maintenance aimed to ensure proper functioning of the system requires a technological adaptation in order to allow the system to work in any meteo-climatic conditions and protect the environment by wastewater (Art. 10).

Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)

The Directive does not include any specific reference to climate change adaptation. The types of measures listed in Table 11 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach.

Table 11: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Promotion of good agricultural and breeding practices (e.g. water-sensitive agricultural practices, improvement of water retention capacity of the soil and water conservation, integrated land use and water management)			•
Diversification and crop rotation on farms (reduction of nitrogen inputs, etc.); Control of nitrates leaching		•	
Buffer zones to reduce nutrient leakage from fields; constructed wetlands in agriculture to reduce nutrient leakage and partially for flood protection; winter time vegetation cover (different slopes); perennial grass (different slopes); controlled drainage; optimal fertilization; cultivation techniques and technologies for water and nutrient management (Kalajoki)		•	

Promotion of good agricultural and breeding practices (e.g. water-sensitive agricultural practices, improvement of water retention capacity of the soil and water conservation, integrated land use and water management). The Directive sets out, among other issues, the definition of codes for good agricultural practices or training and information activities for farmers aimed at reducing water pollution by nitrates from agricultural sources. There are requirements on different issues: the use of fertilizers for the water-saturated, flooded, frozen or snow-covered soil; limitation of the land application of fertilizer according to the characteristics of the vulnerable zone concerned; the maintaining, during rainy periods of a minimum vegetation cover capable of retaining the nitrogen that otherwise, reaching water bodies, would pollute water with an excessive intake of nitrates; the prevention of water pollution from run-off and water percolation […].

Extreme events such as heavy rainfall and subsequent flooding can cause overflow of untreated discharges, resulting in pollution of rivers and aquifers. The leaching of nitrogen in the soil in nitrate form can reach the deeper layers of soil and later underground aquifers. During drought periods, the decreasing water level in receptor bodies determines an increase in the level of pollutants concentration, and this might result in the intensification of eutrophication events in final receptor bodies. These measures are not explicitly established for adapting to climate change, however, a proper planning for nitrates use in relation to meteorological events (rainy periods and so on) or according to soil characteristics (flooded or water-saturated) is strongly recommended.

Diversification and crop rotation on farms (reduction of nitrogen inputs, etc.); Control of nitrates leaching. The Directive is intended to reduce pollution by nitrates from agricultural sources. Action programs are a tool for farmers to achieve this objective. Action programs should consider the adoption of restrictions, prohibitions, minimum structural requirements and farm good management practices to improve the quality of water resources. Other additional measures that might be included are: land use management, including the use of crop rotation systems and the proportion of land devoted to permanent crops with respect to annual crops; the development of fertilization plans for each farm, the application of fertilizer to waterlogged, flooded, frozen or snow-covered soil; the maintenance of a minimum vegetation cover during the rainy periods that is capable of retaining nitrogen that would otherwise reach and pollute water bodies with an excessive intake of nitrates; the prevention of water pollution from run-off and water percolation. These measures are not explicitly established to adapting to climate change in the agricultural sector. However, measures to prevent or reduce water pollution by nitrates definitely require to take into consideration also meteo-climatic changes together with soil characteristics (flooded or water-saturated soil).

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Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy

The types of measures listed in Table 12 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach.

Table 12: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Water management plans (e.g. water restrictions and consumption cuts; water saving measures; programs to promote efficient water use and reduction of water consumption; water recycling; increased capacity of basins and reservoirs that allow multi-year plan for resource management); Land use planning to reduce flood risk**; Improve water quantity supply, expected to be under**			•

pressure due to the decrease and deterioration of the bog layer (Dartmoor); Water saving measures - increase of water retention, change in irrigation practices (South Moravia); Creating more flexibility in the water levels of the lake and surrounding water systems (Ijsselmeer)			
Water retention in the landscape: rainwater harvesting in farms, by farmers, through the creation of permanent lakes and small dams (Alentejo); Rain water harvesting for collecting and storing rainwater (Cascais)	•		
Managing groundwater levels to reduce saltwater intrusion and/or increase storage capacity		•	
Improving irrigation efficiency; wastewater reuse for irrigation purposes	•		
Economic incentives for behavioral change; Development of economic instruments for climate risk management (insurance, mutual funds, etc.)			•
Desalinization	•		
Development and strengthening of decision supporting systems (forecasting, early warning systems for drought, floods, landslides, etc)			•
Climate-proofing flood prone areas; structural interventions in areas subject to flooding; Innovative systems for flood and sea river protection; Adapting existing dykes and dams; Reinforcing sea flood protection infrastructure; Establishing wooded riparian areas/buffer strips along water bodies; **Measures related to managing flood risks): flood risk management through strategic (small) flood barriers and strategic planning and cutting (floods are expected to increase due to decrease of the bog layer and increase in precipitation peaks) (Dartmoor); Offshore dikes; Large dikes on the coast and land; Phasing out of vulnerable areas with human settlement during this century (Kalundborg); Flood protection structures (Kalajoki)**	•		
Water streams requalification in consideration of the maintenance of vital outflows and ecological quality during changes in precipitation regimes; **Peat land and water course restoration: restoration actions to promote water retention in the landscape and increase carbon storage (Šumava)**		•	
Improve water quality, as the tick bog layer purifies precipitation water (Dartmoor)		•	
Construction of a pipeline connecting the reservoir with the rice fields (Donãna)	•		
Sewage system (Copenhagen)	•		
Beach sand replacement (sand nourishment		•	

operations, periodic monitoring activities of sea-level rises and increased coastal erosion); Reinforcing the dune system (by building sand dikes, and relocate farming fields); maintain existing structures (groynes); Re-vegetation of affected dune areas to support beach sand replacement (Ílhavo & Vagos)			
Coastal protection measure in combination with the finishing and landscaping-project (Timmendorfer Strand)	•		
Climate proofing of river basins management plans (Kalajoki)			•
Identification and mapping of (relatively) high flood risk areas; Flow regulation (Kalajoki)			•
Measures to slow down flow of water from drained areas and clear cuts; Restoring drained wetlands for flood protection and reduction of nutrient leakage through increased water retention capacity (Kalajoki)		•	

Water management plans (e.g. water restrictions and consumption cuts; water saving measures; programs to promote efficient water use and reduction of water consumption; water recycling; increased capacity of basins and reservoirs that allow multi-year plan for resource management); Land use planning to reduce flood risk. The Directive (Art. 1) [...] establishes a framework for water protection with the aim of mitigating the effects of floods and droughts. The Directive requires a management plan for the river basin (Art. 13) in each hydrographic district. This plan must contain a number of measures (Art. 11), including those ones aimed at ensuring an efficient and sustainable water use and other measures to prevent significant losses of pollutants from technical installations or reduce the impact of accidental pollution incidents, such as floods (also through systems to detect or give warning of such events). Other additional measures that can be included into this plan are: codes of good practice, wetland restoration, demand management measures, including the promotion of low water-demanding crops in drought-affected areas, measures to promote water efficiency and reuse, including low water-consumption irrigation techniques, restoration projects; aquifers artificial recharge, etc. Although management plans are not explicitly required to cope with adaptation to climate change, plans for river basin management may be considered as useful tools also for such a kind of policy. The objective is to protect waters through the mitigation of flooding and drought impacts, whose frequency and intensity is closely related to climate change.

Managing groundwater levels to reduce saltwater intrusion and/or increase storage capacity. According to the Directive, Member States shall protect, enhance and restore all groundwater bodies, and ensure a balance between abstraction and recharge of groundwater in order to achieve a good groundwater status. Furthermore Art. 11 authorizes the aquifer recharge with water used for geothermal purposes.

Improving irrigation efficiency; wastewater reuse for irrigation purposes. Measures in management plans may be designed to achieve an efficient and sustainable use of water (Art. 11), as well as they may act more on the demand management side with the promotion of low water demanding crops in areas affected by drought and low water consumption irrigation techniques (Annex VI).

Economic incentives for behavioral change; Development of economic instruments for climate risk management (insurance, mutual funds, etc.). The Directive requires to act through specific water-pricing policies to stimulate users to use efficiently water resources (Art. 9). In addition, according to Annex VI Part B, Member States may adopt economic and fiscal instruments and put

them in the plans for river basin management. Economic measures (direct incentives, pricing policies and other forms of financial support) are aimed at changing the behavior of citizens or entities involved in a perspective of sustainable use of water resources and are tools to face critical situations such as the shortage of water.

Desalination. The construction of desalination plants is one of the additional measures that Member States may decide to adopt within each river basin district under the program of measures (Annex VI part B). Desalination of sea water represents a technological measure to face periods of water scarcity whose higher frequency and intensity is linked to climate change.

Development and strengthening of decision supporting systems (forecasting, early warning systems for drought, floods, landslides, etc). Concerning the program of measures (Art. 11), the directive defines the basic measures to prevent and/or reduce the impact of accidental pollution incidents as a result of floods, including systems to detect or give warning of such events.

Climate-proofing flood prone areas; structural interventions in areas subject to flooding; Innovative systems for flood and sea river protection; Adapting existing dykes and dams; Reinforcing sea flood protection infrastructure; Establishing wooded riparian areas/buffer strips along water bodies. Art. 1 is expected to contribute to the mitigation of the flood effects. The programs of measures might include control measures on the abstraction of fresh surface water and groundwater, containment of surface fresh water, etc.

Water streams requalification in consideration of the maintenance of vital outflows and ecological quality during changes in precipitation regimes.

Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration

Art. 1 - Purpose 1 establishes specific measures as provided for in Article 17(1) and (2) of Directive 2000/60/EC in order to prevent and control groundwater pollution. These measures include in particular: (a) criteria for the assessment of good groundwater chemical status; and (b) criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversals.

Box 1 Exemptions in case of adaptation circumstances

Art. 6. Measures to prevent or limit inputs of pollutants into groundwater

*[…].*3. *Without prejudice to any more stringent requirements in other Community legislation, Member States may exempt from the measures required by paragraph 1 inputs of pollutants that are: […] (c) the consequences of accidents or exceptional circumstances of natural cause that* ***could not reasonably have been foreseen, avoided or mitigated****; […] (f) the result of interventions in surface waters for the purposes, amongst others, of* ***mitigating the effects of floods and droughts****, and for the management of waters and waterways, including at international level. Such activities, including cutting, dredging, relocation and deposition of sediments in surface water, […].*

Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks

The types of measures listed in Table 13 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach

Table 13: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Improvement of flood forecasting and warning; Rehabilitation of early warning systems for landslides, floods, diseases and pathogen attacks			•
Land use planning to reduce flood risks; Crisis management; Disaster management; Evacuation and contingency management plans; Non-structural measures: disaster response management, risk transfer tools, monitoring and management; **Non-structural measures: disaster response management, risk transfer tools, monitoring and management (Prague); Identification and mapping of (relatively) high flood risk areas; Flow regulation (Kalajoki)**			•
Improve water retention; **Rain water gardens; Green corridors and rehabilitation of Cascais streams (Cascais); Local rainwater retention measures (green areas, permeable surfaces; ponds; etc.) (Copenhagen); Creating more flexibility in the water levels of the lake and surrounding water systems (Ijsselmeer)**		•	
Giving space to rivers and increasing water discharge capacity		•	
Flooding warnings to citizens (in Holstebro & Lolland)			•
Separation of surface and ground water and establishment of network of water ways to channel cloudburst rains into e.g. the harbour or the lakes; Renovation of housing in regenerated areas; Dikes; Sluices; Backflow valve in basements (Copenhagen)	•		
Beach sand replacement (sand nourishment operations, periodic monitoring activities of sea-level rises and increased coastal erosion) (Venice); Reinforcing the dune system (by building sand dikes, and relocate farming fields); maintain existing structures (groynes); Re-vegetation of affected dune areas to support beach sand replacement (Ílhavo & Vagos)	•		
Offshore dikes; Large dikes on the coast and land; Phasing out of vulnerable areas with human settlement during this century (Kalundborg)	•		
Grey infrastructure; Sustainable Urban Drainage Systems (SuDS); (Leeds)	•		
Ecosystem-based approach (EBA) (Leeds)		•	
Structural: Improving flood defenses (engineering): Fixed barriers (levees, dykes), Mobile barriers, Other measures (closures and pumping systems in the canalization) (Prague) (Venice); Dike reinforcement; Water storage Grevelingen; Room for the River measures; Channel deepening; Full closure with dams and sluices (Rotterdam); Flood protection structures (Kalajoki)	•		
Coastal protection measure in combination with the finishing and landscaping-project	•		

(Timmendorfer Strand)			
Adaptation to privately owned residential and commercial buildings mitigating flood risks (Venice)	•		
Regulation of lowest permitted distance from water level (Kalajoki)			•

The Directive states that the flood risk management plans should include the measures that are mentioned in Art. 7 and the measures in the field of flooding adopted within the framework of other European Acts such as the Directive 2000/60.

Improvement of flood forecasting and warning; rehabilitation of early warning systems for landslides, floods, diseases and pathogen attacks. Art. 7 point 3 states that […] flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems.

Land use planning to reduce flood risks; crisis management; disaster management; evacuation and contingency management plans. Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems, taking into account the characteristics of the particular river basin or sub-basin. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event (Art. 7 point 3).

Improve water retention. Improvement of water retention is mentioned among the measures that may be implemented in the flood risk management plans.

Giving space to rivers and increasing water discharge capacity. Flood risk management plans may also include the improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.

3.2.4 Coastal protection

Climate change and coastal protection: relevant impacts

Anthropogenic changes, strong urbanization, overbuilding of riverside embankments, barrage or changing of waterways, development of infrastructure (e.g. roads, bridges, water works, energy installations, etc), unsustainable exploitation of aquifers, adoption of intensive farming and breeding practices, poor maintenance of the territory, abandonment of forestry practices and terraces maintenance, have made the coastline particularly vulnerable over time. Climate change represents a further pressure on coastal areas: extreme events such as heavy rainfall, in already compromised lands with hydro-geological instability (e.g. floods, landslides) and habitats alteration, can have serious consequences and cause damages to existing assets and infrastructures. Furthermore, coastal areas have already experienced rapid erosion of the shorelines. These events are related to the enormous anthropogenic impact (i.e. irrational use of coastal areas by human activities in the last decades) but also to the sea level rise due to ice melting, subsidence and ocean thermal expansion as a result of climate change already underway. Mediterranean coastal ecosystems are already highly vulnerable to climate change, with rapid coastal erosion phenomena.

In selecting adaptation measures to climate change for coastal areas it should be important to take into account not only the pressures “coming from the sea” but also the phenomena occurring behind the coastline. Therefore, beside the coastal nourishment measures addressed to face erosion and the construction of barriers to protect the coastline from the sea (sea-side measures), coastal adaptation should also imply soil and water management measures as well as measures related to biodiversity and agriculture (land-side measures): environmental engineering on sensitive parts of slopes such as agricultural terraces, riverbeds, the construction of check dams able to retain several thousand cubic meters of debris and tree trunks along the torrential rods upstream of towns to prevent the debris flows to the sea as a result of weather events, maintenance, actions for the safety of territory, maintenance of dry stone walls, streams and terraces, sustainable farming practices, etc.

Furthermore, the area designated to agricultural land in coastal areas could decrease significantly in the future due to the potential increase of flooding events. The intrusion of saltwater into the groundwater could have a negative impact on water quality for irrigation and consequently on crop yield. Sustainable farming practices able to keep the soil in good condition in the coastal area may therefore represent valid climate change adaptation measures as they help to prevent erosion and landslide. Nevertheless they still need to be integrated with adaptation measures “from the sea side” such as infrastructural intervention (dikes and breakwater, etc) to protect coastlines from flooding.

Legal framework and objectives

Table 14 provides a scheme of the most relevant European legal provisions (i.e. Regulations, Directives, etc) for adaptation to climate change. For further insights see ANNEX II to this report.

Table 14: Legal framework on coastal protection

Legal reference	Year	General objectives
Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora	21.05.1992	The aim of this Directive shall be to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies. Measures taken pursuant

		to this Directive shall be designed to maintain or restore, at favorable conservation status, natural habitats and species of wild fauna and flora of Community interest.
Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy	23.10.2000	The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater (prevents further deterioration and protects and enhances the status of aquatic ecosystem, promotes sustainable water use based on a long-term protection of available water resources, measures for the progressive reduction of discharges, emissions and losses of priority substances [...] contributes to mitigating the effects of floods and drought...).
Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks	23.10.2007	The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community.
Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds	30.11.2009	This Directive relates to the conservation of all species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies. It covers the protection, management and control of these species and lays down rules for their exploitation.
Council Regulation (EC) No 74/2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)	19.01.2009	This Regulation lays down the general rules governing Community support for rural development, financed by the EAFRD, by outlining the rural development programs intended to implement the national strategy plan.
Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006	17.12.2013	This Regulation lays down the common rules applicable to the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund, the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF), which operate under a common framework (the 'European Structural and Investment' - 'ESI Funds'). It also lays down the provisions necessary to ensure the effectiveness of the ESI Funds and their coordination with one another and with other Union instruments. The common rules applying to the ESI Funds are set out in Part Two.
Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005	17.12.2013	This Regulation lays down general rules governing Union support for rural development, financed by the European Agricultural Fund for Rural Development ("the EAFRD") and established by Regulation (EU) No 1306/2013. It sets out the objectives to which rural development policy is to contribute and the relevant Union priorities for rural development. It outlines the strategic context for rural development policy and defines the measures to be adopted in order to

		implement rural development policy. In addition, it lays down rules on programming, networking, management, monitoring and evaluation on the basis of responsibilities shared between the Member States and the Commission and rules to ensure coordination of the EAFRD with other Union instruments.
Regulation (EU) No 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008	17.12.2013	This Regulation lays down the rules on: (a) the financing of expenditure under the Common Agricultural Policy (CAP), including expenditure on rural development; (b) the farm advisory system; (c) the management and control systems to be put in place by the Member States; (d) the cross-compliance system; (e) clearance of accounts.
Regulation (EU) No 1307/2013 of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009	17.12.2013	This Regulation establishes: (a) common rules on payments granted directly to farmers under the support schemes listed in Annex I ("direct payments") (b) specific rules concerning: (i) a basic payment for farmers (.....(iv) a payment for farmers observing agricultural practices beneficial for the climate and the environment (in example, crop diversification, maintenance of existing permanent grassland, the constitution of an area of ecological interest on agricultural area).
Regulation (EU) No 1308/2013 of the European Parliament and of the Council establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007	17.12.2013	This Regulation establishes a common organization of the markets for agricultural products, which means all the products listed in Annex I to the Treaties with the exception of the fishery and aquaculture products as defined in Union legislative acts on the common organization of the markets in fishery and aquaculture products. Within for the single common organization of agricultural markets established by this Regulation, Regulation (EU) 1370/2013, applies. The Regulation provides for measures on fixing prices, levies, aid and quantitative limitations.

Relevance of the legal framework with the adaptation issue

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

The Directive does not include any specific reference to adaptation. In terms of measures the Directive emphasizes the need to monitor, protect and improve the habitats. Among these habitats also coastal zones and wetlands, receiving many migratory species, are included. The preservation and the protection of habitats and biotopes could be intended as actions addressed to reduce the impacts of climate change on these particular ecosystems, and therefore also to adapt to climate change. The Directive requires the protection of natural habitats including “coastal habitats, coastal sand dunes and inland dunes, freshwater habitats” in addition to vegetation and fauna.

Table 15: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Measures to enhance biodiversity: Changes in land management, to protect peat and allow the ecosystem to adapt to the changing climate (Dartmoor)		•	

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy

The types of measures listed in Table 16 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach

Table 16: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Environmental engineering on sensitive parts of slopes (e.g. agricultural terraces, riverbeds, the construction of check dams able to retain several thousand cubic meters of debris and tree trunks along the torrential rods upstream of towns to prevent the debris flows to the sea as a result of weather events; maintenance; actions for the safety of territory, maintenance of dry stone walls, streams and terraces); river restoration; giving space to rivers and increasing time water discharge capacity; **Rainwater harvesting (Cascais); Creating more flexibility in the water levels of the lake and surrounding water systems (Ijsselmeer)**	•		
Improvement of flood forecasting; Establishment of an early warning system			•
Land use planning to reduce flood risk; Integrated land use and water management; Shoreline management plans management; **Climate proofing of river basin management plans; Identification and mapping of (relatively) high flood risk areas (Kalajoki)**			•
Managing groundwater levels to reduce saltwater intrusion and/or increase storage capacity		•	
Economic incentives for behavioral change; Development of economic instruments for climate risk management (insurance, mutual funds, etc.)			•
Flood-proofing infrastructure; structural interventions in areas subject to flooding; Innovative systems for flood and sea river protection; Reinforcing protection infrastructure from sea-flooding; Adapting existing dykes and dams; Artificial reefs along the coastline;	•		

Adapting the design factor for flood protection; **Build an artificial reef in front of either Barra or Vagueira beach (Ílhavo & Vagos); Flood protection structures (Kalajoki)**			
Increase the resilience of the rivers delta to climate change; Soft coastal defenses; Beach nourishment and dune replenishment; establishing wooded riparian areas/buffer strips along water bodies; **Beach sand replacement (sand nourishment operations, periodic monitoring activities of sea-level rises and increased coastal erosion); Reinforcing the dune system (by building sand dikes, and relocate farming fields); maintain existing structures (groynes); Re-vegetation of affected dune areas to support beach sand replacement (Ílhavo & Vagos); Coastal protection measure in combination with the finishing and landscaping-project (Timmendorfer Strand);**		•	
Protection of species whose ability to adapt to climate change is uncertain: in Annex VI the Directive refers to measures from other directives (e.g. Directive 79/409 / EEC on wild birds and the Directive 92/43 / EEC on habitats)		•	
Identification of more sensitive receptors to the potential effects of climate change (e.g. beaches, wetlands, river deltas)	•		
Sewage system (Copenhagen)	•		
Offshore dikes; Large dikes on the coast and land; Phasing out of vulnerable areas with human settlement during this century (Kalundborg)	•		
Measures to slow down flow of water from drained areas and clear cuts; Restoring drained wetlands for flood protection and reduction of nutrient leakage through increased water retention capacity (Kalajoki)		•	
Regulation of lowest permitted distance from water level (Kalajoki)			•

Environmental engineering on sensitive parts of slopes (e.g. agricultural terraces, riverbeds, the construction of check dams able to retain several thousand cubic meters of debris and tree trunks along the torrential rods upstream of towns to prevent the debris flows to the sea as a result of weather events; maintenance; actions for the safety of territory, maintenance of dry stone walls, streams and terraces); river restoration; giving space to rivers and increasing time water discharge capacity. (Art. 1) the Directive contributes to mitigating the effects of floods [...]. Controls over abstraction of fresh surface water and groundwater are included in the programs of measures.

Improvement of flood forecasting; establishment of an early warning system. In relation to the program of measures (Art. 11) the Directive defines the basic measures to prevent and/or reduce the impact of accidental pollution incidents, such as a result of floods, also through systems able to detect or give warning of such events.

Land use planning to reduce flood risk; integrated land use and water management; shoreline management plans management. The Directive (Art. 1) [...] establishes a framework for water protection with the aim of mitigating the effects of floods and droughts. The Directive requires a management plan for the river basin (Art. 13) in each hydrographic district. This plan must contain a number of measures (Art. 11), including those ones aimed at ensuring an efficient and sustainable water use and other measures to prevent significant losses of pollutants from technical installations or reduce the impact of accidental pollution incidents, such as floods (also through systems to detect or give warning). Other additional measures that can be included into these plans are: codes of good practice, wetland restoration, demand management measures, including the promotion of low water-demanding crops in drought-affected areas, measures to promote water efficiency and reuse, including low water-consumption irrigation techniques, restoration projects; aquifers artificial recharge, [...]. Although management plans are not explicitly required in order to cope with adaptation to climate change, plans for river basin management may be considered as useful tools also for such a kind of policy. The objective is to protect waters through the mitigation of flooding and drought impacts, whose frequency and intensity could be related to climate change. Coastline management plans are not mentioned, however measures dealing with the river basin management may also include those ones relating to protection of the coastline.

Managing groundwater levels to reduce saltwater intrusion and/or increase storage capacity. According to the Directive, Member States shall protect, enhance and restore all groundwater bodies, and ensure a balance between abstraction and recharge of groundwater in order to achieve good groundwater status. In Annex V the presence or absence of salt intrusion is mentioned among the elements that allow to define the state of groundwater quality.

Economic incentives for behavioral change; development of economic instruments for climate risk management (insurance, mutual funds, etc.). The Directive requires to act through specific water-pricing policies to stimulate users to use efficiently water resources (Art. 9). In addition, according to Annex VI Part B, Member States may adopt economic and fiscal instruments and put them in the plans for river basin management. Economic measures (direct incentives, pricing policies and other forms of financial support) are aimed at changing the behavior of citizens or entities involved in a perspective of sustainable use of water resources and are efficient tools to face critical situations such as the shortage of water.

Flood-proofing infrastructure; structural interventions in areas subject to flooding; Innovative systems for flood and sea river protection; reinforcing protection infrastructure from sea-flooding; adapting existing dykes and dams; artificial reefs along the coastline; adapting the design factor for flood protection; One of the objectives of the Directive is to contribute to mitigate the effects of floods and droughts (Art. 1). The directive does not specify the type of projects that may fall in this measure, nevertheless the measures to be adopted in programs have the aim to protect, enhance and restore all bodies of surface water and groundwater, in this case, ensuring a balance between abstraction and recharge of groundwater in order to achieve a good groundwater status (Art. 4). Flooding and landslides following heavy rains are becoming more frequent and intense because of climate change. In order to deal with these extreme events, the design and construction of buildings, infrastructures that are able to contain and limit the damage resulting from these events are likely needed.

Increase the resilience of the rivers delta to climate change; soft coastal defenses; beach nourishment and dune replenishment establishing wooded riparian areas/buffer strips along water bodies.

Protection of species whose ability to adapt to climate change is uncertain: in Annex VI the Directive refers to measures from other directives (e.g. Directive 79/409 / EEC on wild birds and the Directive 92/43 / EEC on habitats).

Animal species are adversely affected by climate change. The early arrival of many spring migratory birds is one of the clearest and easily observable event of the climate change underway. Climate

change also determines changes in the breeding season: some species cease to migrate, others modify their routes or reproduce themselves in advance. When these events become frequent, they have negative effects on the population and species. The European Directives Habitat (43/92 EEC) and Birds (79/409 EEC) and the EU strategy for biodiversity provide a good basis for the conservation of animal and plant species in the presence of climate change, protecting natural areas and making sure that the management of the landscapes around is compatible with the conservation of species and habitats. Even conservation strategies must change as a consequence of climate change: it is necessary to increase the resilience of the natural environment, that is its capability to withstand climate change through a series of conservation measures (e.g.: protected areas).

Identification of more sensitive receptors to the potential effects of climate change (e.g. beaches, wetlands, river deltas). In Art. 6 the Directive introduces registries for each river basin designated as special protection areas according to relevant EC legislation, in order to protect surface water and groundwater and preserve habitats and species that depend directly from that water. Protected areas include areas designated for the protection of habitats and species where the maintenance or improvement of the water status is important for their protection, including relevant sites of the Natura 2000 in accordance with Directive 92/43 / EEC (1) and Directive 79/409/EEC (2). The Directive sets out the identification of areas belonging to river basin without explicit reference to the coastline or adaptation to climate change. Nevertheless the Directive has, among the main objectives, the reduction or prevention of the impact from floods and droughts. This implies that the measures to be taken must be adequately accompanied by an analysis of the territory and its most vulnerable areas, in order to protect surface water and groundwater, and preserve habitats and species that depend directly on water.

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

The types of measures listed in Table 17 are aggregates of potential options for action to be considered contiguous in an integrated intervention approach.

Table 17: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Sensitive slopes stabilization (i.e. agricultural terraces, check dams aimed at retaining several thousand cubic meters of debris and tree trunks along the rods torrential upstream of towns to prevent debris flows to the sea as a result of weather events; maintenance; securing the territory; maintenance of dry stone walls, streams and terraces); River restoration; Giving space to rivers and increasing water discharge capacity; **Creating more flexibility in the water levels of the lake and surrounding water systems (Ijsselmeer)**		•	
Improvement of flood and landslide forecasting and warning			•
Land use planning to reduce flood risks; Integrated land use and water management			•
Crisis management; Disaster management; Evacuation and contingency management plans; **Disaster response management, risk transfer**			•

tools, monitoring and management (Prague)			
Flood proof infrastructure; Climate proofing flood prone areas; Innovative flood sea and river protection; Reinforce flood sea protection infrastructure; Adapting existing dykes and dams; Artificial reefs along the coastline; Adapting the design factor for flood protection; Enhancing capacity of waters; Making deltas cope with the effects of climate change; **Flood risk management through strategic (small) flood barriers and strategic planning and cutting (floods are expected to increase due to decrease of the bog layer and increase in precipitation peaks) (Dartmoor); Build an artificial reef in front of either Barra or Vagueira beach(Ílhavo & Vagos); Offshore dikes; Large dikes on the coast and land; Phasing out of vulnerable areas with human settlement during this century (Kalundborg); Structural: Improving flood defences (engineering): Fixed barriers (levees, dykes), Mobile barriers, Other measures (closures and pumping systems in the canalization (Prague); Dike reinforcement; Water storage Grevelingen; Room for the River measures; Channel deepening; Full closure with dams and sluices (Rotterdam); Coastal protection measure in combination with the finishing and landscaping-project (Timmendorfer Strand); Flood protection structures (Kalajoki); Installation of domestic flood gates, Installation of sluice gates upstream to hold back flood water (South Devon)**	•		
Soft coastal defenses; **Beach sand replacement (sand nourishment operations, periodic monitoring activities of sea-level rises and increased coastal erosion) (Venice); Reinforcing the dune system (by building sand dikes, and relocate farming fields); maintain existing structures (groynes); Re-vegetation of affected dune areas to support beach sand replacement (Ílhavo & Vagos);**		•	
Improvement of water retention capacity of the soil;		•	
Risk maps for the main climate change impacts on coastal areas (i.e. flooding due to storm surges and to sea level rise, coastal erosion, changes in water quality, saltwater intrusions) – Hazard and vulnerability analysis related to climate change extreme events			•
Integration of vulnerability assessment and adaptation measures in consolidated planning procedures (city planning, water resources, coastal system protection, civil protection)			•
Widening of river floodplains; High water level protection; Extended watercourse	•		

routing; Local dam; Retaining water through decentralized dam solutions (Holstebro & Lolland); Dikes, Sluices, Backflow valve in basements (Copenhagen)			
Flooding warnings to citizens (Holstebro & Lolland)			•
Rainwater gardens; Green corridors and rehabilitation of Cascais streams (Cascais); Local rainwater retention measures (green areas, permeable surfaces; ponds; etc.) (Copenhagen)		•	
Separation of surface and ground water and establishment of network of water ways to channel cloudburst rains into e.g. the harbour or the lakes (Copenhagen)	•		
Renovation of housing in regenerated areas	•		
Grey infrastructure; Sustainable Urban Drainage Systems (SuDS) (Leeds)	•		
Ecosystem-based approach (EBA) (Leeds)		•	
Adaptation to privately owned residential and commercial buildings mitigating flood risks (Venice)	•		

The Directive explicitly mentions climate change and sea flooding. Nevertheless the Directive does not mention that, in some cases, coastal areas are not just threatened by the sea but also from the areas behind it, especially in case of hilly or mountainous areas. The Directive requires that flood risk management plans should include the measures that are mentioned in Art. 7 and the measures on flooding adopted under other acts (i.e. the Directive mentions for example the measures included in the Directive 2000/60, […]. As reported in the Directive, flood risk management plans have to take into account relevant aspects such as […] soil and water management, spatial planning, land use, nature conservation and port infrastructure, […], and address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems.

Sensitive slopes stabilization (i.e. agricultural terraces, check dams aimed at retaining several thousand cubic meters of debris and tree trunks along the rods torrential upstream of towns to prevent debris flows to the sea as a result of weather events; maintenance; securing the territory; maintenance of dry stone walls, streams and terraces); river restoration; giving space to rivers and increasing water discharge capacity. As stated in Art. 7 (3) […] flood risk management plans have to address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems.

Improvement of flood and landslide forecasting and warning. As stated in Art. 7 (3) […] flood risk management plans address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems. The setting of early warning systems is essential in order to prevent the consequences of flood and landslide. These measures can help protect the coastline from both sea flooding and the pressures coming from upstream (i.e. landslide at sea).

Land use planning to reduce flood risks/Integrated land use and water management. Chapter IV (Flood risk management plans) states that Member States establish flood risk management plans […], focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity. Also non-structural initiatives to reduce the likelihood of flooding are considered, if appropriate. Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems [...]. They may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event. These plans take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes, areas with potential to retain flood water (i.e., natural floodplains, the environmental objectives of Art. 4 of Directive 2000/60/EC), soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure. The Directive does not mention explicitly coastal management plans, however coastal management measures could be considered among the measures for prevention and protection from sea flooding.

Crisis management; Disaster management; Evacuation and contingency management plans. Art. 7, 3) chapter IV states that Member States establish flood risk management plans […] to address all aspects of flood risk management focusing on prevention, protection, preparedness (i.e. evacuation plans, disaster management plans […], soil and water management, spatial planning, land use, nature conservation.

Flood proof infrastructure; Climate proofing flood prone areas; Innovative flood sea and river protection; Reinforce flood sea protection infrastructure; Adapting existing dykes and dams; Artificial reefs along the coastline; Adapting the design factor for flood protection; Enhancing capacity of waters; Making deltas cope with the effects of climate change. Chapter IV (Flood risk management plans) states that Member States establish flood risk management plans […], focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity. Flood risk management plans address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems [...]. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of flood event. They take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes, areas with potential to retain flood water (i.e., natural floodplains, the environmental objectives of Art. 4 of Directive 2000/60/EC), soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure. The Directive does not mention explicitly some of the considered measures (i.e. adapting existing dykes and dams). However, since the plans take into account all aspects of flood risk management (in particular prevention, protection and preparedness), infrastructural and management measures represent useful tools in order to achieve the objectives of the plan.

Soft coastal defenses; Beach nourishment and dune replenishment.

Improvement of water retention capacity of the soil; incentive to landowners to improve the retention capacity. As stated in chapter IV, flood risk management plans […] may also include improvement of water retention among the measures to be potentially adopted.

Risk maps for the main climate change impacts on coastal areas (i.e. flooding due to storm surges and to sea level rise, coastal erosion, changes in water quality, saltwater intrusions); Hazard and vulnerability analysis related to climate change extreme events. As stated in Art. 4 a preliminary flood risk assessment has to be undertaken to provide an assessment of potential risks, based on available or readily derivable information, such as records and studies on long term developments, in particular impacts of climate change on the occurrence of floods. On the basis of this preliminary assessment, Member States prepare at the level of the river basin district or unit of management, flood hazard maps and flood risk maps at the most appropriate scale for areas identified under Art. 5 (1).

Integration of vulnerability assessment and adaptation measures in consolidated planning procedures (city planning, water resources, coastal system protection, civil protection). As reported in the Annex of the Directive, flood risk management plans include specific measures reported in the Directive itself and also flood related measures taken under other Community acts, including the Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, the Directive 96/82/EC on the control of major accident hazards involving dangerous substances, the Directive 2001/42/EC on the assessment of the effects of certain plans and programs on the environment and the Directive 2000/60/CE. This perspective requires an integrated approach with other sectors (water resources, city planning).

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

The Directive does not include any specific reference to climate change and does not identify any adaptation measures. However, the Directive emphasizes the need to monitor, protect, improve specific habitats and biotopes for birds conservation. Also coastal zones and wetlands receiving many migratory species are included among these habitats. The preservation and the protection of habitats and biotopes are addressed to the reduction of climate change impacts on these particular ecosystems, and could be therefore considered as potential measures for adaptation to climate change.

Council Regulation (EC) No 74/2009 of 19 January 2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

The Regulation 74/2009 amends the Regulation 1698/2005 (now repealed) on the financing operations to meet the new challenges and opportunities established following the assessment of the health state of the Common Agricultural Policy ("CAP Health Check"). After the assessment ("Health Check") of the CAP reform implementation in 2003, the Regulation identifies climate change among the "new challenges" for the European agriculture and sets out a priority for climate change adaptation and mitigation. Annex II provides a list of measures that are also potentially effective for adapting to climate change: soil management practices (e.g. tillage methods, catch crops, diversified crop rotations), prevention and management of flood, preventive mechanisms against adverse effects of climate-related extreme events (e.g. setting up of hail nets), land use change (e.g. conversion of arable land to pastures, permanent set-aside, flood prevention and management measures (e.g. projects related to coastal and interior flood protection), training and use of farm advisory services in relation to climate change, prevention actions against forest fires and climate-related natural disasters, conversion to more resistant forest stand type).

Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006

The Regulation addresses the issue of climate change both in term of mitigation and adaptation, and refers to coastal areas by recalling the integrated coastal management. Specific references to coastal area are reported in the Common Strategic Framework (CSF) which should facilitate the sectoral and territorial coordination of intervention under the ESI Funds, with other relevant Union policies and

instruments, in line with the targets and objectives of the Union Strategy for smart, sustainable and inclusive growth, and taking into account the key territorial challenges of the various types of territories (urban, rural and coastal areas).

Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005

An indicative list of measures and operations on climate change mitigation and adaptation is included in this Regulation (Annex IV – the measures are described in Regulation No 1305/2013 - "Agriculture"). The Regulation mentions the issue of climate change both in term of mitigation and adaptation. There is just a mention to coastal protection and no specific detail is provided (Art. 32). Union priorities for rural development are set out in Art. 5: promoting food chain organization, including processing and marketing of agricultural products, animal welfare and risk management in agriculture; restoring, preserving and enhancing ecosystems related to agriculture and forestry; promoting resource efficiency and supporting shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors; promoting social inclusion, poverty reduction and economic development in rural areas […]. All those priorities might contribute to the cross-cutting objectives of innovation, environment and climate change mitigation and adaptation. Though there is no specific reference to coastal protection measures, some of them may represent adaptation measures if implemented on coastal areas.

Regulation (EU) No 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008

The Regulation mentions the issue of climate change both in term of mitigation and adaptation. However, specific references to coastal areas are missing. Measures for good agricultural and environmental condition of waters, soil and biodiversity are listed in Annex II. If addressed to coastal areas these measures might contribute to coastal protection from climate change impacts (the measures are described in Regulation No 1306/2013 – "Agriculture").

Regulation (EU) No 1307/2013 of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009

The Regulation mentions the issue of climate change (both in term of mitigation and adaptation) and explicitly identifies adaptation measures. However, specific references to coastal areas are missing. Should be addressed to coastal areas, these measures might contribute as well to coastal protection from climate change impact. The new Regulation n. 1307/2013 lays down a code and establishes rules for direct payments to farmers under support schemes within the framework of the Common Agricultural Policy (the measures are described above in Regulation No 1307/2013 – "Agriculture"). In addition to the basic payment or the single area payment scheme, each farm may receive a payment per hectare in case good farm practices for climate and environment are adopted. Member States may use 30% of their national financial envelopes for these payments. This is a mandatory measure and failure to comply with environmental requirements will result in penalties above the cost of payment for environmental sustainability. Three relevant measures are included:

- practices equivalent to crop diversification;

- practices equivalent to maintenance of permanent grassland;

- practices equivalent with ecological focus area.

The rules related to cross-compliance are confirmed and simplified, by subordinating the reversion of direct payments to the compliance with: a) agricultural and environmental conditions established by Member States aimed at limiting soil erosion, maintaining the structure and the percentage of soils organic substances and ensure a minimum level of maintenance; b) European rules on public health, animal health, environment and animal welfare. In case farmers do not comply with the cross-compliance rules, the direct payments may be partially cut or even completely cancelled.

Ensuring an appropriate funding under the CAP is essential to promote measures to adapt to climate change that also contribute to a sustainable agriculture. Under the new CAP the enhancement of environmental performance has become a mandatory “greening” component of direct payments which will support agricultural practices beneficial for the climate and the environment (“whereas” n. 37). Those practices, primarily addressed to achieve climate and environmental policy goals, consist of simple, generalized, non contractual and annual actions that go beyond cross-compliance and that are linked to agriculture: crop diversification, the maintenance of permanent grassland, including traditional orchards where fruit trees are grown in low density on grassland, and the establishment of ecological focus areas.

Regulation (EU) No 1308/2013 of the European Parliament and of the Council establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007

The Regulation explicitly refers to climate change mitigation (Art. 152). Nevertheless, “actions to support crop insurance, which help to protect producers’ income in case of losses due to natural disasters, are constrained by the need to introduce or maintain farming practices that help to mitigate climate change and facilitate the adaptation". Specific references to coastal areas are missing. However, if addressed to coastal areas these measures might contribute to coastal protection from climate change impacts. The Regulation emphasizes the need to use agricultural practices and production techniques that respect the environment, water and soil. This implies agricultural practices that can keep the soil in good conditions, and therefore able to better respond to climate change effects. No specific details are reported on how to achieve these objectives. Awareness campaigns about potential impacts and behavioural change might represent an example of potential adaptation measure. In order to prevent and manage crisis Art. 33 provides for training measures and exchange of best practice; promotion and communication, either for prevention or during a crisis period. The Commission may adopt implementing acts and establish measures concerning: i) promotion, communication and training measures in case of crisis prevention and management (Art. 38).

Crisis in the agricultural sector may be caused by adverse weather conditions (i.e. frost, drought, heavy rainfall), leading to a reduction of crops and products quality that have market effects. Overall, measures to prevent or manage crises, including measures of education and information, may represent additional tools for adapting to climate change, if crisis are generated by climate change impacts.

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3.2.5 Energy

Climate change and energy: relevant impacts

Off-shore hydrocarbons exploitation activities may increase the risks for all environmentally sensitive marine and coastal ecosystems, especially for ecosystems playing an important role in mitigating and adapting to climate change, such as salt marshes and meadows of sea grass. Concerns about the impact that climate change may have on such operations led to the Proposal for a Regulation of the European Parliament and of the Council on safety of offshore hydrocarbons prospection, exploration and production (COM/2011/688 def) which clearly states that the risk assessment concerning the safety of offshore hydrocarbons prospection, exploration and production activities must take into account the environmental hazards, including the impact that weather conditions and climate change (extreme precipitation events, storms or floods that may undermine the functioning of an installation and even cause an accident) could have on the long-term recovery of plants. As off-shore hydrocarbons activities in a Member State might have significant negative effects on the environment of another Member State, the proposal also sets out that it is necessary to establish and apply specific provisions in accordance to the Convention on the environmental impact assessment across borders.

In addition, climate change has an impact on the achievement of many relevant legal provisions dealing with different aspects of the electricity production from renewables, in particular affecting air and water temperatures, reducing the availability of resources (e.g.: water shortage in the hydroelectric sector, wind supply for power plants), modifying the seasonality of rainfall or through an increase in the intensity and frequency of extreme events such as storms, floods, and sea level rise.

These factors can determine several and serious problems, partially related to the operation of thermal and nuclear power plants (cooling systems suffering from lack of water and increased water temperature) and partly due to the difficulties in the production of hydropower attributable to a progressive reduction of water resources. Furthermore, damages might occur to the integrity of the energy infrastructure along the coast affected by floods, storms and increased sea levels. Inland electric networks and distribution systems for electricity might experience a power outage due to the consequence of heavy rains, fires, hurricanes. Also heat-waves, and generally rising temperatures, could lead to an increase in the use of air conditioning/cooling air and more frequent electricity supply breakages from overloads in peak demand (Terna, 2013).

Maintaining a balance between inflow and outflow of electricity from and to the electricity network also becomes more difficult when weather conditions are extreme, such as in conditions of water scarcity or extreme hot and cold. This increases the probability of critical situations that may result in a temporary electricity outage for users in the affected areas.
Potential benefits may derive from distributed generation systems (Bossi et al., 2001): available technologies that allow a wide variety in the choice of fuel, mitigating the financial risk due to uncertainty of fuel costs and energy demand, heat generation for hot water and industrial uses (production of low pressure steam), cost savings in transmission and distribution of electricity, more efficient balance of electric load peak and seasonal load profile, better use of gas distribution facilities. The storage of large quantities of energy from renewable sources and flexible small-scale generation plants may ensure the availability of electricity supply on the network, especially in case of increasing instability caused by climate change.

Legal framework and objectives

The Table 18 provides a scheme of the most relevant European legal provisions (i.e. Regulations, Directives, etc) for adaptation to climate change. For further insights see ANNEX II to this report.

Table 18: Legal framework on energy

Legal reference	Year	General objectives
Directive 2005/89/EC of the European Parliament and of the Council "concerning measures to safeguard security of electricity supply and infrastructure investment"	18.01.2006	This Directive establishes measures aimed at safeguarding security of electricity supply so as to ensure the proper functioning of the internal market for electricity and to ensure: an adequate level of generation capacity; an adequate balance between supply and demand; and an appropriate level of interconnection between Member States for the development of the internal market. Member States shall ensure a high level of security of electricity supply by taking the necessary measures to facilitate a stable investment climate and by defining the roles and responsibilities of competent authorities, including regulatory authorities where relevant, and all relevant market actors and publishing information thereon. The relevant market actors include, inter alia, transmission and distribution system operators, electricity generators, suppliers and final customers. Member States shall ensure a high level of security of electricity supply by taking the necessary measures to facilitate a stable investment climate and by defining the roles and responsibilities of competent authorities, including regulatory authorities where relevant, and all relevant market actors and publishing information thereon.
Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings	19.05.2010	This Directive promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.
Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC	23.04.2009	This Directive establishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. It lays down rules relating to statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from renewable sources. It establishes sustainability criteria for biofuels and bioliquids.
Directives 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in	13.07.2009	The Directive establishes common rules for the generation, transmission, distribution and supply of electricity, together with consumer protection provisions, with a view to improving and integrating

electricity and repealing Directive 2003/54/EC		competitive electricity markets in the Community. It lays down the rules relating to the organization and functioning of the electricity sector, open access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorizations and the operation of systems. It also lays down universal service obligations and the rights of electricity consumers and clarifies competition requirements. The Directive aims to a competitive, secure and environmentally sustainable market in electricity.
Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC	13.07.2009	This Directive establishes common rules for the transmission, distribution, supply and storage of natural gas. It lays down the rules relating to the organization and functioning of the natural gas sector, access to the market, the criteria and procedures applicable to the granting of authorizations for transmission, distribution, supply and storage of natural gas and the operation of systems.
Regulation (EC) No 714/2009 of the European Parliament and of the Council on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003	13.07.2009	This Regulation aims at: (a) setting fair rules for cross-border exchanges in electricity, thus enhancing competition within the internal market in electricity, taking into account the particular characteristics of national and regional markets. [...] (b) facilitating the emergence of a well-functioning and transparent wholesale market with a high level of security of supply in electricity. It provides for mechanisms to harmonize the rules for cross-border exchanges in electricity.
Regulation (EC) No 67/2010 of the European Parliament and of the Council laying down general rules for the granting of Community financial aid in the field of trans-European networks	30.11.2009	This Regulation defines the conditions and procedures for granting Community aid of the Treaty to projects of common interest in the field of trans-European networks for telecommunications infrastructures and to the projects of common interest in the field of trans-European networks for transport and energy infrastructures.
Regulation (EU) No 994/2010 of the European Parliament and of the Council concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC	20.10.2010	This Regulation establishes provisions aimed at safeguarding the security of gas supply by ensuring the proper and continuous functioning of the internal market in natural gas (gas), by allowing for exceptional measures to be implemented when the market can no longer deliver the required gas supplies and by providing for a clear definition and attribution of responsibilities among natural gas undertakings, the Member States and the Union regarding both preventive action and the reaction to concrete disruptions of supply. This Regulation also provides transparent mechanisms, in a spirit of solidarity, for the coordination of planning for, and response to, an emergency at Member State, regional and Union levels.

Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives2004/8/EC and 2006/32/EC	25.10.2012	This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020.
Regulation (EU) No 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009	17.04.2013	This Regulation lays down guidelines for the timely development and interoperability of priority corridors and areas of trans-European energy infrastructure set out in Annex I ('energy infrastructure priority corridors and areas'). In particular, this Regulation: (a) addresses the identification of projects of common interest necessary to implement priority corridors and areas falling under the energy infrastructure categories in electricity, gas, oil, and carbon dioxide set out in Annex II ('energy infrastructure categories'); (b) facilitates the timely implementation of projects of common interest by streamlining, coordinating more closely, and accelerating permit granting processes and by enhancing public participation; (c) provides rules and guidance for the cross-border allocation of costs and risk-related incentives for projects of common interest; (d) determines the conditions for eligibility of projects of common interest for Union financial assistance.
Directive 2013/30/EU of the European Parliament and of the Council on safety of offshore oil and gas operations and amending Directive 2004/35/EC	12.06.2013	The objective of the Directive is to reduce as far as possible the occurrence of major accidents relating to offshore oil and gas operations and to limit their consequences, thus increasing the protection of the marine environment and coastal economies against pollution, establishing minimum conditions for safe offshore exploration and exploitation of oil and gas and limiting possible disruptions to Union indigenous energy production, and to improve the response mechanisms in case of an accident.

Relevance of the legal framework with respect to adaptation and potential adaptation measures

Directive 2005/89/EC of the European Parliament and of the Council "concerning measures to safeguard security of electricity supply and infrastructure investment"

The Directive does not include any specific references to climate change and adaptation. It provides Member Countries with guidelines to select the measures needed to fulfill the objective of the

Directive, and some of the criteria taken into account may be considered as linked to climate change adaptation (i.e. measures to ensure the supply of electricity). In this context, potential options for adaptation action are listed in Table 19.

Table 19: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
The integration and development of networks	•		
Promotion of renewable energy and energy efficiency	•		
Distributed generation	•		
Using contracts proposing the interruption of the service			•
Energy conservation programs and consumption reduction measures			•
The diversification of primary sources	•		
Generation reserve capacity	•		
Demand Side Management			•

The integration and development of networks. The Directive emphasizes the importance of an adequate regulatory framework to ensure the functioning and development of networks ("whereas 15"). With regard to the implementation of measures ensuring a high level of electricity supply security, the need for regular maintenance is also emphasized as well as, where necessary, the renewal of the transmission and distribution networks to maintain an efficient performance. Article 6 is entirely devoted to the investment in networks and underlines the need to provide favorable signals for investment so that either operators of transmission or distribution systems can develop their networks in order to meet the expected demand from the market. A good maintenance of the networks, energy grid protection from soil erosion or possible flooding, underground networks, the use of flexible transmission systems in alternating current circuits that allow more control, or the installation of monitoring systems that facilitate the integration of intermittent sources might be considered as adaptation to climate change, as climate change determines events of energy outage, damage to the power grid due to floods and other extreme events. Integrated networks design also allows to respond to fluctuations in production from renewable sources, or to changes in availability of cooling water for traditional power plants.

Promotion of renewable energy and energy efficiency. As stated in Art. 3, Member States may take into account a range of issues in measures implementation, including the importance of encouraging energy efficiency and the adoption of new technologies (in particular technologies related to demand management, renewable energy and distributed generation). The promotion of energy efficiency is a measure of adaptation in case it is conceived to cope with negative effects of climate change on the electrical system such as changes in electricity consumption for cooling indoor environment. The promotion of renewable energies may be also perceived as a measure of adaptation in case it is implemented to address a decrease of other energy sources jeopardized by the impact of climate change (e.g. hydropower by shortage in water availability due to drought) or energy breakages and voltage electric drops related to increasing energy consumption during heat

waves. Integrating the traditional network based on fossil fuels with energy supplied from other sources (renewable and distributed ones) can provide greater flexibility and continuity of service.

Distributed generation. As stated in Art. 3, Member States may take into account the adoption of new technologies, among which distributed power generation might be considered as an adaptation measure. The advantages of this type of power generation, supported by adequate storage systems or with adequate capacity of the interconnected grid to transfer it elsewhere, are manifold: reduction of leakage from the network, capability to balance the electric load peak related to the effects of climate change, mitigation of financial risk due to the uncertainty of the energy demand. Distributed generation allows to spread the risks from climate change over several and different infrastructures, succeeding in further isolating localized damages and increasing the capacity of autonomous systems of energy production in case of natural disaster events.

Using contracts proposing the interruption of the service. In order to ensure a balance between supply and demand the Directive suggests, among the measures to be taken, to remove barriers that prevent from the use of interruptible contracts or the conclusion of contracts for varying lengths for both producers and customers (Art 5). Maintaining a balance between inflow and outflow of electricity from and to the electricity network becomes more difficult when weather conditions are extreme (i.e., in conditions of water scarcity or extreme hot and cold). This increases the probability of critical situations that may result in the temporary electricity outage for users in critical areas. Interruptible contracts (sometimes this kind of contract is signed with certain categories of customers that accept to stop receiving electricity with a variable notice of time) are used to adapt to changes related to electricity demand (changes in electricity consumption for indoor environment cooling) and to the available generation capacity (variation in availability of water for plant operation).

Energy conservation programs and consumption reduction measures. Measures to promote actions in favor of energy conservation are planned in order to maintain a balance between energy supply and demand (Art 5), particularly in extreme weather conditions (i.e. in conditions of water scarcity or extreme hot and cold with temporary electricity outage for users).

The diversification of primary sources. The Directive emphasizes the importance of ensuring a degree of diversity in electricity generation and encourage technology adoption to generate energy from renewable sources (Art 3). Energy diversification is a measure of adaptation when adopted in order to cope with the loss of some primary energy sources due to climate change (see also in this context the hydroelectric power crisis due to water shortages or problems related to climate change operation of power plants using river water for their operation of water cooling). The diversification of primary sources and the promotion of renewable energy allow to better address changes in network load and ensure uninterrupted supplies of energy, whatever the causes that may threaten the continuity (including climate change).

Generation reserve capacity. The need to ensure sufficient transmission and generation reserve capacity for stable operation is one of the aspects for the development of measures to which a Member State has to pay attention (Art. 3). Ensuring the availability of an increasing share of generation reserve capacity, particularly flexible to cope with the network instability determined by climate change, can be an example of adaptation measure to climate change.

Demand Side Management. As stated in Art. 5, in order to maintain a balance between supply and demand (a balance that must therefore take into account all aspects that may alter, including impacts of climate change), it is suggested to adopt measures in order to encourage the introduction of technologies for demand management in real time, such as advanced metering systems or measures to promote actions in favor of energy saving. This type of measures allows to intervene on the demand side of energy, fostering changes of behaviour to better respond to critical situations (management of consumption peak) in the electricity sector, also those possibly related to climate change. In particular, by encouraging consumers to adopt energy-saving behaviour and invest in renewable energy will enable citizens to be able to cope with energy outage caused by peaks in energy demand.

Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings

In order to promote the improvement of the energy performance of buildings within the Union, the Directive lays down requirements (Table 20).

Table 20: Requirements for the improvement of the energy performance of buildings within the Union (Art.1)

Art. 1	Grey, green or soft option		
	Grey	Green	Soft
(a) the common general framework for a methodology for calculating the integrated energy performance of buildings and building units;			•
(b) the application of minimum requirements to the energy performance of new buildings and new building units;			•
(c) the application of minimum requirements to the energy performance of: (i) existing buildings, building units and building elements that are subject to major renovation; (ii) building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced; and (iii) technical building systems whenever they are installed, replaced or upgraded;			•
(d) the common general framework for a methodology for calculating the integrated energy performance of buildings and building units;			•
(e) the application of minimum requirements to the energy performance of new buildings and new building units;			•
(f) the application of minimum requirements to the energy performance of: (i) existing buildings, building units and building elements that are subject to major renovation; (ii) building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced; and (iii) technical building systems whenever they are installed, replaced or upgraded.			•

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

References to climate change are included in the Directive although in terms of mitigation. Table 21 lists some examples of adaptation measures that could be potentially adopted within the framework of the Directive.

Table 21: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Demand side management and awareness campaigns about potential impacts and behavioral change			•
Construction and design of buildings - adaptation actions aimed at lowering air conditioning requirements	•		
Economic incentives for behavioral change			•
The diversification of primary sources	•		
The promotion of renewable energy and energy efficiency	•		
The use of energy storage systems	•		
The integration and the development of networks	•		
Energy conservation programs and consumption reduction measures			•
Distributed production system	•		

Demand side management and awareness campaigns about potential impacts and behavioral change. in Art. 14 Member States are asked to develop adequate information, awareness, guidance or training in order to inform citizens about the benefits and practicalities related to the development and use of energy from renewable sources. Furthermore, the Directive requires that: information on supporting measures is made available to all stakeholders (such as consumers, builders, installers, architects and suppliers of equipment and heating systems, etc); information on net benefits, cost and energy efficiency of equipment and systems for the use of heat, cooling and electricity from renewable energy sources is made available by the supplier of the equipment or system; certification schemes or equivalent qualification systems are made available for small-scale installers; information on certification schemes or equivalent qualification systems is made available to the public; information on standard rules relating to the bearing and sharing of technical adjustments costs (such as grid connections and network strengthening) are made available, improved network management and rules on non-discriminatory application of the network codes are required to integrate new producers feeding electricity from renewable energy sources into the interconnected grid.
This type of measures allows to act on the demand side of energy, fostering changes of behaviour to better respond to critical situations (management of consumption peak) in the electricity sector, also those possibly related to climate change. In particular by encouraging consumers to adopt energy-saving behaviour and invest in renewable energy will enable citizens to be able to cope with energy

outage caused by peaks in energy demand. Also, by informing the other parties of the supply chain of the energy sector (installers, building contractors, architects, etc.) on possible supporting measures at their disposal, could help create a more stable and secure electricity grid and therefore more capable to better adapt to critical situations likely determined by climate change.

Construction and design of buildings - adaptation actions aimed at lowering air conditioning requirements. Member States recommend to all actors, in particular local and regional administrative bodies, to ensure the installation of equipment and systems for production of electricity, heat and cooling from renewable energy sources when planning, designing, building and refurbishing industrial or residential areas. Local and regional administrative bodies are encouraged to include heating and cooling from renewable sources in the planning of city infrastructure (Art. 13). Furthermore, the introduction of appropriate measures in regulations and codes relating to building is required in order to increase the share of all kinds of energy from renewable sources in the building sector. Member States may take into account national measures relating to substantial increases in energy efficiency and relating to cogeneration and low or zero energy consumption buildings. In regulations and codes on construction, Member States shall require the use of minimum levels of energy from renewable sources in all new buildings and existing buildings undergoing major renovation. In regulations and codes on construction, Member States shall promote the use of systems and equipment for heating and cooling from renewable energy sources that achieve a significant reduction in energy consumption. Improving energy efficiency in buildings to make them more comfortable (cooled) in high-temperature climate conditions represents an immediate need for adaptation.

Economic incentives for behavioral change. The Directive requires the use of supporting schemes instruments, arrangements or applied mechanisms, to promote the use of energy from renewable sources by reducing costs, increasing the selling price, or increasing, by means of obligations concerning renewable energy or other means, the volume of such purchased energy. Among the envisaged measures, there may be subsidies to investments, tax exemptions or tax relief, tax refunds, various supporting regimes for renewable energy, including those using green certificates, and direct supporting schemes to prices, including tariffs and other subsidies. Appropriate measures are introduced in regulations and codes relating to building in order to increase the share from renewable sources in the residential sector. Member States may take into account national measures relating to substantial increases in energy efficiency and relating to cogeneration and low or zero energy consumption buildings. Economic incentives proposed in the Directive can be considered as adaptation measures as they are designed to promote a series of actions that allow to better respond to the impacts of climate change.

The diversification of primary sources. The promotion of renewable energy, main purpose of the Directive, and their integration into the electrical network system, as well as the definition of sustainability criteria for biofuels represent measures aiming at diversifying primary sources. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

The promotion of renewable energy and energy efficiency. The Directive aims to promote renewable energy and energy efficiency. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

The use of energy storage systems. The Directive takes into consideration the development of energy storage systems (Art. 16). However, in this context it is conceived in order to make the electrical system able to function correctly with the progressive integration of renewables into the energy system. Energy storage is a challenge for the stability and availability of electricity and ensures the availability of an increasing share of generation reserve capacity, particularly flexible and efficient to cope with the network instability determined by climate change.

The integration and the development of networks. The Directive requires the development of the network infrastructure for transmission and distribution to develop smart grids [...] with the aim to

allow the safe operation of the power system in the further development of electricity production from renewable energy sources, including interconnection among Member States and between Member States and third countries. [...] The operators of the transmission system and distribution system are also obliged to draw up and make public their standard rules relating to the bearing and sharing of costs of technical adaptations, such as grid connections and network strengthening, better management of the network and the rules on non-discriminatory application of the network codes, necessary to integrate new producers feeding into the interconnected grid electricity produced from renewable energy sources. The integration and the development of networks seem to be focused on ensuring market penetration of renewables in the electricity production system in view of the achievement of the objectives set for climate change mitigation (Kyoto protocol, etc.). However a good maintenance of the networks, an infrastructure of transmission and distribution developed and enhanced with interconnection systems can better address the impacts that climate change may have on the electrical system. By allowing the optimal integration of renewable energy into the power system, the network ensures the system ability to cope with changes in electricity consumption for buildings cooling systems, or peaks in demand which are mainly related to heat waves.

Energy conservation programs and consumption reduction measures. The Directive promotes and encourages efficiency and energy saving. As stated in Art. 13 Member States promote, in the regulations and codes on construction, the use of systems and equipment for heating and cooling from renewable energy sources that are supposed to achieve a significant reduction in energy consumption. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

Distributed production system. In whereas 53 it is stated that "it is appropriate to allow the emerging consumer market of electricity from renewable sources to contribute to the construction of new plants for the production of energy from renewable sources. Member States should, therefore, be able to require electricity suppliers to inform end users about their energy mix in accordance with Article 3, paragraph 6 of Directive 2003/54 /CE". The distributed power generation may be considered a potential measure of adaptation to climate change as the advantages of this type of power generation (with adequate storage systems or with adequate capacity of the interconnected grid to transfer it elsewhere) are manifold: reduction of leakage from the network, capability to balance the electric load peak related to the effects of climate change, mitigation of financial risk due to the uncertainty of the energy demand. Distributed generation allows to spread the risks from climate change over several and different infrastructures, succeeding in further isolating localized damages and increasing the capacity of autonomous systems of energy production in case of natural disaster events.

Directives 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

The Table 22 lists some examples of adaptation measures that could be potentially adopted within the framework of the Directive.

Table 22: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Economic incentives for behavioural change			•
Construction and design of building	•		
The diversification of primary sources	•		

The promotion of renewable energy and energy efficiency	•		
Distributed production system	•		
The integration and the development of networks	•		
Using contracts proposing the interruption of the service			•
Demand side management			•

Economic incentives for behavioural change. The Directive lays down that regulatory authorities, when fixing or approving tariffs or methodologies and balancing services, ensure that appropriate incentives are provided to transmission system operators and distribution system operators both in short and long terms in order to improve efficiency, to promote market integration and the security of energy supply. The Directive sets out that a good functioning of internal market of electricity should provide appropriate incentives to producers in order to invest in new energy production (i.e. renewable energy) that allow to better respond to the impacts of climate change.

Construction and design of building. The Directive encourages measures to improve energy efficiency, including those related to energy efficiency in buildings with the aim to tackle energy shortage and make them more comfortable (cooled) in high-temperature climate conditions.

The diversification of primary sources. The Directive promotes the integration of electricity production at large and small scale with renewable sources by facilitating the access to the network for new generation capacity. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

The promotion of renewable energy and energy efficiency. The Directive aims to promote renewable energy and energy efficiency. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

Distributed production system. The directive promotes the decentralized electricity generation in transmission and distribution networks. In “whereas 27” it states that “Member States should encourage the modernization of distribution networks, such as through the introduction of smart grids which should be built in a way that encourages decentralized generation and energy efficiency”. For more insights on how the measure is associated to adaptation, see the explanation provided in Directive 2009/28/EC.

The integration and the development of networks. Art. 3 refers to “the maintenance and construction of the necessary network infrastructure, including interconnection capacity […] in order to achieve the objectives of social and economic cohesion and environmental protection. The construction and maintenance of the necessary network infrastructure, including interconnection capacity, should contribute to ensuring a stable electricity supply. The maintenance and construction of the necessary network infrastructure, including interconnection capacity and decentralized electricity generation, are important elements in ensuring a stable electricity supply”. Climate change could affect security and functioning of interconnection systems, cross-borders flows, network operations (both with power outage and damages to energy grids due to soil erosion or possible flooding). Measures addressed to secure network interconnections or cooperation between transmission system operators or measures to improve the efficiency of networks as well as the definition of operating procedures in emergencies might be considered as measures aimed at reduce the impact of climate change. A good maintenance of the networks, carried out through the protection of energy grid from soil erosion or possible flooding, the use of flexible transmission systems in alternating current circuits that allow more control, or the installation of monitoring systems that

facilitate the integration of intermittent sources, might be considered adaptation to climate change. Networks integration also allows to respond to fluctuations in production from renewable sources and to changes in water availability for power plants cooling systems.

Using contracts proposing the interruption of the service. Demand side management and innovative supply contracts (implying electricity service interruption) may reduce the primary energy consumption and peak loads. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

Demand Side Management. The definition of "energy efficiency and demand-side management" refers to "a global or integrated approach aimed at influencing the amount and timing of electricity consumption in order to reduce primary energy consumption and peak loads […]". The Directive states also that if "information on energy costs are provided to consumers frequently enough, it will create incentives for energy savings because it will give customers direct feedback on the effects of investments in energy efficiency and change of behaviour". Measures aimed at encouraging the introduction of technologies addressing the real time demand-side management, such as intelligent metering systems, promote the active participation of consumers in the supply of electricity: though not properly designed in order to respond to the impacts of climate change this makes possible to respond to crises in the electricity sector due to the peaks of energy demand during heat-waves.

Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

The Directive refers explicitly to climate change and provides Member States with guidelines for the selection of the measures needed to fulfill its objectives (Table 23).

Table 23: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Construction and design of buildings	•		
Economic incentives for behavioural change			•
Promotion of renewable energy and energy efficiency	•		
The integration and development of networks	•		
Using contracts proposing the interruption of the service			•
Demand Side Management			•

Construction and design of buildings. In "whereas 50" improvement of energy efficiency in buildings are mentioned among the measures needed to face energy shortage, with the implicit aim to tackle energy shortage and make them more comfortable (cooled) in high-temperature climate conditions

Economic incentives for behavioural change. Art. 3 on public service obligations and customer protection, mentions among the measures to combat also climate change [...] "the provision of adequate economic incentives using, where appropriate, all existing national and Community tools, for the maintenance and construction of necessary network, including interconnection capacity". Art.

41 reports that the regulatory authority has to ensure that transmission and distribution system operators are granted appropriate incentive, over both the short and long term to increase efficiencies, foster market integration and security of supply.

Promotion of renewable energy and energy efficiency. The Directive mentions the promotion of renewable energy and energy efficiency. For more insights on how the measure is associated to adaptation, see the description provided in the Directive 2005/89/EC.

The integration and development of networks. The maintenance and construction of necessary network infrastructure, including interconnection capacity are reported in Art. 3. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

Using contracts proposing the interruption of the service. The Directive reports in "whereas 39" that "Member States or […] the regulatory authority, should encourage the development of interruptible supply contracts". For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89/EC.

Demand Side Management. The Directive mentions in "whereas 47" that "[…] information on energy costs provided to consumers frequently enough will create incentives for energy savings because it will give customers direct feedback on the effects of investment in energy efficiency and change of behaviour". For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/28/EC.

Regulation (EC) No 714/2009 of the European Parliament and of the Council on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003

The Regulation does not contain any specific reference to climate change. However, it defines the measures that might be considered as a response to the negative impacts of climate change, in particular ensuring the security of gas supply. Table 24 lists some examples of adaptation measures that could be potentially adopted within the framework of the above mentioned Regulation.

Table 24: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
The integration and the development of networks	•		
The use of energy storage systems	•		

Measures to ensure the safety of networks interconnection or measures of cooperation between operators of transmission system are necessary as climate change may have a negative impact on the operation of interconnectors and disrupt cross-border flows.

The integration and the development of networks. The Regulation states that "increase cooperation and coordination among transmission system operators is required to create network codes for providing and managing effective and transparent access to the transmission networks across borders, and to ensure coordinated and sufficiently forward-looking planning and sound technical evolution of the transmission system in the Community". "Common network operation tools to ensure coordination of network operation in normal and emergency conditions" are required. "The network codes shall cover the following areas, taking into account regional specificities: a) network

security and reliability rules, including rules for technical transmission reserve capacity for operational network security; b) network connection rules; c) third-party access rules; f) operational procedures in an emergency; g) capacity-allocation and congestion-management rules; h) rules for trading related to technical and operational provision of network access services and system balancing; k) rules regarding harmonized transmission tariff structures including locational signals and inter-transmission system operator compensation rules; i) energy efficiency regarding electricity networks". The network codes shall be developed for cross-border network and market integration issues and shall be without prejudice to the Member States' right to establish national network codes which do not affect cross-border trade. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/72/EC.

The use of energy storage systems. The development of network codes should take into account the definition of balancing rules, including network-related reserve power rules (Art 12). Energy storage is a challenge for the stability and availability of electricity and ensures the availability of an increasing share of generation reserve capacity particularly flexible to cope with the network instability determined by climate change.

Regulation (EC) No 67/2010 of the European Parliament and of the Council laying down general rules for the granting of Community financial aid in the field of trans-European networks

The Regulation does not include any specific reference to climate change. Table 25 offers an example of adaptation measure that might be potentially adopted within the framework of the Regulation.

Table 25: Adaptation measure

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
The integration and the development of networks	•		

The integration and the development of networks. The Regulation lays down the general principles for the granting of Community financial aid in the field of trans-European networks. Aids are foreseen also for the development of projects related to national energy network for their safety and interoperability. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/72/EC.

Regulation (EU) No 994/2010 of the European Parliament and of the Council concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC

The Regulation aims to ensure the security of gas supply also potentially undermined by climate change. Table 26 lists some examples of adaptation measures that could be potentially adopted within the framework of the Regulation.

Table 26: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Awareness campaigns about potential impacts and			•

behavioural change				
Crisis management; Disaster management				•
Using contracts proposing the interruption of the service				•
The diversification of primary sources		•		
The promotion of renewable energy and energy efficiency		•		
The use of energy storage systems		•		
The integration and the development of networks		•		
Demand side management				•
Annex II – List of market-based security of gas supply measures				
Supply-side measures	facilitating the integration of gas from renewable energy sources into the gas network infrastructure	•		
	use of long-term and short-term contracts			•
Demand-side measures	use of interruptible contracts			•
	increased efficiency	•		
	increased use of renewal energy sources			•

Awareness campaigns about potential impacts and behavioural change. The Regulation aims at ensuring the security of gas supply and handling crisis situations. It provides a series of demand-side measures addressed to change users behaviours: use of interruptible contracts, fuel switch possibilities, voluntary firm load shedding, increased efficiency, increased use of renewable energy sources, which directly affect the balance demand/supply (Annex II). This type of measures allows to intervene on the demand side of energy, fostering changes of behaviour to better respond to critical situations (management of consumption peak) in the electricity sector, also those possibly related to climate change. In particular, by encouraging consumers to adopt energy-saving behaviour and invest in renewable energy will enable citizens to be able to cope with energy outage caused by peaks in energy demand (i.e. during heat-waves). Also informing the other parties of the supply chain of the energy sector (installers, building contractors, architects, etc.) on possible supporting measures at their disposal, may help to create a more stable and secure electricity grid to better adapt to critical situations likely determined by climate change.

Crisis and Disaster management. Art. 4 (Establishment of a Preventive Action Plan and an Emergency Plan) lays down that: "[…] the Competent Authority of each Member State shall establish at national level: a) a Preventive Action Plan containing measures needed to remove or mitigate the

risks identified, in accordance with the risk assessment undertaken pursuant to Art. 9; b) an Emergency Plan containing the measures to be taken to remove or mitigate the impact of a gas supply disruption in accordance with Art. 10". Furthermore, Art. 9 sets out a risk assessment of the risks affecting the security of gas supply. Although an explicit reference to climate change is missing, the risk assessment and the definition of action and emergency plans to deal with crisis might also be considered as measures to respond to climate change impacts on the system, as they are intended to ensure continuity and security of supply.

Using contracts proposing the interruption of the service. In order to safeguard the security of gas supply, the Regulation suggests various measures both on the supply-side and the demand-side to be included in the Preventive Action Plan and the Emergency Plan. The Regulation identifies the use of interruptible contracts among the possible measures (Annex II). For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

The diversification of primary sources. In order to safeguard the security of gas supply, the Regulation suggests various measures both on the supply-side and the demand-side to be included in the Preventive Action Plan and the Emergency Plan (i.e., "facilitating the integration of gas from renewable energy sources into the gas network infrastructure", Annex II). For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

The promotion of energy efficiency and renewable energy. Measures addressed to increase the use of renewable energy and improve energy efficiency are mentioned for the demand-side (Annex II). Measures facilitating the integration of gas from renewable energy sources into the gas network infrastructure are referred to the supply-side. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

The use of energy storage systems. The Regulation identifies gas storage systems among the possible measures to be promoted (Annex II). For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/28/EC.

The integration and the development of networks. The Regulation identifies "investments in infrastructure" among the possible measures to be adopted (gas infrastructure includes the gas transmission network including interconnectors as well as production, LNG and storage facilities) (Annex II). For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

Demand side management. In order to safeguard the security of gas supply and handle the crisis of the system, the Regulation suggests various demand-side measures: use of interruptible contracts, fuel switch, voluntary firm load shedding, increased efficiency, increased use of renewable energy sources. These measures have a direct impact on demand and supply balance. Only in case of emergency, various steps of mandatory demand reduction are foreseen, including: enforced fuel switching, enforced utilization of interruptible contracts, enforced firm load shedding (Annex II). For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives2004/8/EC and 2006/32/EC

References to climate change are present in the Directive. Table 27 lists some examples of adaptation measures that could be potentially adopted within the framework of the Directive.

Table 27: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Awareness campaigns about potential impacts and behavioral change			•
Design and construction of buildings	•		
Economic incentives for behavioral change and demand side management			•
The promotion of energy efficiency	•		
Diversification of primary sources	•		
Distributed generation	•		

Awareness campaigns about potential impacts and behavioral change. In order to achieve the energy efficiency objectives Member States may introduce measures aimed at changing the behaviour of buildings residents (Article 5). Among the measures suggested to Member States, there is the adoption of training and education programs, including advisory programs on energy and the application of efficient technologies or techniques in terms of energy able to reduce the final energy consumption [...]. Member States shall also encourage training programs for energy auditors qualification in order to foster the availability of a sufficient number of experts (Art. 8), establish appropriate conditions for market operators to provide consumers with adequate and targeted advice on energy efficiency (Article 17) and take appropriate measures to raise consumer awareness on the availability of certification schemes. For more insights on how the measure is associated to adaptation, see the explanation provided in the Regulation (EU) No 994/2010.

Design and construction of buildings. The Directive emphasizes the need to increase the rate of restructuring properties, as the existing building stock represents the sector with the greatest potential for energy savings, and sets out an annual rate of renovation for the buildings owned by the central government in order to improve their energy performance. In accordance with Art. 4 Member States shall establish a long-term strategy for mobilizing investment in the renovation of all the residential and commercial buildings, both public and private.

Economic incentives for behavioral change and demand side management. There are financing instruments or fiscal incentives that lead to the application of efficient technologies or techniques in terms of energy and have the effect to reduce the consumption of final energy (Art. 7). Appropriate measures to promote and facilitate the efficient use of energy by small energy customers, including households are: tax incentives, loans, grants or subsidies (Art. 12). Member States (Art. 15) shall ensure that network operators have an incentive to improve the efficiency of the design and the functioning of infrastructure and [...] that tariffs allow suppliers to improve consumer participation to system efficiency, including demand management. In addition the retail tariffs can support dynamic pricing for demand management measures of end-customers, such as: a) different rates depending on the time of consumption; b) critical peak rates; c) charging in real time pricing and d) reduced pricing in rush hour. Economic incentives in general are designed to promote a series of actions that allow to better respond to the impacts of climate change, improving consumer participation to system efficiency (improving energy efficiency, reducing energy requirements as a response for example to network overload caused by heat waves). In particular by encouraging consumers to adopt energy-saving behaviour and invest in renewable energy, citizens will be able to cope with energy breakage caused by peaks in energy demand. Demand management is considered an important tool to

improve energy efficiency, as it greatly increases the chance for consumers to act on the basis of the information of consumption and billing. It represents a mechanism to reduce or redirect consumption and optimize the use of the networks and facilities in production, transmission and distribution of energy. Measures are suggested for moving the load of end customers from peak to off-peak hours, taking into account the availability of renewable energy, energy from cogeneration and distributed generation.

The promotion of energy efficiency. Energy efficiency is the objective of the Directive and is addressed either to the final consumer or the energy supply. The promotion of energy efficiency is a measure of adaptation in case it addresses the negative effects of climate change on the electrical system such as changes in electricity consumption for cooling indoor environment.

Diversification of primary sources. Member States (Art. 15) take appropriate measures to develop efficient heating and cooling infrastructure or to adapt existing ones to the development of high efficiency cogeneration and use of heating and cooling from waste burning and renewable energy sources. Member States may establish a classification between renewable energy and high efficiency cogeneration and shall in any case ensure that priority access to various renewable energy sources is not hindered. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

Distributed generation. Member States should encourage the introduction of measures and procedures to promote cogeneration installations […] in order to promote distributed energy (whereas 37). Network charges shall reflect cost savings in networks due to more efficient demand management and distributed generation, including savings from reduced costs of delivery or network investment. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

Regulation (EU) No 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009

The Regulation includes some reference to climate change. Table 28 lists some examples of adaptation measures that could be potentially adopted within the framework of the Regulation.

Table 28: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Economic incentives			•
The promotion of renewable energy and energy efficiency	•		
The diversification of primary sources	•		
The integration and the development of networks	•		
Distributed production system	•		

Economic incentive. The Regulation provides rules and guidance for the cross-border allocation of costs and risk-related incentives for projects of common interest (Art. 1, c). Where a 'project promoter incurs higher risks for the development, construction, operation or maintenance of a project of

common interest […] Member States and national regulatory authorities shall ensure that appropriate incentives are granted to that project. The national regulatory authorities decide to grant the incentives [...] by taking into account the results of the cost-benefits analysis. The national regulatory authorities shall further analyze the specific risks incurred by the project promoters, the risk mitigation measures taken and the justification of this risk profile in view of the net positive impact provided by the project, when compared to a lower-risk alternative' (Art. 13). Incentives for projects of common interest contribute to modify the behaviour of interested parties such as distribution system operators. This measure allows changes in behaviour in order to better respond to critical situations in the system, even those due to climate change, thus contributing to create a more stable and safe network.

The promotion of renewable energy and energy efficiency. The Regulation lays down rules for the timely development and interoperability of trans-European energy networks in order to achieve the energy policy objectives of the Treaty on the Functioning of the European union (TFEU) to ensure functioning on the internal Energy market and security of supply in the Union, to promote energy efficiency and energy saving, the development of new and renewable forms of energy and the interconnection of energy networks ("whereas 17"). Projects of common interest (Art.4), as for electricity transmission and storage projects, shall include criteria for the integration of renewable energy into the grid and the transmission of renewable generation to major consumption centres and storage sites. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

The diversification of primary sources. The Regulation promotes the diversification of primary sources integrating the traditional production with electricity derived from renewable energy sources and consolidating infrastructure network. Annex I (Energy infrastructure priority corridors and areas) mentions "North-South electricity interconnections in Western Europe (NSI West Electricity): interconnections between Member States of the region and with the Mediterranean area including the Iberian peninsula, notably to integrate electricity from renewable energy sources and reinforce internal grid infrastructures to foster market integration in the region". For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2005/89.

The integration and the development of networks. The Regulation lays down rules for the timely development and interoperability of trans-European energy networks in order to achieve the energy policy objectives ("whereas 17"). In "whereas 8" the Regulation states that Union-wide integrated networks and deployment of smart grids are vital for ensuring a competitive and properly functioning integrated market, for achieving an optimal utilization of energy infrastructure, for increasing energy efficiency and distributed renewable energy sources. The promotion of smart grid is one of the main objectives of the Regulation in which "smart grid" is defined as an electricity network that can integrate in a cost efficient manner the behaviour and actions of all users connected to it, including generators, consumers and those that both generate and consume, in order to ensure an economically efficient and sustainable power system with low losses and high levels of quality, security of supply and safety (Art. 2). The Regulation clearly defines the link between energy infrastructure and climate change. In fact, "whereas 9" states that the Union's energy infrastructure should be upgraded in order to prevent technical failure and increase its resilience against such failure, natural or man-made disasters, adverse effects of climate change and threats to its security. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/72/EC.

Distributed production system. The Regulation promotes the integration of distributed renewable energy sources and the development of innovative transmission technologies for large scale electricity integration of renewable energy and distributed energy resources. For more insights on how the measure is associated to adaptation, see the explanation provided in the Directive 2009/28/EC.

Directive 2013/30/EU of the European Parliament and of the Council on safety of offshore oil and gas operations and amending Directive 2004/35/EC

Table 29 offers an example of adaptation measure that could be potentially adopted within the framework of the Directive.

Table 29: Adaptation measures

Adaptation measures	Grey, green or soft option		
	Grey	Green	Soft
Risk assessment and disaster management			•

Risk assessment and disaster management. The Directive establishes minimum requirements for preventing major accidents in offshore oil and gas operations and limiting the consequences of such accidents. In “whereas 26” it is stated that operators and owners are encouraged to establish effective corporate safety and environmental policies and give effect to them in a comprehensive, safety and environmental management system and emergency response plan. In order to ensure effective response to emergencies, operators or owners should prepare internal emergency response plans (“whereas 28”) including the measures to prevent escalation and limit the consequences of a major accident related to offshore oil and gas operations. The plan has to include an analysis of the oil spill response effectiveness (Art. 14). Furthermore, operators and owners should prepare a document describing their safety and environmental management system (including plans and emergency responses) while Member States shall prepare external emergency response (Art. 29) including arrangements for the mitigation of the negative impacts on wildlife both onshore and offshore. The report on major hazards (“whereas 33 and Art. 12) should, inter alia, take into account risks to the environment, including the impact of climatic conditions and climate change on the long term resilience of the installations. Overall, the risk assessment required by the Directive, together with the corporate policies for severe accidents forecasting, the safety and environmental management systems, the external emergency response plans, the internal emergency response plans, the specific constraints in the issuing of licenses for offshore operations have to take into consideration the risk associated to climate change.

3.2.6 Health

Climate change and health: relevant impacts

Climate change affects population health, in particular threatening vulnerable groups settled down in hydro-geological risk areas, in disadvantaged socio-economic conditions, or children, elderly and chronically ill people. The direct effects of climate change are due in particular to heat-waves (i.e. excess in mortality and morbidity) and to the socio-economic impacts resulting from the increasingly frequent adverse weather events (i.e. health problems caused by damages to settlements and infrastructure, mortality, mental and physical diseases). Weather disasters affect human health by causing loss of life and injuries. The non fatal effects of natural disasters include: increased risk of water-related diseases from disruption of water supply or sewerage systems (diarrheal cases due to limited shelter and access to potable water for survivors), increases in respiratory illnesses, effects on mental health that may be long lasting and exposure to dangerous chemicals or pathogens released from storage and waste disposal sites into flood waters.

Indirect health risks should be considered as a consequence of the impacts of meteo-climatic factors on ecosystems, biodiversity, drinking and bathing water, soil, outdoor and indoor air.

The meteorological and environmental factors responsible for climate change effects on health could have different consequences on: (i) the emerging of infectious diseases which are transmitted by climate-sensitive vectors (i.e. mosquitoes, ticks and sand flies); (ii) food poisoning (infection due to pathogenic microorganisms that colonize the intestinal mucosa to the ingestion of contaminated food) and water-borne diseases; (iii) the adverse effects of pollutants in indoor and outdoor air, or the risk of diseases that are already recognized as associated with them, such as asthma and respiratory allergies, cardiovascular and respiratory diseases; (iv) agricultural practices (weed species) with an increasing risk of exposure to chemical contaminants in food and for workers; v) the occurrence of further impacts resulting from ozone, CO_2, increase in average temperature, heat-waves, alternating periods of droughts and heavy rainfall that compromise the nutritional quality of essential food through change in photosynthesis, the absorption and transport of nutrients in plants, the gene expression and the enzymatic activity.

Climate change may alter the distribution of vector species (increasing or decreasing) depending on whether conditions which are favourable or unfavourable for their breeding places (such as vegetation, host or water availability) and their reproductive cycle. Factors responsible for determining the incidence and geographical distribution of vector-borne diseases are complex and involve many demographic and societal as well as climatic factors. Temperature can also influence the reproduction and maturation rate of the infective agent within the vector organism and the survival rate of the vector organism, by further influencing disease transmission. Vectors, such as mosquito, flies or ticks, that do not regulate their internal temperatures are therefore sensitive to external temperature and humidity. Some vectors may transmit many important infectious diseases. Tick-borne encephalitis (TBE) is a tick-borne disease of humans that causes long-term neurological disabilities and up to 1,4 % fatal outcomes. The disease can be prevented by vaccination and during recent years it has increased in incidence and spread to new geographical areas in Europe. Furthermore, climate change combined with the way in which food is produced, stored and consumed, can potentially influence food safety and occurrence of food-borne diseases. A statistical association between diseases and temperature change in the short term suggests that food-borne diseases shall be influenced by climate change in the long term. Epidemiological studies were conducted to describe and quantify the effect that environmental temperature has on food-borne diseases. According to observations the number of cases of salmonellosis increases by 5-10% for each 1℃ of raise in the weekly temperatures and for average temperatures above 5 ℃. About one third of salmonellosis transmission cases in England, Wales, Poland, Netherlands, Czech Republic, Switzerland and Spain can be caused by temperature changes. Changes in the distribution of rainfall may increase drought risk. One consequence of drought would be a failure of the domestic water supply, resulting in a need

for standpipes and other methods of water delivery. The potential health effects of this would include water related diseases. Access to sufficient water for the elderly, disabled and other vulnerable groups would be a concern. Localized water shortages may be particularly important. A potential increase in drought could substantially affect water resources and sanitation in situations where water supply is effectively reduced. This could lead to an increased concentration of pathogenic organisms in raw water supplies. Additionally, water scarcity may require using poorer-quality sources of fresh water, such as rivers, which are often contaminated. All these factors could increase the incidence of diseases. Epidemiological assessment should be used to quantify this risk. The health consequences of drought include diseases resulting from lack of water. In times of shortage, water is used for cooking rather than hygiene. In particular, this increases the risk of fecal-oral (primarily diarrhea) diseases and water-washed diseases (such as trachoma and scabies). Another concern is associated with the use of unsafe new sources of water (such as untreated waste water) for human activities (i.e., irrigation). These practices lead to an increased risk of infectious diseases by use of food contaminated by unsafe water.

Legal framework and objectives

Table 30 provides a scheme of the relevant European legal provisions (i.e. Regulations, Directives, etc) most related to climate change adaptation. For further insights see ANNEX II to this report.

Table 30: Legal framework on health

Legal reference	Year	General objectives
Directive 2003/99/EC of the European Parliament and of the Council on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/117/EEC	17.11.2003	The purpose of this Directive is to ensure that zoonoses, zoonotic agents and related antimicrobial resistance are properly monitored, and that food-borne outbreaks receive proper epidemiological investigation, to enable the collection in the Community of the information necessary to evaluate relevant trends and sources. This Directive covers:(a) the monitoring of zoonoses and zoonotic agents;(b) the monitoring of related antimicrobial resistance;(c) the epidemiological investigation of food-borne outbreaks; and(d) the exchange of information related to zoonoses and zoonotic agents.
Regulation (EC) No 2160/2003 of the European Parliament and of the Council on the control of salmonella and other specified food-borne zoonotic agents	17.11.2003	The purpose of this Regulation is to ensure that proper and effective measures are taken to detect and to control salmonella and other zoonotic agents at all relevant stages of production, processing and distribution, particularly at the level of primary production, including in feed, in order to reduce their prevalence and the risk they pose to public health.
Regulation (EC) No 851/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European centre for disease prevention and control	21.04.2004	This Regulation establishes an independent European agency for disease prevention and control, its mission, tasks and organization. 2. The Agency shall be named the European Centre for Disease Prevention and Control. The mission of the Centre shall be to identify, assess and communicate current and emerging threats to human health from communicable diseases. In the case of other outbreaks of illness of unknown origin which may spread within or to the Community, the Centre shall act on its own initiative until the source of the outbreak is known. In the case of an outbreak which clearly is not caused by a communicable disease, the Centre shall act only in cooperation with the competent authority upon request from that authority. In pursuing its mission the Centre shall

		take full account of the responsibilities of the Member States, the Commission and other Community agencies, and of the responsibilities of international organizations active within the field of public health, in order to ensure comprehensiveness, coherence and complementarity of action.
Regulation (EU) No 282/2014 of the European Parliament and of the Council on the establishment of a third Program for the Union's action in the field of health (2014-2020) and repealing Decision No 1350/2007/EC Text with EEA relevance	11.03.2014	The program 2014-2020 has 4 overarching objectives. It seeks to: - Promote health, prevent diseases and foster supportive environments for healthy lifestyles taking into account the 'health in all policies' principle; - Protect Union citizens from serious cross-border health threats; - Contribute to innovative, efficient and sustainable health systems; - Facilitate access to better and safer healthcare for Union citizens. Operational objectives: - Identify, disseminate and promote the up-take of evidence-based and good practices for cost-effective disease prevention and health promotion activities; - Identify and develop coherent approaches and implement for better preparedness and coordination in health emergencies; - Identify and develop tools and mechanisms at Union level to address shortages of resources, both human and financial, and facilitate the voluntary up-take of innovation in public health intervention and prevention strategies; - Increase access to cross-border medical expertise and information for medical conditions of low prevalence, high specialization or rare diseases; - Facilitate the application of research results and developing tools.

Relevance of the legal framework with respect to adaptation and potential adaptation measures

Directive 2003/99/EC of the European Parliament and of the Council on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/117/EEC

The Directive does not include any specific reference to climate change but it refers to the monitoring of zoonoses and zoonotic agents. In normal conditions water supply and sanitation are managed to prevent water bodies pollution and hygiene-related diseases. Under extremes or adverse weather conditions they may become an important source of pollution. The resilience of water supply and sanitation system (WSS) is a potential factor of vulnerability under climate change scenarios for both technical and regulations aspects. Generally WSS are very sensitive to changes in water loads, sea level rise, storm surge and energy outages that may further impair their functioning with a consequent increased risk for waterborne and food-borne diseases.

Regulation (EC) No 2160/2003 of the European Parliament and of the Council on the control of salmonella and other specified food-borne zoonotic agents

The Regulation does not include any specific reference to climate change but it refers to the monitoring of salmonella and zoonotic agents. The purpose of this Regulation (Art.1) is to ensure that proper and effective measures are taken to detect and control salmonella and other zoonotic agents at all relevant stages of production, processing and distribution (particularly at the level of primary production in order to reduce their prevalence and the risk they pose to public health). This Regulation covers (Art.2): (a) the adoption of targets for the reduction of the prevalence of specified zoonoses in animal populations (i) at the level of primary production and (ii) where appropriate for the zoonosis or zoonotic agent concerned, at other stages of the food chain, including in food and feed; (b) the approval of specific control programs established by Member States and food and feed business operators; (c) the adoption of specific rules concerning certain control methods applied in the reduction of the prevalence of zoonoses and zoonotic agents; (d) the adoption of rules concerning intra-Community trade and imports from third countries of certain animals and products thereof.

Regulation (EC) No 851/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European centre for disease prevention and control

The Regulation does not include any specific reference to climate change. The Regulation establishes an Independent Agency for disease prevention and control but do not explicitly refer to issues potentially attributable to climate change.

Regulation (EU) No 282/2014 of the European Parliament and of the Council on the establishment of a third Program for the Union's action in the field of health (2014-2020) and repealing Decision No 1350/2007/EC Text with EEA relevance

Box 2 lists very few examples of adaptation measures that could be potentially adopted within the framework of the above mentioned Regulation.

Box 2. Public information on climate-related health threats and prevention.

Previous statements of the Regulation:

(15) In order to minimize the public health consequences of cross-border threats to health as set out in Decision No 1082/2013/EU of the European Parliament and of the Council (1), which could range from mass contamination caused by chemical incidents to pandemics, like those unleashed recently by E. coli, influenza strain H1N1 or SARS (severe acute respiratory syndrome), or health effects resulting from increasing population movements, the program should contribute to the creation and maintenance of robust mechanisms and tools to detect, assess and manage major cross-border health threats. Due to the nature of those threats, the program should support coordinated public health measures at Union level to address different aspects of cross-border health threats, building on preparedness and response planning, robust and reliable risk assessment and a strong risk and crisis management framework. In that context, it is important that the Program benefit from complementarity with the work program of the European Centre for disease prevention and control.

Annex 1

THEMATIC PRIORITIES

2. Protect Union citizens from serious cross-border health threats

*2.3 Actions required by, or contributing to, the implementation of Union legislation in the fields of communicable diseases and other health threats, including those caused by biological and chemical incidents, environment and **climate change**. Such action may include activities aimed at facilitating the implementation, application, monitoring and review of that legislation.*

3.2.7 Adaptation measures and sectoral policies in BASE project's case studies

An overview of the BASE project's case studies are reported in table 31 where the measures analyzed[18] are directly associated with key sectoral policies. This represents the reference framework under which to foster adaptation in line and, above all, in synergy with sectoral policy provisions already in force. Generalizations cannot be made from cases to any group of similar contexts. This is because the cases are not selected on the basis of statistical samplings from a well-defined population of possible cases. The list of measures taken into consideration is intended to provide a menu of options among which institutions, managing authorities and private stakeholders may better orient their own decisions for a better adaptation mainstreaming. This list, however, does not claim to be exhaustive in itself. These options should be understood as guiding options which in turn should drive spending priorities based on national or regional circumstances and needs in terms of vulnerability management

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[18] For better insights about case studies and measures, refer to deliverables in Work Package 5.

BASE Case Study	Primary Climate Change Impacts	Climate Adaptation Measures	European Sectoral Legislation
Alentejo	Heat stress, Water Scarcity, Droughts, Soil erosion	Water retention in the landscape: rainwater harvesting in farms, by farmers, through the creation of permanent lakes and small dams Regeneration of soils, diversification of crops, species and varieties Increase adaptive capacity of rural communities through local rural development	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Regulation 1305/2013 Regulation 1306/2013 CAP - Common Agricultural Policy Regulation 1305/2013 Regulation 1306/2013 Regulation 1307/2013 Regulation 1308/2013
Holstebro & Lolland	Holstebro: Fluvial flooding, Pluvial flooding Lolland: Pluvial Flooding	- Widening of river floodplains - Extended watercourse routing - Local dam - Retaining water through decentralized dam solutions - Flooding warnings to citizens (non-structural)	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Regulation 1305/2013 Regulation 1307/2013
Dartmoor	Droughts, Pluvial flooding	Measures to enhance biodiversity: changes in land management to protect peat and allow the ecosystem to adapt to the changing climate Improve water supply quantity, expected to be under pressure two to decrease and deterioration of the bog layer Improve water quality, as the thick layer bog precipitation purifies water Agri-environmental landscape management: remove vegetation where needed to reduce potential of wildfires Measures related to managing flood risks: flood risk management through strategic (small) flood barriers and strategic planning and cutting	Habitats Directive Directive 2000/60 / EC of the European Parliament of the Council - For Establishing community action in the field of water policy Regulation 1305/2013 Directive 2007/60 / EC on the assessment and management of flood risks
Jena	Heat stress, Pluvial flooding	Green structures (trees, bushes, façade greening, roof greening); Reflective properties of surfaces (albedo); Type and extent of soil sealing; Composition and properties (size, etc.) of building structures	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Green Infrastructure — enhancing Europe's natural capital* com/2013/0249 final (6.5.2013)

Šumava (Green roof)	Ecosystem degradation	Sustainable forest management: choice of native tree species, promotion of diverse age classes, game regulation, selective thinning, etc. Peat land and water course restoration: restoration actions to promote water retention in the landscape and increase carbon storage	CAP - Common Agricultural Policy Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy
South Moravia	Water Scarcity, Droughts, Damages from extreme weather related events	Agricultural management practices: permanent set aside of arable land, adaptation measures related to changes in planted crop variety, shift in the timing of agricultural activities (e.g., time of planting, sowing, treatment) Water saving measures - increase of water retention, change in irrigation practices Soft measures - Insurance policies Farm Advisory System and dissemination of information on the prospective impact of climate change Risk sharing tools and awareness campaigns	Regulation 1305/2013 Regulation 1307/2013 Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Regulation 1306/2013 Regulation 1308/2013
Donãna	Water Scarcity, Droughts	Water transfer from the upper basin to ensure quantity and quality Agri-environmental practices Farmer training: -Water recirculation and reutilization -Increase of technical efficiency of the irrigation systems.	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Regulation 1305/2013 Regulation 1306/2013 Regulation 1307/2013 Regulation 1308/2013
Ústí	Water Scarcity, Droughts, Damages from extreme weather related events	Agricultural management practices: permanent set aside of arable land, adaptation measures related to changes in planted crop variety, shift in the timing of agricultural activities (e.g., time of planting, sowing, treatment) Water saving measures: increase of water retention, change in irrigation practices	Regulation 1305/2013 Regulation 1307/2013 Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy

		Soft measures - Insurance policies: Farm Advisory System and dissemination of information on the prospective impact of climate change Risk sharing tools and awareness campaigns	Regulation 1306/2013 Regulation 1308/2013
Cascais	Heat stress, Water scarcity, Pluvial flooding, Coastal erosion, Damages from extreme weather related events	Rain water gardens: to store and slow down rainwater flow in order to mitigate its impacts downstream Green corridors and rehabilitation of Cascais streams: re-naturing or rehabilitating a river or a stream achieved by a number of different actions (giving the stream more room; letting the river/stream meander again; enlarging and flattening the stream banks; enhancing erosion control, replanting native species; removing non-native species Rain water harvesting for collecting and storing rainwater	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy
Copenhagen	Flooding (storm surge; urban heat islands) Coastal flooding, Coastal erosion, Damages from extreme weather related events Pluvial flooding	Local rainwater retention measures (green areas, permeable surfaces; ponds; etc.) Separation of surface and ground water and establishment of network of water ways to channel cloudburst rains into e.g. the harbour or the lakes Renovation of housing in regenerated areas. Dike, Sluices Backflow valve in basements Sewage system	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Ílhavo & Vagos	Coastal flooding, Coastal erosion, Damages from extreme weather related events	Beach sand replacement (sand nourishment operations, Periodic monitoring activities of sea-level rises and increased coastal erosion) Reinforcing the dune system (by building sand dikes, and relocate farming fields); maintain existing structures (groynes); Build an artificial reef in front of either Barra or Vagueira beach (or both) Re-vegetation of affected dune areas to support beach sand replacement	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks

Kalundborg	Coastal flooding	Visions identified by stakeholders: Offshore dikes Large dikes on the coast and land Phasing out of vulnerable areas with human settlement during this century Quicker conversion to natural areas (no temporary protection)	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Leeds	Fluvial flooding	Grey infrastructure Sustainable Urban Drainage Systems (SuDS) Ecosystem-based approach (EBA)	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Prague	Fluvial flooding, Heat Stress	Non-structural measures: disaster response management, risk transfer tools, monitoring and management Structural: Improving flood defences (engineering): Fixed barriers (levees, dykes), Mobile barriers, Other measures (closures and pumping systems in the canalisation	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Rotterdam	Coastal flooding, Fluvial flooding, Damages from extreme weather related events	Dike reinforcement Water storage Grevelingen Room for the River measures Channel deepening Full closure with dams and sluices	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
South Devon	Coastal flooding Coastal erosion: Damages from extreme weather related events Fluvial flooding	Maintaining and strengthening existing sea defences, conducting repairs to damage to the rail infra-structure, cliffs and sea wall from storm events: this would involve strengthening and heightening the sea wall, stabilising the cliffs through wire netting and bolting, and measures to mitigate the erosion of beech material (e.g. improved groynes), reroute the railway inland away from the Dawlish coast. Installation of domestic flood gates at 50 at risk properties Installation of sluice gates up stream to hold back flood water	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks

Timmendorfer Strand	Coastal flooding, Coastal erosion	Coastal protection measure in combination with the finishing and landscaping-project.	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy
Venice	Coastal flooding	Adaptation measures applied to privately owned residential and commercial buildings in attempts to mitigate flood risks (e.g., raising premises floor levels and public pavements, wall cutting, installation of barriers, tanks and pumps) . Also development of flood risk maps, knowledge production, information communication, awareness raising and public engagement, and the provision of few economic incentives	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Cornwall	UV radiation	Cancer Research 'Sunsmart' Met Office 'UV Index' prediction Save Our Skins toolkit	Not applicable
IJsselmeer	Water Scarcity, Flooding, Droughts	Creating more flexibility in the water levels of the lake and surrounding water systems	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
Kalajoki	Fluvial flooding, Water quality, Damages from extreme weather related events	Climate proofing of river basin management plans Identification and mapping of (relatively) high flood risk areas Flood protection structures Flow regulation	Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy

		Buffer zones to reduce nutrient leakage from fields Constructed wetlands in agriculture to reduce nutrient leakage and partially for flood protection. Winter time vegetation cover (different slopes) Perennial grass (different slopes) Controlled drainage Optimal fertilization Cultivation techniques and technologies for water and nutrient management --- Measures to slow down flow of water from drained areas and clear cuts Restoring drained wetlands for flood protection and reduction of nutrient leakage through increased water retention capacity Regulation of lowest permitted distance from water level	Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC) Regulation 1303/2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund Regulation 1305/2013; Regulation 1306/2013; Regulation 1307/2013; Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks
England	Mental health	Anti-depressant prescribing	Not applicable
Madrid	Heat stress, Precipitations, Water Scarcity, Droughts, Damages from extreme weather related events	Reuse of urban water Water rights exchange programs Heat-health warning systems Green infrastructures: trees in the street, parks, green roofs	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Green Infrastructure — enhancing Europe's natural capital* com/2013/0249 final (6.5.2013)
Health Assessment Model	Salmonella associated with increased average temperature	Medical visits Hospital admission Public health campaign	Regulation (EC) No 2160/2003 of the European Parliament and of the Council on the control of salmonella and other specified food-borne zoonotic agents

Agriculture Model	Negative impacts on agriculture productivity, Water scarcity, drought	MANAGEMENT This includes a set of measures to minimize. A list of specific measures is: a) Improve resiliency and adaptive capacity. This can be achieved through the implementation of regional adaptation plans to enhance effectiveness of adaptation measures, improvement of monitoring and early warning b) Development of innovation and technology to improve agricultural practices and to reduce costs. This can be achieved through more intensive use of agricultural machinery and development of better fertilizers, change in crops and cropping patterns to decrease economic risk to farmers, development of climate change resilient crops c) Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. IRRIGATION This includes a set of measures to compensate for loss of agricultural production through irrigation. A list of specific measures is: a) Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources b) Development of additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale reservoirs or small-scale water reservoirs on farmland, wastewater recycling for agriculture	CAP - Common Agricultural Policy Regulation 1305/2013; Regulation 1306/2013; Regulation 1307/2013; Regulation 1308/2013

Flood risk Model	River flooding	FLOOD PREVENTION Flood prevention includes a set of measures to minimize the probability of river flooding. A list of specific measures is: a) Dike construction/upgrading: by creating new, or improving the height and strength of dikes, dams and levees, the probability of flooding is reduced. b) Reservoir construction and water retention: by retaining water in reservoirs of retention areas downstream, the probability of flooding of vulnerable areas is reduced. c) Other measures, including widening of river floodplains, reduction of obstruction in floodplains (such as bridges). VULNERABILITY REDUCTION This includes a set of measures to reduce the impacts of river flooding, once a flood occurs. A list of specific measures is: a) Adapted construction of buildings: so that water can either not enter the building (dry-proofing), or when water enters it does no harm (wet-proofing) b) Emergency measures, including local barriers, and sand bags to prevent water from entering vulnerable urban areas. c) Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects	Directive 2007/60/EC of the European parliament and of the council of 23 October 2007 on the assessment and management of flood risks Directive 2000/60/EC of the European Parliament of the Council - For establishing community action in the field of water policy

Table 31: BASE case studies impacts, measures and related EU legislation frameworks.

The overall analysis raises proposals for upgrading climate policy integration and its coherence in the most relevant sectors for adaptation policy by providing a list of measures that would represent according to the authors' opinion, good practices to facilitate adaptation at the sectoral level.

A more consistent sectoral policy with adaptation to climate change materializes as concrete actions, taken partly in terms of management or regulation, but mainly in the form of changed practices from target groups, are normally implemented at the local level.

This analysis does investigate and report on concrete actions and measures showing that there are overlapping policy domains where sectoral policies and climate change adaptation objectives find a convergent ground. The way how policies are implemented plays therefore a fundamental role.

Priority should be given to options that achieve important synergies or bring co-benefits for other sectors: water management, agriculture, coastal protection and floodings among others. This would help to promote climate adaptation under different legislation frameworks and development programs.

Uncertainty about the way in which measures can be used to address climate adaptation priorities results in a disincentive to implement activities that could improve resilience to climate change in practice. Part of the uncertainty is surely attributable to the projected climate scenarios, and however also the lack of technical knowledge on how to assess the specific adaptation measures required (cost/benefit analysis and proper timing) leads to uncertainties about how to integrate adaptation needs into programs design and sectoral policies implementation.

Continuous capacity building on concrete types of measures would help to fill this gap, and in this regard the current report would work in this direction.

3.3 Mainstreaming processes in BASE project's case studies: empirical evidence

The case study owners have been asked to trace back the process that has led to the planning or implementation of adaptation measures and describe, where in place, the mainstreaming process upstream from the high-level institutional strategies to the regional or local action. Case study owners were also asked to explain the influence and implications this process has had or will likely have on the measures' effectiveness. In few cases interventions are planned as being the final action of an aware mainstreaming process, mainly driven by legislation provisions and aiming to facilitate adaptation to climate change concerns. They represent few successful attempts for better integration and search of enhanced coherence with respect to sectoral policies or EU/national legislation, and the empirical evidence from the case studies describe how site-specific measures have been supported and fostered by higher institutional-level legislative frameworks. At the same time, we cannot state that local projects were concretely triggered by sectoral legislative frameworks, though surely helped focus and speed up climate adaptation integration into sectoral fields. From a multi-level governance perspective, it is important to say that some mainstreaming process has somehow worked, as a sequence of linked actions along the multi-level governance system. Yet it would be unbalanced also to ascribe all planned or implemented climate adaptation actions to a legislative *impetus* for compliance. The main drivers for getting climate adaptation on the agenda remain extreme events or serious impacts experienced in recent years. Sectoral legislative frameworks still do not ensure implementation of adaptation measures without an increased awareness of the issue among public bodies and managing authorities.

In some case studies there is instead clear evidence that local authorities have taken independent initiatives to adapt without being solicited by any institutional strategies. Autonomous adaptation takes place only when measures are promoted by individual or group of stakeholders that take action although not showing an explicit purpose to adapt. In this case the main purpose lies in sectoral policies management and are thus more geared towards current risks rather than adapting to increased future risk.

How far policy integration and policy coherence may really take us on the adaptation path when uncertainty calls for flexibility of measures and implementation systems is still a major issue, as well as the choice of the appropriate scale for coherence to optimize the desired outcomes.

The case of Coastal Wetlands in **Doñana** (Spain) had the objective to explore flexible adaptation options to climate change in agricultural water management with the direct engagement of farmers. The Doñana coastal wetland is recognised as an internationally important site and declared as a Ramsar Wetland, UNESCO World Heritage Site and Biosphere Reserve for being one of the richest natural ecosystems in Europe. The coastal wetland of Doñana is located in the lower part of the Guadalquivir River District (Southern Spain) on the Atlantic coast of Andalusia, the protected area covers an area of over 121,600 hectares under the protection status of Doñana Natural Park, and in the eastern side is also located the largest rice (*Oryza sativa L.*) farming area of the country (ca. 36,000 hectares). Water in Doñana park is regulated by the "Confederación hidrográfica del Guadana", an institution under the Ministry of Agriculture and the Environment which implements the National Hydrologic Plan.

Farmers in Doñana received approximately 1,670 €/ha as public subsidies (within the framework of the CAP, Regulation EC/1782/2003) and 398 €/ha (Regulation EC/1257/1999) under the cross-compliance to meet integrated production commitments and adopt the best management practices. The case study is also affected by the EU Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy).

The **Madrid** case study deals with the cross-sectoral adaptation strategies to reduce the impacts of heat waves in the area of Madrid, mainly focused on the co-benefits of green roofs and heat warning systems. In this case both the National Adaptation Plan to Climate Change (MMA, 2006) and the National Adaptation Plan to Climate Change (MMA, 2006), designed as a framework for coordination among public authorities in the activities of assessing impacts, vulnerability and adaptation to climate change, provide a framework for action and foster integration of climate change adaptation planning across the sectors involved in the assessment. Also the 'Plan of preventive actions of the temperature excess effects on health' (2011) provides support to heat wave warring systems implementation as it establishes measures to be implemented by national authorities, autonomous communities and local authorities and establishes criteria to monitor mortality and other kind of information to preventively act against these health impacts. At the municipal level the mainstreaming process has been helped by the 'Plan of Alert and Prevention of heat waves' (2003), aimed to improve the information given to professional health services, authorities and citizens about prevention measures.

The case study on mental health in **England** is part of a growing body of research that associates increased mental health problems – depression and anxiety – to exposure to climate impacts, starting from the increased extreme flooding events. Health and wellbeing, although prioritized in the UK Climate Change Risk Assessment, have not been translated into concrete plans on mental health. The Sustainable Development Unit of the National Health Service has produced a 'Health and Care System Adaptation Report (2015)' which acknowledges that flood events can cause mental health issues. Although some actions are recommended, conducting further research is still poor. Despite this, there are some references to mental health problems associated with the increased flooding in the UK in its National Adaptation Program (2013), beyond the inclusion in NHS Emergency Planning Guidance' (2005) and 'NHS Emergency Planning Guidance on planning the psychosocial and mental health care of people affected by major accidents and disasters (2009)'. None of these ones brings concrete plans to deal with the mental health issues – anxiety and depression – related to climate impacts (e.g. exposure to floods, heat wave stress etc).

The Cornwall case study in the South West of England deals with an area which has already the highest incidents of skin cancer in the UK due to the high UV rates (SWPHO 2014) with up to 80,000 new cases reported each year. This number might increase further as climate change is likely to result in greater UV levels. There is no explicit strategy for Cornwall or the South West, but two national public health campaigns: 1) Met office UV index prediction to warn of days with high UV and 2) Cancer Research Sun Smart which is the UK's skin cancer prevention campaign promoting public awareness of the risk of UV radiation and providing advice on how to reduce these risks. These two programs are not formally tied to UK adaptation policy. Instead they are a more general health and well-being response to increased understanding of the risks of skin cancer from UV, increased rates in skin cancer and concerns over the impacts of the hole in the ozone layer. They are thus more geared towards current risks rather than adapting to increased future risk.

The **Dartmoor** National Park case study assesses measures for bog preservation and restoration (in the Mires on the Moor project, 2010-2015), with the aim to facilitate habitat for upland wildlife, expected to be under pressure due to climate change impacts such as dryer hotter summers, improve water quantity supply (expected to be under pressure due to decrease and deterioration of the bog layer), and improve water quality (as the thick bog layer purifies precipitation water and enables a continuous supply of drinking water). According to the managing authorities, this initiative was bottom-up, taken jointly by Drinking Water Company, National Park Authority and academic researchers. The National Park Authority does make reference to the European Commission's Habitat Directive and the Habitat Directive as legislative frameworks that have led to action in a Special Area for Conservation and Site of Special Scientific Interest (parts of Dartmoor Park). There are measures envisaged but not implemented, such as from the Climate Change Adaptation Strategy from 2011. Apparently, the Climate Change Act from 2008 has stimulated the English National Park Authorities to develop adaptation strategies. Nevertheless it has not managed to enable enough the Dartmoor Adaptation Strategy to be actually implemented. There are measures implemented through the Management

Plan 2014-2019, which actually address some expected climate change impacts, though they are neither labeled under this heading, nor is their implementation being monitored. However the 5-year research project on bog restoration will not continue because its funder, South West Water, was unsatisfied with the process and results of the project. The agri-environmental landscape management[19] (namely the Dartmoor Farming Futures project, 2010- expected to end 2016) is a bottom-up project funded through the national agri-environmental schemes program (which is derived from the EU's CAP Pillar 2 – Indirect payments program). So this local program works as an alternative interpretation of the agri-environmental schemes (i.e. CAP-pillar 2) policy. Dartmoor Farming Futures is also used as a way to deliver goals for the UK's Sites of Special Scientific Interest, which concerns biodiversity conservation. It is expected it will not be continued after 2016.

The **South Devon** coast case study deals with measures for repairing the seawall[20] of the Dawlish railway line, that after a series of heavy storms in Feb 2014 was severely damaged. Apparently also in this case there is no concrete evidence that neither policy documents[21] from 2011 on climate resilient infrastructure (including railways) nor the National Adaptation Program[22] (2013) have explicitly indicated actions and mainstreamed adaptation into a site such as Dawlish, though they both express the ambition that resilience should be enhanced for vulnerable sites.

The water sector case study in **Kalajoki** has focused on an area designated as one of the 21 nationally significant flood risk areas[23], including Kalajoki river, in Finland. It shows how several different policies are relevant for practical adaptation at the local level, how the influence of European and national policies can be traced to the actual measures and the different policies are integrated at the level of local plans and actions. The Kalajoki case study activities supported the integration of climate change adaptation in the flood risk and river basin management planning processes in the case study area. Specifically, the role of the case study was to advance climate proofing of river basin management plans (RBMP) and flood risk management plans (FRMP) in the Kalajoki river basin beyond the level that is likely to occur in the planning processes on their own. The focus was on integrating adaptation considerations into existing planning processes rather than promoting additional measures under the specific umbrella of 'climate change adaptation'. The aim of the case study was to promote adaptation considerations in the assessment of potential measures through the evaluation of 'if and how' the various measures proposed for the RBMP and the FRMP support adaptation to climate change (in the first round RBMPs a rudimentary climate check was applied to some plans but this was not systematic). For the RBMP, the case study assessed how climate-proof the water protection measures for the agriculture sector are at the local level, in particular through nutrient loading modeling and calculation of the cost-effectiveness of planned agri-environmental measures.

[19] Measures to maintain and enhance public access and to assist accessibility of archaeological sites (mainly through grazing), which is expected to be impacted through more shrub growth enabled by slightly less wet circumstances; Measures to enhance biodiversity in the entire commons area, which is expected to be impacted by dryer hotter summers; Maintain training of commoners to able to fight wildfires and remove vegetation where needed to reduce potential of wildfires, which is expected to be impacted by dryer hotter summers.

[20] Installing a temporary sea wall made from 19 welded shipping containers to prevent further damage, rebuilding and fortifying the breach with more than 6,000 tonnes of concrete and 150 tonnes of steel, removing 25,000 tonnes of collapsed cliff, repairing dozens of other sites along a four mile stretch of coastal railway, clearing hundreds of tonnes of debris and repairing over 600m of parapet wall, rebuilding half of Dawlish station with a new platform, installing over 13 miles of new cables, designing and installing a new temporary signaling system and replacing over 700m of track and ballast. Further ongoing measures include: fully restoring the signaling and electronic equipment, removing the shipping container temporary sea wall, rebuilding Brunel's original sea-wall at the breach site, restoring the public footpath on the seaward side of the sea wall.

[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69269/climate-resilient-infrastructure-full.pdf

[22] https://www.gov.uk/government/publications/adapting-to-climate-change-national-adaptation-program.

[23] Decision 3234/448/2010 by the Ministry of Agriculture and Forestry of 20.12.2011.

The regulatory framework has been a strong driver for planning adaptation measures and their implementation. In this respect the main drivers have been the national implementation of the EU Floods Directive (FD) and the Water Framework Directive (WFD)[24]. Due to closely aligned objectives and stakeholders, the planning processes for RBMPs and FRMPs are closely linked and in 2011 the Act on Water Resources Management was revised for coherence with the 2010 Flood Risk Management Act. This revision of the regulations has enabled improved consideration of adaptation aspects in RMBPs.

River basin management planning links with a number of sectors including agriculture, land use planning, forestry and peat production that all generate pressures and demands for the quantity and quality of water supply. Likewise actions in many of these sectors are central to flood risk management planning. How and to what extent adaptation considerations have been integrated in these sectors is important to mainstreaming adaptation into river basin and flood risk management planning, and to ensuring coherence at the level of local implementation. In the Kalajoki case study, a broad selection of planned adaptation measures linked to the above mentioned sectors was assessed over the course of the planning process. The actual measures[25] included in the final RBMP that covers the Kalajoki river area were decided in consultation with stakeholders during the planning process and the final RBMP was approved on 3 December 2015 by the Finnish government. The mainstreaming approach to integrating adaptation into sectoral planning emphasizes the need for flexibility. A recent analysis[26] carried out for the main artificial lake in the Kalajoki river basin showed that the current regulatory regime which is fixed to a particular spring time date does not function as intended when the flood peak comes earlier and the snow mass decreases in a future climate.

Agricultural activities put significant pressure on water quality and controlling nutrient loading in catchment areas is a key part of river basin management. Impacts of climate change, especially milder winters and extreme precipitation events may result in higher nutrient load to the aquatic systems, which is likely to worsen the ecological status of water bodies. A number of adaptation measures can be implemented in agriculture to manage nutrient loading in a changing climate: many of them are intimately linked to water management as the nutrient loads are a function of the flow of water. Flood management is therefore also relevant for nutrient loads. The Kalajoki area is generally low-lying and has a high degree peat soils. These factors impact the suitability and effectiveness of some key water protection measures in agriculture such as buffer strips (ineffective in flat areas) and the use of manure for fertilization (mineral soils bind nutrients such as phosphorus much more efficiently than peat soils), that have been highlighted as climate relevant in the operational program for agriculture (EAFRD). The effectiveness of many measures is also dependent on awareness and motivation of individual farmers, as policies and subsidy systems cannot be targeted at field level. This highlights the importance of advisory services to increase awareness among farmers and support them in selecting suitable measures that support adaptation objectives in the right locations.

The Kalajoki area is also characterized by high forest cover and thus actions in the forests are significant for river hydrology, as the area has a very low percentage of lakes (1.8%) that can moderate the flow. The management of drainage water from forests and peatlands fulfils a dual function of reducing nutrient loads and contributing to flood protection. The latter has so far not been a major concern, but both drainage of peatlands and clear cutting of forests increase the likelihood of

[24] In Finland the Floods Directive is implemented through the Flood Risk Management Act (620/2010) and the related Decree on Flood Risk Management (659/2010). The WFD has been transposed into national legislation through the Act on Water Resources Management (1299/2004, revised in 272/2011), Decree on Water Resources Management (1040/2006) and the Decree on River Basin Districts (1303/2004) that steer river basin management planning.

[25] Identification and mapping of (relatively) high flood risk areas, flood protection structures (Major measures include dykes protecting the Alavieska community, drainage of Evijärvi and Kalaja areas, dredging of tributaries, building of artificial lakes, other measures including watershed management plan and flow regulation (regulation of flow from natural lakes and reservoirs).

[26] Keskitalo, Lauri 2015.Hautaperän tekojärven padotus- ja juoksutusselvitys.MSc Thesis, University of Oulu, Faculty of Technology, http://jultika.oulu.fi/Record/nbnfioulu-201510082029/Description.

flooding. The recognition of climate change impacts and adaptation needs in forestry planning together with climate proofing of river basin management plans can contribute to a reduction of intermediate flood risks (peak floods are only marginally affected) (e.g. Koivusalo et al., 2008[27]; Koivusalo et al., 2009[28]).

The **Venice** case study addresses the occasional flooding events related to exceptionally high tides entering the Lagoon from the Adriatic Sea. For a long time such extreme events were attributed to a combination of meteorological, tidal and oceanographic phenomena. The increase in the frequency of flooding has mainly been discussed in the context of local subsidence tendencies, determined by local anthropogenic and natural factors[29]. Indeed the city of Venice sinks at a rate of approximately 0.05 cm/year due to tectonically induced subsidence[30]. This process of sinking affects the entire urban area of Venice and has been taking place for centuries. A more recent survey has depicted a more articulate picture revealing higher rates of subsidence in few parts of the city, as well as in the northern and southern part of the lagoon and the shoreline. The reported values range between 2-4 mm of subsidence per year in some places, as a result of mixed impacts including settlement processes, tectonics and subsidence due to water abstraction[31]. The increase in flooding events has stimulated the design and implementation of activities for the safeguarding of the city of Venice. In particular a major flood event in 1966, during which more than 90% of the city centre of Venice was flooded, was one of the main drivers for initiating this process. Safeguarding activities have included a combination of hard (e.g., flood protection measures, buildings' flood proofing restoration, protection of historic monuments) and soft protection measures, as well as early warning systems[32]. The connection of flooding events to climate change (e.g., that climate change related sea level rise will exacerbate these phenomena, making flooding events even more frequent and intense) has been addressed relatively recently[33]. The exposure of urban surfaces to floods generated a range of economic and social impacts and climate change started gaining importance with respect to urban policies. Despite the series of international presentations of the Venice experience and strategies, however, the increasing flooding events have not managed to initiate a change in local policies. The experience accumulated in adapting its urban system of Venice to rising flooding levels has not been the result of a homogeneous climate change adaptation plan. In fact, the process of developing an adaptation action plan in Venice has only very recently started taking momentum, after a first initiative which produced a declaration of intents, approved by one of the previous Venetian urban governments in 2014[34]. The Venice Metropolitan area, which corresponds to former Province of Venice (transformed in Metropolitan area in 2015) is driving new initiatives, searching for external funding and support through international initiatives (Rockefeller Foundation, C40 Cities) for the

[27] Koivusalo, H., Ahti, E., Laurén, A., Kokkonen, T., Karvonen, T., Nevalainen, R., Finér, L. 2008. Impacts of ditch cleaning on hydrological processes in a drained peatland forest.Hydrology and Earth System Sciences, 12, 1211-1227.

[28] Koivusalo, H., Hökkä, H., Ahti, E., Sarkkola, S., Marttila, H., Nieminen, M., Laurén, A. 2009. Role of vegetation cover in the water balance of a drained forested peatland in southern Finland. In: Ukonmaanaho, L., Nieminen, T.M., Starr, M. (eds.) 6th International Symposium on Ecosystem Behaviour BIOGEOMON 2009, Working Papers of the Finnish Forest Research Institute 128:136.

[29] Camuffo & Sturaro 2003, Carminati, Doglioni & Scrocca 2005.

[30] Carbognin, Teatini, Tomasin & Tosi 2009.

[31] Teatini, P., L. Tosi, T. Strozzi, L. Carbognin, G. Cecconi, R. Rosselli, and S. Libardo. 2012. "Resolving Land Subsidence within the Venice Lagoon by Persistent Scatterer SAR Interferometry." Physics and Chemistry of the Earth, Parts A/B/C 40-41 (January): 72–79. doi:10.1016/j.pce.2010.01.002.

[32] For example, public pavements have been raised to ease traffic and communication during flooding, raising ground floor levels and inserting small mobile flood barriers.

[33] http://climate-adapt.eea.europa.eu/viewmeasure?ace_measure_id=3334.

[34]http://www.comune.venezia.it/flex/cm/pages/ServeAttachment.php/L/IT/D/6%252Fe%252F6%252FD.da5d926f3453bb363eed/P/BLOB%3AID%3D73377/E/pdf

definition of a local resilience strategy[35]. Instead, the case study of Venice constitutes primarily an example of autonomous adaptation, where the implementation of the relevant adaptation measures has been supported mainly by private funds and to some extent by national funds under a special law for Venice and its lagoon. Many of the measures, which are currently seen as contributing towards the successful adaptation of Venice to climate change, were not initially conceived as such, at least not in explicit terms, nor did their implementation initiate further activities for adaptation to climate change. Flooding events and their consequent damages rather than climate change *per se* was the primary driver for their development and implementation of such measures. Clearly this suggests that flooding and climate change have been perceived as two separate issues. A major flood protection measure is the infrastructure project the MOSE (Modulo Sperimentale Elettromeccanico (MOSE), Experimental Electromechanical Module). Mobile barriers at the lagoon inlets, integrated with local defense measures, get activate at the occasion of high water, allowing for a temporary separation of lagoon and Adriatic Sea[36]. This project has been substantially promoted in recent years as a potential adaptation measure. Although not designed in view of changing climatic conditions and increased sea levels, the MOSE is anticipated to have the physical capacity of withstanding increasing sea levels up to 60 cm throughout the coming 100 years[37]. The implementation of this infrastructure under the rising sea levels is expected to have implications for the urban economy, in terms of delays and interruptions of the commercial traffic in the harbor. These have been already discussed in the literature[38]. The potential ecological consequences of frequent closure of the flood gates under increasing sea levels has actually being investigated using hydraulic modeling of the water renewal time. Results from these models indicate that these phenomena "[are] more evident in the central part of the lagoon, where most of the pollutant sources are located. This implies that the area close to the city of Venice and close to the industrial zone will experience the most intense ecological consequences of the human-induced, locally and globally, modifications."[39] The absence of a strong linkage between the flooding events experienced in the city of Venice and climate change seems that it has weakened arguments supporting the need for a planned adaptation action until very recently. Descriptions of the measures applied to prevent the impacts of floods do not include explicit references to climate change adaptation and mainly represent examples of autonomous adaptation action, supported primarily by private funds. In this context, there is no evidence to suggest that a strong mainstreaming process of adaptation is taking place.

Jena case study is concerned with a project developed under JenKAS strategy (Jena Climate Adaptation Strategy) that was formally adopted by the City Council in May 2013 and consists of various elements. Its backbone is a handbook on climate change sensitive urban planning including information on current and future climate conditions and their potential impacts in Jena. The handbook also includes information on the legal framework conditions and instruments for climate change adaptation. Furthermore, good practice examples of the successful climate change adaptation in Jena and elsewhere are presented. For each city district climate conditions are described in detail in the handbook and risks visualized using a traffic light labeling system. The main focus for implementing JenKAS is on mainstreaming climate change adaptation into administrative decision-making, i.e., the consideration of adaptation-related aspects in these processes. The Department of Urban Development and City Planning (DUDCP) promotes the mainstreaming through various in-house activities, e.g. trainings for the use of locally adapted decision support tools. As a

[35] Personal information from a collaborator in the Venice local authority.

[36] http://climate-adapt.eea.europa.eu/viewmeasure?ace_measure_id=3334

[37] https://www.mosevenezia.eu/?page_id=16&lang=en accessed on Sept. 18th, 2014, http://climate-adapt.eea.europa.eu/viewmeasure?ace_measure_id=3334

[38] Fontini, Umgiesser, & Vergano 2010, Vergano, Umgiesser, & Nunes 2010

[39] Ferrarin, C., M. Ghezzo, G. Umgiesser, D. Tagliapietra, E. Camatti, L. Zaggia, and A. Sarretta. 2013. "Assessing Hydrological Effects of Human Interventions on Coastal Systems: Numerical Applications to the Venice Lagoon." *Hydrology and Earth System Sciences* 17 (5): 1733–48. doi:10.5194/hess-17-1733-2013. p. 1746

consequence of these efforts, a constantly growing number of land development plans refer to JenKAS when making recommendations or substantiating restrictions. Beyond the actions directed at internal municipal processes, there are several activities addressing local citizens and associations, e.g., a nature trail with display boards financed by local businesses that provide information about important aspects of the changing urban climate as well as the local adaptation strategy. JenKAS refers to a number of pieces of legislation on state and federal level, namely the German Climate Adaptation Strategy (Deutsche Anpassungsstrategie an den Klimawandel, DAS), adopted in 2008, and the Thuringia Climate Adaptation Program (Thüringer Klimaanpassungsprogramm) from 2009. The federal and state regulation can also be seen as one, but not the most decisive, driver for adopting JenKAS. Furthermore, reference to the German Code of Building Law (Baugesetzbuch, BauGB) is made. The latter was amended in 2011 to include climate change and adaptation in spatial planning and to follow an approach of sustainable urban development. As emphasized in JenKAS, the municipality of Jena is in charge of climate adaptation action insofar as the impacts of climate change become relevant for spatial planning. A number of adaptation measures are mentioned in JenKAS which are then related to specific instruments of the Building Law, as a basis for action. In this context, also the German Regional Planning Act (Raumordnungsgesetz, ROG) is mentioned. Here, it functions as a national legal framework in which urban planning to include climate considerations must be embedded. Some references are also made to national Environmental Impact Assessment (Umweltverträglichkeitsprüfung, UVP) and Strategic Environmental Assessment (Strategische Umweltprüfung, SUP) as relevant instruments for implementing climate adaptation measures.

In general, the German (national) and the Thuringia (federal) strategies on climate adaptation form the overall context, in which the adoption of the local adaptation strategy takes place. More specifically, the issue at question here is mainstreaming climate adaptation in planning and building legislation. Climate adaptation was integrated in the respective German legislation in this area. In the case of Jena this inclusion promoted the already on-going development of JenKAS and will drive its implementation in the future. The changes of the political and legal framework conditions were relevant but not the most stimulating factors for taking climate action in Jena. Other more relevant factors included knowledge on climate risks in Jena, political support at the local level as well as good relationships of the political administration with science (research project on climate adaptation in Jena). More specifically, the introduction of climate adaptation in German planning and building legislation promoted the on-going process, but was not a precondition for the local level (municipality) to take action.

Coastal defense in the **Timmendorfer Strand** case study is mainly a participatory process. The work started already in 1999 and the last implementations on-site were done in 2011. The process followed three steps: assessment of socio-economic values, sensitivity analysis, and an ideas competition. First, the socio-economic assessment revealed the damage potential in case of a flooding, which highlighted the need for coastal protection. It was the basis for the second step: a sensitivity analysis – the part with the actual participatory approach. By a computer-aided model, possible future developments under different scenarios were simulated at different stakeholder events. The focus of these meetings was how different coastal protection measures would affect the community (system) with the assumption of increasing risks of flooding due to climate change. The participants eventually recommended a combination of coastal protection and flood defense measures, and agreed upon further involvement in the implementation process. The results of this step then formed the basis of the third step: an ideas competition. Here four engineering offices were asked to develop innovative ideas for coastal defense measures. The implementation on site started in 2006 and finished in 2011. Competences for coastal protection in Germany are regulated on a federal level, in this case the Water Law of Schleswig-Holstein (Landeswassergesetz Schleswig-Holstein, LWG). This piece of legislation makes reference to two EU Directive relevant for coastal protection, namely the Directive on the assessment and management of flood risks (2007/60/EC) and the Water Framework Directive (2000/60/EG). The former is implemented in Germany with the national Water Ressources Law (Wasserhaushaltsgesetz, WHG) and the federal Water Law for Schleswig-Holstein (LWG). The

Water Law of Schleswig-Holstein stipulates that the federal government (here: Schleswig-Holstein) is in charge of “Landesschutzdeiche und Regionaldeiche” (that means regional dikes). The coastal defence measure for Timmendorfer Strand was however not classified as a dike. The financing of the coastal protection measure came partly from the federal level and partly from the municipality. Additional funds for the related finishing and landscaping project stemmed from the municipality and from the EU European Regional Development Fund. The legal framework can be seen as a basic structure to regulate competences of the adaptation action, but less as a key factor for the success of its development and implementation. The substantial financial resources needed for implementing the adaptation measure – which in part resulted from the legal responsibilities of the federal level for coastal protection –, along with the engagement of key actors, can be seen as crucial for the overall successful implementation.

Holstebro case study has analyzed ‘the Farmer as Water Manager’ measure, under which farmers would enter a contract to let part of his land flood, permanently or temporarily, in exchange for a monetary compensation. Specific instruments flood control instruments could include farming practice measures such as controlled drainage and changes in tillage; nature-oriented measures such as wetland restoration or physical/technical measures such as barriers. The primary objective is to prevent or attenuate flooding in the nearby town of Holstebro, hence the title of the program of ‘Farmer as water manager’. For some farmers this measure also offers an opportunity to earn an income from fields that will be more exposed to flooding in the future. The measure is still under consideration, but it has not been implemented. A choice experiment was conducted to assess farmers’ willingness to participate in a scheme. ‘The farmer as water manager’ project came about as network cooperation between the Knowledge Centre for Agriculture (now SEGES), municipalities in selected areas of Jutland and agricultural organizations. Holstebro Municipality is a participant in this network, but so far SEGES has played the key role in developing the concept as well as organizing network activities and participation. Under an agreement between the Danish Government and Local Government Denmark, which represents the Danish municipalities, all municipalities were required to develop a climate adaptation plan by the end of 2013. The plan was to assess risk and vulnerabilities to climate change, define priority areas for action and consider climate adaptation measures. Moreover, the Municipality of Holstebro includes one of the ten areas appointed by the Danish Government in 2011 as flooding risk areas according to the Flooding Directive 2007/60/EC (Ministry of Environment and Ministry of Transport 2011). Consequently, the municipality is required to take measures to prevent damage to humans and physical assets. The climate adaptation plan of Holstebro was finally adopted in 2014. The Farmer as Water Manager is one of 11 potential measures described in the plan, but so far none of these measures have been adopted yet. To the extent that ‘the Farmer as Water Manager’ is implemented through establishment of wetlands it may create co-benefits and cohere with the Water Framework Directive as wetlands contribute to N-retention and thus contributes to improved water quality. Likewise, wetlands reduce CO2 emissions and therefore the measure, if implemented could also create synergies with climate mitigation policies. Sectoral policies, notably the Common Agricultural Policy, potentially enables the measure, if making land available for flood control is in compliance with the mandatory greening components of direct payments (Regulation 1307/2013) or under the Rural Development Program (Regulation 1305/2013). However, Regulation 1307/2013 also represents a possible barrier for implementation of the measure, as farmers are hesitant to sign up for the Farmer as Water Manager program out of concern that it may jeopardize their direct payments. According to the cross compliance rules under Regulation 1307/2013 farmers may be sanctioned for violations of agro-environmental regulation through cuts in their direct payments, and farmers express concern that if they enter an agreement that involves flooding of their land they may somehow violate or put themselves at risk of violating environmental regulation. Likewise they fear that land committed to the scheme might not be eligible for direct payments because it would no longer be considered in good agricultural condition, which is a prerequisite for receiving direct payments. In general these concerns reflect a high level of uncertainty regarding the cross compliance rules and a sense among Danish farmers that even small errors are penalized (interviews). Therefore, generally, we cannot say that the project was concretely

triggered by sectoral legislative frameworks, although the EU flooding Directive, in particular coupled with major floodings, has sparked the need for climate adaptation planning in Holstebro Municipality, which in turn led to an interest in 'the Farmer as Water Manager' project as one of the several action options. The Directive and the national mandate for municipal climate adaptation plans may surely help focus and speed up climate adaptation in general, but will not ensure implementation of this particular measure: Denmark has experienced major flooding events over the last 10 years and they have been the major drivers for getting climate adaptation on the agenda.

In **Kalundborg** case study the mainstreaming process has taken place from the national to the municipality level: though all adaptation measures were developed and described in the local adaptation plan and in the overall municipal plan, the National "Action plan for a climate-proof Denmark" along with the National and Regional Climate Strategy decisively spurred the municipal adaptation plans. Denmark has adopted both a National strategy for climate change (2013) and a National strategy for climate change adaptation (2008). However, these strategies have not imposed any obligation on municipalities to make their own strategies, nor they provided municipalities with much information on how to proceed with such strategies. In autumn 2011 the new minister of the Environment announced that all municipalities had to make a climate adaptation strategy within the next two years (by the end of 2013) – through the so-called "Action plan for a climate-proof Denmark". The municipalities' climate adaptation strategies need to contain: a mapping of the risk of flooding in the municipality to create an overview of the situation for the municipality to be able to prioritize the needed actions[40]. It is required that the climate adaptation strategy is implemented in the overall strategy for the municipality (kommuneplanen) or as an appendix to the overall strategy for the municipality. The Danish state provides data and maps for the municipalities to use in the mapping of risks[41] and the Government a guide for the municipalities on how to make climate adaptation strategies in practice[42]. In addition to that, 17 municipalities (Kalundborg served as part of the steering group) in the region of Zealand have also developed their own regonal climate strategy with the objective to provide an overview of the existing challenges and the available strengths to meet them.

In the **Copenhagen** case study as with Kalundborg, the mainstreaming process on a national basis has been conducted through the National Adaptation Strategy first and then the "Action plan for a climate-proof Denmark", that spurred the municipal adaptation plans also in coherence with the overall Municipal plan and the Municipal wastewater plan. As capital of Denmark with strategic importance and significantly more financial and administrative abilities, compared to other municipalities, Copenhagen has been able to adopt an adaptation strategy more independently from national guidelines and even from the prescriptions of EU legislation on floodings that also require to focus on *"the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community'.*

The overall adaptation plan is divided into two branches, based on the city's adaptation needs and climatic threats; Cloudburst and Storm-surge. Of the two, cloudburst has progressed to the stage of implementation, because of historic climatic impacts. In this regard, storm-surge is at a stage of strategical planning and assessment, as the impacts are more long-term.

[40] Kalundborg plan focuses on public campaign, emergency preparedness, mapping of new potential protected nature areas, revision of strategies, implementation of flooding maps.

[41] Regeringen & KL 2012:7 (aftale om kommunernes økonomi).

[42] Miljøministeriet/Naturstyrelsen 2013 (klimatilpasningsplaner og lokalplaner – Vejledning).

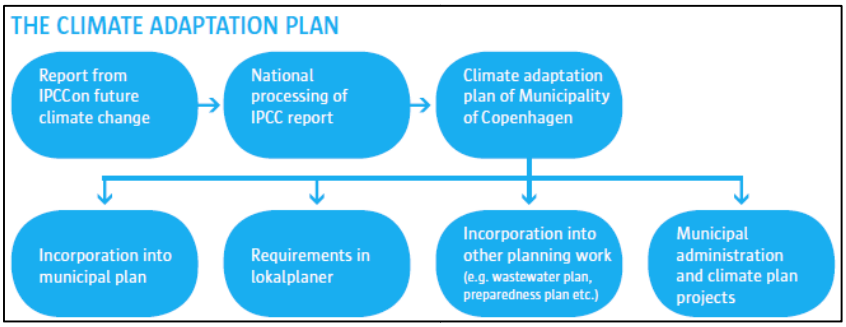

Figure 4: Process of adaptation policy planning and implementation in Copenhagen[43]

Copenhagen's "Skybrudsplan" (Cloudburst Management Plan) was finally approved by "Borgerrepræsentationen" the 13th of December, 2012 after it had been submitted for public hearing. Three overall adaptation approaches are in play to counter flooding from cloudburst: 1) expansion of the sewer system, basins, and pump stations 2) local handling of rainwater through green and low-tech solutions 3) Ensure that eventual flooding happens controlled and in places of least damage.

In the plan, the Copenhagen area has been divided into 26 different water catchment areas (CPH Cloudburst Management Plan pp. 15). 8 out of the catchment areas fall under the Municipality of Copenhagen. The mapping has been done on the basis of an analysis of the way the water flows. A water catchment area is defined as an area where the water will flow the same way under a cloudburst (CPH Cloudburst Management Plan pp. 14). From this mapping, a prioritization has been made based on an economic risk assessment, an assessment of the implementation severity, and on the potential for synergy with other plans (CPH Cloudburst Management Plan pp. 15; COWIs Skybrudsplan pp. 52). The outcome is a prioritization of 4 areas in which the development – and implementation process will begin. The 4 areas are: Indre by, Østerbro. Sluseholmen, Vesterbro/Ladegårdsåen (Ibid.). Prioritization amongst the water catchment areas is needed as the Copenhagen Cloudburst Plan operates within a 20 year timeline (CPH Cloudburst Management Plan pp. 23). The 20 years are divided into 3 investment periods (2013-2016, 2016-2025 and 2026-2033) and because of the time-division in the investments, it has been important for the Municipality of Copenhagen to find a way to prioritize efforts, once it has been clear that the whole plan[44] could not be carried out at a time (CPH Cloudburst Management Plan pp. 23 and pp. 14). The policy initiative and process on storm-surge adaptation is currently in the planning phase, and an independent policy with an implementation plan is expected in the coming years, equal to the one existing one cloudburst. No decisions have been made yet; however, the municipality has produced reports on possible adaptation measures. The most feasible solutions will be to establish dikes with sluices in each of the harbors entries. Policy wise, all these solutions will be fed into the overall adaptation plan, while the municipal plans displayed in the above figure 4 will be the place of implementation.

The **Alentejo** agriculture and forestry case study is both a retrospective and prospective participatory study implemented jointly to local stakeholders, with the aim to identify the appropriate adaptation measures for the agriculture and forestry in the region of Alentejo. The study included 21 interviews with farmers and non-governmental organisations that implemented adaptation measures from which resulted more than 30 adaptation measures. The adaptation measure of 'water retention landscapes'[45], implemented in the Tamera Ecovillage, was analyzed in depth with a participatory cost-benefit analysis, including an ecosystem services valuation. Furthermore, also adaptation

[43] (lokalplaner: Local plans)

[44] Sluices and dikes installed in the harbour of Copenhagen in order to protect the inner city against SLR and storm-surges, sewage system, backflow valve in basements, surface adaptation solutions (waterways and temporary basins to counter flooding during cloudbursts).

[45] Creation of permanent lakes and small dams.

measures in agriculture[46] were subjected to a multicriteria analysis and selected by farmers and stakeholders. In the past programming period 2007-2013, CAP and Rural Development Program (ProDeR) measures to finance irrigation infrastructures such as lakes and dams were supported. A total of 25,7 M€ were invested in improvement of dams security in ProDeR 2007-2013 while measures for improving efficiency in dams and irrigation (30,2M€) are still waiting for funding to be concluded from previous program. The National Strategy for Public Irrigation, though specifically mentions adaptation to climate change, does not allocate funding available to support these specific projects of irrigation demanded by farmers.

The **South of Aveiro** case study (coast of Ílhavo and Vagos) has been a prospective and participatory study implemented with local stakeholders, with the aim to identify the appropriate adaptation measures for protecting the coast against extreme weather events and flooding. The resulting main measures proposed for the following 75 years were: sand nourishment operations, a sand dike in a particular vulnerable stretch, with a high risk of overtopping and a detached submerged breakwater in a vulnerable stretch with urban settlements endangered by flooding. Sand nourishment represents a typology of measure that has been taken in the past mainly in response to emergencies. The fact that it is now recommended in the local Program for the Coastal Orla (POC), jointly also to regulation for shoreline constructions, highlights that this program has had an impact on the selection of measures and has fostered a mainstream process by promoting this type of intervention. The Shoreline management plan is supposed to push forward also the implementation of coastal protection measures, since the plan integrates top EU directives[47], as well as national strategies for coastal development and protection, and local context-specific challenges (e.g. not respecting legislation for shoreline constructions; high risk of flooding). This mainstream process was strengthened, following a period of storm surges during the winter of 2014, after which the Portuguese Minister of the Environment, Spatial Planning and Energy announced a budget of 300 million euros for coastal protection operations in Portugal.

The **Cascais** municipality case study deals with the high exposure to river flooding from extreme precipitation events not only due to its high urbanization ratio and development but also due to its morphological and geographical specific characteristics. The city is located in Europe's West coast, Portugal, 25 km West from Lisboa and facing the Atlantic Ocean. The Municipality has an approximated area of 30 sq. Km and it is bounded by two natural wonders: the Atlantic Ocean and Sintra-Cascais Natural Park. The adaptation measures considered and analyzed[48] are at the crossroads between urban planning and water management and any action plan has to consider multiple stakeholders from different sectors, multi-level and multi-disciplinary legislation as well as multiple policies. Nevertheless, it is important to mention that Cascais, as all municipalities in Portugal, according to Portuguese law – Decreto-lei Nº 364/98 and Decreto-Lei nº 115/2010 – is

[46] Several sub-measures and practices are dealing with regeneration of soils and diversification of crops, species and varieties as adaptation measures also identified under the national strategy for adaptation and by the farmers and stakeholders participatory process. The objective of regenerating soils and their organic matter is to decrease the vulnerability of plant and forest species. The objective of diversification of crops, species and varieties is to decrease the vulnerability to climate unpredictability, extreme events and also increase the genetic pool that promotes the phenotipical adaptation of species to climate.

[47] The EU "flooding directive" [2007/60/EC] in Portugal, is a binding directive, transposed to Portuguese policies, both in coastal planning programs, as well as in other spatial planning instruments. All administrative regions have done an extensive cartography with flood risk assessments and this cartography should be by law integrated at the different levels of spatial planning (local, regional and national), including the POC (referred above).

[48] Rainwater gardens (a planted depression or a hole that allows rainwater runoff from impervious urban areas, like roofs, driveways, walkways, parking lots aimed to store and slow down rainwater flow in order and mitigate its impacts downstream), Green corridors and the renaturing of Ribeira das Vinhas (renaturing or rehabilitating a river or a stream to bring it back to its original structure and functions, in order to increase the streams capacity to withstand extreme rainfall events, slow down river stream flow upstreams, increase water natural infiltration in river banks, slow down stream flow and finally to allow the stream to follow its natural course instead of overflowing to urbanized and vulnerable areas), Rainwater harvest (a technology used for collecting and storing rainwater from rooftops, land surfaces or rock catchments using simple techniques such as natural and/or artificial ponds or reservoirs)

obliged to have a Chart of Flooding Areas as well as to create measures to mitigate and adapt the risk of flooding within its territory, a crucial element in the city's urban planning and development and in the delimitation of its Ecologic Reserve Area (REN). It is also important to mention that REN has a mandatory implementation and already foresees a number of restrictions for flood prone areas - Decreto-Lei nº166/2008 Artigo 20º and Decreto-Lei nº239/2012 Artigo 20º - namely, the prohibition to: a) allotment operations, b) urbanization and construction projects, c) roads and other accesses, d) digging and embankment, e) destruction of natural ecosystems or the natural existent environment, except for normal agricultural practices and fire prevention measures regarding forest cleaning. Cascais has had flood maps since 1998, where 16 water streams have been studied and monitored.

In the **Ústí** region as well as in the **South Moravian** region case studies the main aim of the adopted measures[49] is to enhance the adaptive capacity of agriculture land towards drought and extreme weather events mainly through changes in management practices. Czech agricultural policy in the Rural Development Program 2014-2020 has supported and facilitated some climate friendly farming practices adopted in the case study (e.g. changes in planted crop variety, no-tillage technologies), and nevertheless there is an evident lack of specific adaptation plans, programs and strategies that would explicitly promote and support the kind of adaptation measures developed. Local farmers and farmer associations in Ústí Region have recently been taking some adaptation actions towards extreme droughts and water scarcity but these actions are rather fragmented and autonomous. The 'Conception of the Water Management Policy from the Minister of Agriculture until 2015' has supported and somehow facilitated water saving measures such as increasing retention capacity of some floodplains and catchment areas adopted in the case study.

Prague case study deals with the need for flood defenses improvement and assesses potential structural measures[50] that would improve flood control system with the primary objective to protect the city from floods and prevent damages which could be caused by such events. The 'Strategy for protection against floods' (2000, updated 2006), that was developed to reduce flood risk and damage, launched and facilitated particularly the implementation of structural measures in City of Prague (mainly mobile and fixed barriers) but it also mentions early warning systems and disaster response management as powerful tools for non-structural flood control measures. The 'Plan of flood protection using technical and natural measures' (2010) has instead promoted green measures along with the technical ones, supporting in this way the implementation of ecosystem-based solutions analyzed in the case study such as the restoration of some parts of the Vltava River embankments and channels of some tributaries.

[49] Changes in planted crop variety, permanent set aside of arable land, shift in the timing of agricultural activities (e.g., time of planting, sowing, treatment).

[50] Fixed barriers (levees, dykes), mobile barriers, closures and pumping systems in the canalization.

4 Efficient policy integration and coherence requires action in the budget allocation

4.1 Financing Adaptation: the European Structural and Investment Funds under 2014-2020 programming period

Much of EU spending has impacted, with direct or indirect effects, the achievement of EU's climate change objectives (Medarova-Bergstrom et al. 2011). For this reason climate change adaptation aims have to be embedded not just into the preparation of the governmental budget, but into all stages of the "budgeting life cycle": setting planning expenditure priorities, the formal adoption of the budget; implementing the budget, monitoring, through evaluation and reporting (Wilkinson et al. 2008). This would allow to extend adaptation policy from the level of strategies to instruments, implementation and practice, and be fully incorporated into a multi-level governance framework.

This part of the report investigates the potential financial contribution to climate change adaptation policies from the European Structural and Investment Funds provisions, mainly dedicated to support the Cohesion Policy (CP) and the Common Agricultural Policy (CAP). Clear interconnections exist between the most relevant objectives of each single fund and the good practices in adaptation developed and assessed in the BASE project's case studies and sectoral models[51]. A wide portfolio of these options is here connected to the Thematic and Operational objectives set for implementation within the 2014-2020 programming period (mainly Structural and Investment Funds supporting Cohesion policy and CAP). Managing authorities and institutions will be the beneficial bodies to take advantage of these advice in support to their own decision-making.

The Cohesion Policy and the Common Agricultural Policy are of key relevance as they account for the large majority of EU common provisions allocated to development policies. Consequently investments and spending under both policies and the current EU Multi-Annual Financial Framework (MFF) 2014-2020 must be adequately climate-proofed and robust in their effectiveness under different climate change scenarios, as they are likely to have a major impact on the development of EU economies and ecosystems.

Improved access to funding is a critical factor in building a climate-resilient Europe. The 2014-2020 Multi-annual Financial Framework increased climate-related expenditure approximately to 20%[52] of the EU budget and the EU has included climate change adaptation in almost all relevant EU finance programs for the same period. In addition to Horizon 2020 and the LIFE programs that deal with research and pilot operational projects, a major role in funding is being and increasingly going to be played by the European Structural and Investment Funds, that will provide significant support to Member States, regions and cities to invest in programs and projects dedicated to adaptation.

The EU budget can have significant multiplier effects in important policy areas such as agriculture, flood protection and spatial planning, infrastructure, energy and can help build institutional capacity across European countries. Member States and regions will need to bring climate change adaptation

[51] BASE project Deliverable 5.2 and 6.3.

[52] Hjerp, P., Volkery, A., Lückge, H., Medhurst, J., Hart, K., Medarova-Bergstrom, K., Tröltzsch, J., McGuinn, J., Skinner, I., Desbarats, J., Slater, C., Bartel, A., Frelih-Larsen, A., and ten Brink, P., (2012), *Methodologies for Climate Proofing Investments and Measures under Cohesion and Regional Policy and the Common Agricultural Policy*, A report for DG Climate, August 2012.

in their development planning processes and ensure that a sufficient share of the projects' budget is dedicated to proper prevention and adaptation measures.

Under the 2014-2020 programming period, Member States will be required to demonstrate how they address adaptation in relation to all spending priorities. However, the actual implementation and effectiveness ultimately depends on the interest of different stakeholders or fund end-users (e.g. farmers, land managers) not necessarily aligned to systematic consideration of specific vulnerabilities and adaptation options.

The suggested measures analyzed in the BASE project's case studies and models may represent the relevant 'entry points' in terms of potential opportunities eligible for funding under ESI Funds, and are in the authors' opinion only examples of good practices to be adopted and connections to look at, when searching for financial resources among the financial tools examined. This work does not have the intention to be exhaustive but it aims to stimulate further investigation and search for more insights to associate concrete project measures and relative expenditures to the most adequate and consistent financial tool. The eligibility of each individual measure must be accurately verified on a case-by-case basis under the specific Fund procedures and mechanisms.

The measures suggested in table 33 are related to a number of issues that will allow Member States prioritize options addressing climate change adaptation while pursuing their own development programs (CAP and Cohesion Policy) and consequently ensuring that expenditure under policies is climate-proofed. As in the case of EU legislation implementation (chapter 3), the accurate selection of specific adaptation measures under CAP and Cohesion Policy may also substantially support climate adaptation action and foster its success in various policy domains. The aim is to assess to what extent and in which direction not only regulatory provisions (already examined in subchapter 3.3), but also existing strategic planning and funding instruments in the 2014-2020 programming period may determine opportunities to allocate financial resources and support the implementation of investments and management measures in line with adaptation strategies and plans.

Since the available funding also under the 2014-2020 programming period is limited and there will be competition among different objectives, priority should be given to options that achieve important synergies or bring co-benefits with other sectors and policy areas to help promote and foster climate adaptation under different Thematic objectives of the Common Strategic Framework[53] (table 32) underlying the Structural and Investment Funds: under both Cohesion Policy and CAP, many different categories of expenditure are likely to be sensitive to climate change related impacts.

Table 32: Thematic Objective in the Common Strategic Framework 2014-2020

Thematic Objective	ERDF	ESF	EAFRD	EMFF
1) Strengthening research, technological development and innovation;				
2) Enhancing access to, and use and quality of, ICT;				
3) Enhancing the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of the fishery and aquaculture sector (for the EMFF);				
4) Supporting the shift towards a low-carbon economy in all sectors;				
5) Promoting climate change adaptation, risk prevention and management;				

[53] Common Strategic Framework (CSF): A document that provides a strategic framework of actions to improve the complementarity, coordination and added value of planned development policy for 2014 – 2020 under several financial mechanisms the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF). Regulation (EU) no 1303/2013.

6) Preserving and protecting the environment and promoting resource efficiency;				
7) Promoting sustainable transport and removing bottlenecks in key network infrastructures;				
8) Promoting sustainable and quality employment and supporting labour mobility;				
9) Promoting social inclusion, combating poverty and any discrimination;				
10) Investing in education, training and vocational training for skills and lifelong learning;				
11) Enhancing institutional capacity of public authorities and stakeholders and efficient public administration.				

Similarly to the sectoral legislation analysis, an assessment of possible co-benefits between climate adaptation and development Thematic Objectives needs to identify actions with a high synergy potential (both in terms of investment priorities and procedural requirements) for the implementation of Partnership Agreements[54] (PA), Operational Programs[55] (OPs) and direct projects: many measures for improving energy efficiency or resilience to climate impacts, for instance, have positive economic, fiscal and social effects, because they improve competitiveness, create new employment opportunities or reduce energy bills, thus freeing resources for other investments.

Such 'win-win' solutions should be identified and promoted in current and future funding programs.

4.2 Potential eligible options for mainstreaming adaptation under the Multi-annual Financial Framework expenditure

Climate change adaptation related actions are also eligible under different expenditure categories in several financial mechanisms and instruments supporting the EU Cohesion Policy and CAP. This implies that Member States and regions may embed climate change adaptation considerations in their sectoral and development programming processes and ensure that a sufficient share of the projects' budget and design is dedicated to adopt adaptation measures, with the aim to mainstream climate change adaptation concerns into the entire process of expenditure planning, implementation, reporting and periodic evaluation.

The table 32 highlights opportunities for financing these options in relation to different funding instruments, proposed priority actions and category of expenditures. However climate change adaptation and risk prevention are not exclusively addressed into the Thematic Objectives explicitly referred to them, as these issues may be of a certain relevance also under other topics. This means that some measures of intervention could be pursued under more than one objective, indicating potential for maximizing synergies in funding and for 'win-win' solutions, particularly for integrated

[54] Partnership Agreement: it sets out the Member State's strategy, priorities and arrangements for using the CSF Funds in an effective and efficient way to pursue the EU strategy for smart, sustainable and inclusive growth. It is prepared by the Member State with the involvement of partners in line with the multi-level governance approach, and is approved by the European Commission following the assessment and dialogue with the Member State.

[55] Operational Programs: planning document for the expenditure of the national Partnership agreement developed for regions and/or sectors (e.g. transport, energy, etc.).

mitigation-adaptation projects (e.g.: adaptation actions in urban areas, flood risk management, improvement of water use efficiency, increase of water availability, raising awareness, institutional capacity building, etc). As a general overview in Southern Member States, the focus might refer in particular to water and green infrastructure-related expenditures to meet the challenges from droughts and heat waves, given the magnitude of expected impacts and relatively low adaptive capacity of most countries in this region.

Some categories of expenditure may be used in contexts particularly exposed to climate change risks to fund basic infrastructures (including, dikes, dams, sluices, rail tracks and electricity grids rerouting, etc), public buildings and residential housing or may support softer and green measures such as early warning systems, buffer strips for agricultural land, on-farm water harvesting, awareness raising for SMEs, floodplain management, planting of winter cover for agricultural land to avoid soil erosion, improvement of animal rearing conditions and high-efficiency ventilation.

As far as the CAP is concerned, expenditure in physical infrastructure of the agricultural sector is extremely varied as a wide range of initiatives can be funded. These might include the ongoing potential to fund manure storage, anaerobic digesters, livestock housing, water harvesting and storage, and efficient irrigation systems. There is a need to ensure that the infrastructure being funded are able to face future climate impacts and ideally contribute to the adaptation needs of the sector as a whole. Better use should be made of technical assistance instruments and funding for education, training and institutional capacity building from the European Social Fund, considering that little awareness, knowledge and expertise constraints are main barriers to foster adaptation into projects.

It should be noted that the list of options is not exhaustive and should be regarded as a menu of possible thematic options that would need to be further developed and tailored according to the national, regional and local needs in terms of expected climate change impacts and sectoral priorities, possibly taking into consideration what typology of options is more efficient to be applied into a multi-level governance scale, where coordination among different institutional levels may create economies of scale and consequently overall financial savings.

The Thematic objectives have been outlined in the Elements for a Common Strategic Framework 2014 to 2020 (article 9), Annex to Regulation (EU) no 1303/2013 of the European Parliament and of the council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006. Article 9 provides the list of the Thematic Objectives.

In order to contribute to the Union strategy for smart, sustainable and inclusive growth as well as the Fund-specific missions pursuant to their Treaty-based objectives, including economic, social and territorial cohesion, each ESI Fund shall support the following thematic objectives:

(1) strengthening research, technological development and innovation;

(2) enhancing access to, and use and quality of, ICT;

(3) enhancing the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of the fishery and aquaculture sector (for the EMFF);

(4) supporting the shift towards a low-carbon economy in all sectors;

(5) promoting climate change adaptation, risk prevention and management;

(6) preserving and protecting the environment and promoting resource efficiency;

(7) promoting sustainable transport and removing bottlenecks in key network infrastructures;

(8) promoting sustainable and quality employment and supporting labour mobility;

(9) promoting social inclusion, combating poverty and any discrimination;

(10) investing in education, training and vocational training for skills and lifelong learning;

(11) enhancing institutional capacity of public authorities and stakeholders and efficient public administration.

Thematic objectives shall be translated into priorities that are specific to each of the ESI Funds and are set out in the Fund- specific rules.

Only 4 of the Common Strategic Framework (CSF) Thematic Objectives (the ones previously highlighted in bold) may be considered strictly relevant or somehow related to climate change adaptation issue. These types of expenditure and the size of the funding allocations for the different expenditure types will be determined by decisions taken by each Member State, possibly taking into consideration the level of adaptive capacity. However, relevant 'entry points' that would allow to identify opportunities in the national, sector or project planning process for a better mainstreaming of adaptation action, may be potentially found also in other Thematic Objectives.

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Table 33: Thematic Objective 4 - SUPPORTING THE SHIFT TOWARDS A LOW-CARBON ECONOMY IN ALL SECTORS

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
4. Supporting the shift towards a low-carbon economy in all sectors	European Regional Development Fund (ERDF) Regulation (EU) No 1301/2013	(4) Supporting the shift towards a low-carbon economy in all sectors	(a) promoting the production and distribution of energy derived from renewable sources;			
			(b) promoting energy efficiency and renewable energy use in enterprises			
			(c) supporting energy efficiency, smart energy management and renewable energy use in public infrastructure, including in public buildings, and in the housing sector;			
			(d) developing and implementing smart distribution systems that operate at low and medium voltage levels;			

			(e) promoting low-carbon strategies for all types of territories, in particular for urban areas, including the promotion of sustainable multimodal urban mobility and mitigation-relevant adaptation measures;	Jena – Winzerberge Jena - Inselplatz Jena – Zwätzen Prague - Heat stress Madrid	Use of small-crowned tree species (Sorbus intermedia „Brouwers“) Use of large-crowned tree species (Tilia cordata „Greenspire“) Use of ordinarily coloured cobblestones Use of light-coloured cobblestones --- Increase of green area Increase of water area --- Green roofs	
			(f) promoting research and innovation in, and adoption of, low-carbon technologies;			
			(g) promoting the use of high-efficiency co-generation of heat and power based on useful heat demand;			

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
4**. Supporting the shift towards a low-carbon economy in all sectors**	European Regional Development Fund (ERDF) Regulation (EU) No 1301/2013	5) promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors, with a focus on the following areas	(a) increasing efficiency in water use by agriculture;	Cascais Doñana	Water savings in distribution Water transfer from the upper basin to ensure quantity and quality	**Agriculture Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Irrigation** This includes a set of measures to compensate for loss of agricultural production through irrigation. A list of specific measures is: - Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources - Development of

						additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale reservoirs or small-scale water reservoirs on farmland, wastewater recycling for agriculture
			(b) increasing efficiency in energy use in agriculture and food processing;			
			(c) facilitating the supply and use of renewable sources of energy, of by-products, wastes and residues and of other non food raw material, for the purposes of the bio- economy;			
			(d) reducing green house gas and ammonia emissions from agriculture;			
			(e) fostering carbon conservation and sequestration in agriculture and forestry;			

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
4**. Supporting the shift towards a low-carbon economy in all sectors**	**REGULATION (EU) No 508/2014 European Maritime and Fisheries Fund**	1) Promoting environmentally sustainable, resource–efficient, innovative, competitive and knowledge–based fisheries	(a) the reduction of the impact of fisheries on the marine environment, including the avoidance and reduction, as far as possible, of unwanted catches			
			(b) the protection and restoration of aquatic biodiversity and ecosystems			
			(c) the ensuring of a balance between fishing capacity and available fishing opportunities			
			(d) the enhancement of the competitiveness and viability of fisheries enterprises, including of small–scale coastal fleet, and the improvement of safety and working conditions			
			(e) the provision of support to strengthen technological development and innovation, including increasing energy efficiency, and knowledge transfer			

Thematic Objective 5 - PROMOTING CLIMATE CHANGE ADAPTATION, RISK PREVENTION AND MANAGEMENT

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
(5) Promoting climate change adaptation, risk prevention and management;	**European Regional Development Fund (ERDF) Regulation (EU) No 1301/2013**	Art. 5, comma 5 Promoting climate change adaptation, risk prevention and management	(a) supporting investment for adaptation to climate change, including ecosystem-based approaches;	Green Roof	• Mainly ecosystem-based adaptation measures • Sustainable forest management • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones	**Flood risk management (vulnerability reduction)** - Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects.
				Leeds – Ecosystem-based adaptation	• Ecosystem-based approach (EBA) • Broadleaf woodland planting	
			(b)promoting investment to address specific risks, ensuring disaster resilience and developing disaster management systems;	Timmendorfer Strand	• Coastal protection measure • Finishing and landscaping-project, i.e. improvement of the beach promenade, two new boardwalks established in the dunes and recreational infrastructure, e.g. benches, playground	**Flood risk management (vulnerability reduction)** - Emergency measures, including local barriers, and sand bags to prevent water from entering vulnerable urban areas. - Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects.
				Prague - Flood risk	• Structural measures (part of the flood control system (FCS), 2014) Fixed measures: 12.460 m Mobile measures 6.795 m Heavy mobile measures 130m • Non-structural measures,	

					which are not included in the FCS are not considered for assessment • Awareness raising • Disaster response management • Risk transfer tools • Monitoring Management	**Flood risk management (flood prevention)** Flood prevention includes a set of measures to minimize the probability of river flooding. A list of specific measures is: - Dike construction/upgrading: by creating new, or improving the height and strength of dikes, dams and levees, the probability of flooding is reduced. - Reservoir construction and water retention: by retaining water in reservoirs of retention areas downstream, the probability of flooding of vulnerable areas is reduced. - Other measures, including widening of river floodplains, reduction of obstruction in floodplains (such as bridges).
				Copenhagen - Coastal protection	• Dike • Sluices	
				Copenhagen – Cloudbursts	• Sewage system • Backflow valve in basements • Surface adaptation	
				Kalajoki river basin - Flood risk	• Permanent flood protection structures	
				Holstebro	• Widening of Storå at Storebro + increasing depth of Storå at the stretch below Storebro (structural) • Establishing bridge at overflow ramp (structural) • Increasing depth of Storå at the stretch upstream Østrbrogade to the allotments (structural) • High water level protection at Vigen (structural)	

					• High water level protection of the Music Theatre (structural) • Extended watercourse routing in Lægård Bæk and Frøjk Bæk (structural) • Local dam to retain water east of Vandkraftsøen (structural) • Retaining water through decentralized dam solutions (structural) • SMS flooding warnings to citizens (non-structural) • Citizen report portal (non-structural) • The farmer as water manager (structural (water retention, delaying, storing) and non-structural (economic incentives)	
				Kalundborg	• Laissez-faire • Gradual adaptation • Protection (pumps and dikes)	
				Venice	• Changes in building materials and techniques • Aiming at protecting living environments from being flooded (raising floor levels, small barriers, protection of building elements against intrusion of salt water, with protective	

					construction elements (vasca) • Preventing saline water from penetrating into brick walls by physical barriers introduced into walls	
				South Aveiro Coast	• Artificial beach nourishment • Sea walls • Groins • Detached breakwater • Palisades and walkways on the dunes • Reinforcement of dune systems	
				Cascais	• Green roofs • Rain water gardens • Rain water harvesting • Green corridors and rehabilitation of Cascais streams • Land use change in high risk flood prone areas	
				Madrid	• Green roofs • Well defined and efficient Heat Health Warning System	

				Rotterdam – Fluvial flooding	• Room for the River small 1 • Room for the River small 2 • Room for the River 3 • Room for the River 4 • Water storage lake Grevelingen • Full closure with dams & sluices • Channel deepening • Combination of 2+3	
				Leeds - Sustainable drainage	• Detention basins • Filter drains • Green roofs - extensive sedum • Infiltration basins • Infiltration trenches • Permeable paving • Rainwater harvesting • Retention ponds • Soakaways • Swales • Water butts • Wetlands • Urban trees	
				Leeds - Infrastructure	New wall and embankment at Woodlesford completed for 1 in 200 year protection (downstream from city centre) In the city centre for a 1 in 75 year protection (currently	

					being implemented: • Replacing existing weirs with moveable weirs at Crown Point and Knostrop Cut • Removing Knostrop cut (island) so Canal and River Aire merge • Increasing the height of existing river walls; building new walls, embankments and terracing	
				South Devon Coast – Railway	• Strengthening and heightening the sea wall • Stabilising the cliffs through wire netting and bolting • Reroute the railway	
				South Devon Coast - Fluvial flooding	• The installation of domestic flood gates at 50 at risk properties Individual domestic flood gates to be fitted to all 50 properties. • The installation of sluice gates up stream to hold back flood water, thus protecting property in the two centre. In extreme events this may not be enough to hold back all of the flood water and thus protect all properties	
		Art.5 comma 6	(b) investing in the water sector to meet the	Prague - Heat stress	Increase of water area	**Agriculture**

		Preserving and protecting the environment and promoting resource efficiency	requirements of the Union's environmental acquis and to address needs, identified by the Member States, for investment that goes beyond those requirements	Prague - Flood risk	Structural measures (part of the flood control system (FCS), 2014) Fixed measures: 12.460 m Mobile measures 6.795 m Heavy mobile measures 130m	**Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Flood risk management (Flood prevention):** - Dike construction/upgrading: by creating new, or improving the height and strength of dikes, dams and levees, the probability of flooding is reduced.
				Copenhagen – Cloudbursts	• Sewage system • Backflow valve in basements • Surface adaptation	
				Kalajoki river basin - Flood risk	• Extended use of regulated lakes as water storage • Improving summer flood preparedness in Hautaperä reservoir regulation • Improving summer flood preparedness in lake Reisjärvi regulation • Increasing the retention capacity of the river basin	
				Alentejo	Water retention landscape (Lakes of Tamera)	
				Doñana	Technological measures:	

				Rotterdam – Fluvial flooding	• Increased technical efficiency of the irrigation systems. • Laser levelling • Integrated production --- • Room for the River small 1 • Room for the River small 2 • Room for the River 3 • Room for the River 4 • Water storage lake Grevelingen • Full closure with dams & sluices • Channel deepening • Combination of 2+3	
				Leeds - Sustainable drainage	• Detention basins • Filter drains • Green roofs - extensive sedum • Infiltration basins • Infiltration trenches • Permeable paving • Rainwater harvesting • Retention ponds • Soakaways • Swales • Water butts	

					• Wetlands • Urban trees	
			(d) protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure;	Green Roof	• Sustainable forest management • Peat land and water course restoration • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones	**Flood risk management (vulnerability reduction)** This includes a set of measures to reduce the impacts of river flooding, once a flood occurs. A list of specific measures is: - Emergency measures, including local barriers, and sand bags to prevent water from entering vulnerable urban areas. - Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects. **(Flood prevention)** - Reservoir construction and water retention: by retaining water in reservoirs of retention areas downstream, the probability of flooding of vulnerable areas is reduced.
				Jena – Winzerberge	• Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“)	
				Jena – Zwätzen	• Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“/ Gingko Biloba) • Use of green roofs • Use of façade greening	
				Cascais	• Green roofs • Rain water gardens • Rain water harvesting • Green corridors and rehabilitation of Cascais streams	

				Leeds – Ecosystem-based adaptation	• Broadleaf woodland planting	

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
(5) promoting climate change adaptation, risk prevention and management;	European Agricultural Fund for Rural Development (EAFRD) REGULATION (EU) No 1305/2013	Art. 5 comma 4 restoring, preserving and enhancing ecosystems related to agriculture and forestry	(a) restoring, preserving and enhancing biodiversity, including in Natura 2000 areas, and in areas facing natural or other specific constraints, and high nature value farming, as well as the state of European landscapes;	Green Roof	• Sustainable forest management • Peat land and water course restoration • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones	
				Kalajoki river basin - Water quality	• Buffer zones (different slopes) • Small constructed wetlands (different % of fields) • Medium constructed wetlands (different % of fields) • Large constructed wetlands (different % of fields) • Winter time vegetation cover (different slopes) • Perennial grass (different slopes)	
				Cascais	• Green corridors and rehabilitation of Cascais streams	
			(b) improving water management, including fertilizer and pesticide	Kalajoki river basin - Flood risk	• Using agricultural land as floodplains • Extended use of	**Agriculture Management:**

			management;		regulated lakes as water storage • Improving summer flood preparedness in Hautaperä reservoir regulation	This includes a set of measures to minimize negative impacts on agriculture and to increase agricultural productivity. A list of specific measures is: - Improve resiliency and adaptive capacity. This can be achieved through the implementation of regional adaptation plans to enhance effectiveness of adaptation measures, improvement of monitoring and early warning - Development of innovation and technology to improve agricultural practices and to reduce costs. This can be achieved through more intensive use of agricultural machinery and development of better fertilizers, change in crops and cropping patterns to decrease economic risk to farmers, development of climate change resilient crops - Improvement of water use efficiency to increase water
				Kalajoki river basin - Water quality	• Controlled drainage • Optimal fertilization	
				Holstebro	Increasing depth of Storå at the stretch upstream Østrbrogade to the allotments (structural) High water level protection at Vigen (structural) High water level protection of the Music Theatre (structural) Extended watercourse routing in Lægård Bæk and Frøjk Bæk (structural) Local dam to retain water east of Vandkraftsøen (structural) Retaining water through decentral dam solutions (structural)	
				Alentejo	• Water retention landscape (Lakes of Tamera)	
				Cascais	• Rain water gardens • Rain water harvesting	

				Doñana Rotterdam – Fluvial flooding Leeds - Sustainable drainage Leeds – Ecosystem-based adaptation	• Increased technical efficiency of the irrigation systems • Water storage lake Grevelingen • Detention basins • Filter drains • Infiltration basins • Infiltration trenches • Permeable paving • Rainwater harvesting • Retention ponds • Soakaways • Swales • Water butts • Wetlands	availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Irrigation:** This includes a set of measures to compensate for loss of agricultural production through irrigation. A list of specific measures is: - Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources - Development of additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale

						reservoirs or small-scale water reservoirs on farmland, wastewater recycling for agriculture
			(c) preventing soil erosion and improving soil management.	Alentejo Doñana	dams, farm lakes, keyline, swales, crop diversification, use of adapted species, improvement of species Technological measures: • Increased technical efficiency of the irrigation systems. • Laser leveling • Integrated production Organizational measures • Local monitoring • Accurate, accessible and useful water information at different scales Governance measures • Improve the coordination between institutions • Increase scientific research • Farmer training • Technical advice were governance options	**Flood risk management (vulnerability reduction)** This includes a set of measures to reduce the impacts of river flooding, once a flood occurs. A list of specific measures is: - Emergency measures, including local barriers, and sand bags to prevent water from entering vulnerable urban areas. - Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects. **(Flood prevention)** - Reservoir construction and water retention: by retaining water in reservoirs of retention areas downstream, the probability of flooding of vulnerable areas is reduced.

						Agriculture **Management:** - Development of innovation and technology to improve agricultural practices and to reduce costs. This can be achieved through more intensive use of agricultural machinery and development of better fertilizers, change in crops and cropping patterns to decrease economic risk to farmers, development of climate change resilient crops - management practices to improve soil moisture retention capacity.
		Art.5 comma 5 Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	a) increasing efficiency in water use by agriculture;	Kalajoki river basin - Flood risk Alentejo	A selection of potential measure types that needed further analysis: • Using agricultural land as floodplains • Extended use of regulated lakes as water storage Water retention landscape (Lakes of Tamera)	**Agriculture** **Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology

				Cascais Doñana Leeds - Sustainable drainage	• Rain water gardens • Rain water harvesting Technological measures: • Water transfer from the upper basin to ensure quantity and quality • Increased technical efficiency of the irrigation systems. • Rainwater harvesting • Retention ponds	improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Irrigation** This includes a set of measures to compensate for loss of agricultural production through irrigation. A list of specific measures is: - Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources - Development of additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale reservoirs or small-scale water reservoirs on farmland, wastewater recycling for agriculture

			(b) increasing efficiency in energy use in agriculture and food processing;			

Thematic Objective 6 - PRESERVING AND PROTECTING THE ENVIRONMENT AND PROMOTING RESOURCE EFFICIENCY

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
Preserving and protecting the environment and promoting resource efficiency	**European Regional Development Fund (ERDF) Regulation (EU) No 1301/2013**	Art.5 comma 6: Preserving and protecting the environment and promoting resource efficiency by:	(a)investing in the waste sector to meet the requirements of the Union's environmental acquis and to address needs, identified by the Member States, for investment that goes beyond those requirements;			
			(b)investing in the water sector to meet the requirements of the Union's environmental acquis and to address needs, identified by the Member States, for investment that goes beyond those requirements;	Prague - Flood risk	Structural measures (part of the flood control system (FCS), 2014) • Fixed measures: 12.460 m • Mobile measures 6.795 m • Heavy mobile measures 130m Non-structural measures, which are not included in the FCS are not considered for assessment • Awareness raising • Disaster response management • Risk transfer tools • Monitoring Management	**Agriculture** **Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Flood risk management**

				Copenhagen – Cloudbursts Kalajoki river basin - Flood risk Kalajoki river basin - Water quality	• Sewage system • Backflow valve in basements • Surface adaptation • Using agricultural land as floodplains • Extended use of regulated lakes as water storage • Improving summer flood preparedness in Hautaperä reservoir regulation • Improving summer flood preparedness in lake Reisjärvi regulation • Increasing the retention capacity of the river basin • Permanent flood protection structures • Buffer zones (different slopes) • Small constructed wetlands (different % of fields) • Medium constructed wetlands (different % of fields) • Large constructed wetlands (different	**(Flood prevention):** - Dike construction/upgrading: by creating new, or improving the height and strength of dikes, dams and levees, the probability of flooding is reduced.

					% of fields)	
				Holstebro	• Widening of Storå at Storebro + increasing depth of Storå at the stretch below Storebro (structural) • Establishing bridge at overflow ramp (structural) • Increasing depth of Storå at the stretch upstream Østrbrogade to the allotments (structural) • High water level protection at Vigen (structural)	
				Alentejo	Water retention landscape (Lakes of Tamera)	
				Cascais	• Rain water gardens • Rain water harvesting	
				Doñana	• Water transfer from the upper basin to ensure quantity and quality • Increased technical efficiency of the irrigation systems.	

				Rotterdam – Fluvial flooding	• Room for the River small 1 • Room for the River small 2 • Room for the River 3 • Room for the River 4 • Water storage lake Grevelingen	
			(c) conserving, protecting, promoting and developing natural and cultural heritage;	Green Roof Venice	• Sustainable forest management • Peat land and water course restoration • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones • Changes in building materials and techniques • Aiming at protecting living environments from being flooded (raising floor levels, small barriers, protection of building elements against intrusion of salt water, with protective construction	**Flood risk management (vulnerability reduction)** This includes a set of measures to reduce the impacts of river flooding, once a flood occurs. A list of specific measures is: - Adapted construction of buildings: so that water can either not enter the building (dry-proofing), or when water enters it does no harm (wet-proofing) - Emergency measures, including local barriers, and sand bags to prevent water from entering vulnerable urban areas. - Other measures, including land-use

					elements (vasca) • Preventing saline water from penetrating into brick walls by physical barriers introduced into walls • Early warning systems (e.g., sms, apps)	planning, risk zoning, and relocation of vulnerable objects.
			(d)protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure;	Green Roof Jena – Winzerberge Jena – Zwätzen	• Sustainable forest management • Peat land and water course restoration • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones --- • Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“) • Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata	

					„Greenspire“/ Gingko Biloba) • Use of green roofs • Use of façade greening	
				Cascais	• Green roofs • Rain water gardens • Rain water harvesting • Green corridors and rehabilitation of Cascais streams	
				Leeds – Ecosystem-based adaptation	• Broadleaf woodland planting	
			(e)taking action to improve the urban environment, to revitalize cities, regenerate and decontaminate brownfield sites (including conversion areas), reduce air pollution and promote noise-reduction measures;	Jena – Winzerberge	• Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“) • Use of ordinarily coloured cobblestones (albedo value of 0.3) • Use of light-coloured cobblestones	**Flood risk management (vulnerability reduction)** - Measures to prevent water from entering vulnerable urban areas. - Other measures, including land-use planning, risk zoning, and relocation of vulnerable objects.

					(albedo value of 0.5)	**Health model** - Heat watch warning systems
				Jena – Zwätzen	• Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“) • Use of ordinarily coloured cobblestones (albedo value of 0.3) • Use of light-coloured cobblestones (albedo value of 0.5) • Use of green roofs • Use of water elements	
				Prague - Heat stress	• Increase of green area • Increase of water area	
				Holstebro	• Widening of Storå at Storebro + increasing depth of Storå at the stretch below Storebro (structural) • Establishing bridge at overflow ramp (structural) • Increasing depth of	

					Storå at the stretch upstream Østrbrogade to the allotments (structural) • High water level protection at Vigen (structural) • High water level protection of the Music Theatre (structural) • Extended watercourse routing in Lægård Bæk and Frøjk Bæk (structural) • Local dam to retain water east of Vandkraftsøen (structural) • Retaining water through decentral dam solutions (structural) • SMS flooding warnings to citizens (non-structural) • Citizen report portal (non-structural) • The farmer as water manager (structural (water retention, delaying, storing) and non-structural (economic incentives)	

				Madrid Leeds - Infrastructure	• Green roofs • Well defined and efficient Heat Health Warning System In the city centre for a 1 in 75 year protection (currently being implemented): • Replacing existing weirs with moveable weirs at Crown Point and Knostrop Cut • Removing Knostrop cut (island) so Canal and River Aire merge • Increasing the height of existing river walls; building new walls, embankments and terracing	
			f) promoting innovative technologies to improve environmental protection and resource efficiency in the waste sector, water sector and with regard to soil, or to reduce air pollution;	Prague - Flood risk Madrid	• Awareness raising • Disaster response management • Risk transfer tools • Monitoring Management • Well defined and efficient Heat Health Warning System	**Agriculture** **Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices

				Cornwall	Public health campaigns: • Met Office UV index • SunSmart • „Saving our skins“ toolkit • General behaviour change	to improve soil moisture retention capacity. **Health model** - Heat watch warning systems

CFS Thematic objective	**Specific fund**	**Priority**	**Actions**	**BASE Case Study**	**BASE Case Study Measures**	**BASE Model Measures**
Preserving and protecting the environment and promoting resource efficiency	European Agricultural Fund for Rural Development (EAFRD) REGULATION (EU) No 1305/2013	Art. 5 comma 4 restoring, preserving and enhancing ecosystems related to agriculture and forestry, with a focus on the following areas	(a) restoring, preserving and enhancing biodiversity, including in Natura 2000 areas, and in areas facing natural or other specific constraints, and high nature value farming, as well as the state of European landscapes;	Green Roof Jena – Winzerberge	• Sustainable forest management • Peat land and water course restoration • Enhancement of ecosystem protection, i.e. an enlargement of nature conservation zones • Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata „Greenspire“) • Use of small-crowned tree species (Sorbus intermedia „Brouwers“) • Use of large-crowned tree species (Tilia cordata	

					„Greenspire“/ Gingko Biloba)	
				Jena – Zwätzen	• Use of green roofs • Use of façade greening	
				Cascais	• Green roofs • Rain water gardens • Rain water harvesting • Green corridors and rehabilitation of Cascais streams	
				Leeds – Ecosystem-based adaptation	• Broadleaf woodland planting	
			(b) improving water management, including fertilizer and pesticide management;	Kalajoki river basin - Flood risk	• Using agricultural land as floodplains • Extended use of regulated lakes as water storage • Improving summer flood preparedness in Hautaperä reservoir regulation	**Agriculture** **Management:** - Development of innovation and technology to improve agricultural practices and to reduce costs. This can be achieved through more intensive use of agricultural machinery and development of better fertilizers, change in crops and cropping patterns to decrease economic risk to farmers,
				Kalajoki river basin - Water quality	• Controlled drainage • Optimal fertilization	
				Holstebro	• Increasing depth of Storå at the stretch upstream Østrbrogade to the allotments (structural) • High water level protection	

					at Vigen (structural) • High water level protection of the Music Theatre (structural) • Extended watercourse routing in Lægård Bæk and Frøjk Bæk (structural) • Local dam to retain water east of Vandkraftsøen (structural) • Retaining water through decentral dam solutions (structural)	development of climate change resilient crops - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity. **Irrigation:** - Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources - Development of additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale reservoirs or small-scale water reservoirs
				Alentejo	Water retention landscape (Lakes of Tamera)	
				Cascais	• Rain water gardens • Rain water harvesting	
				Doñana	• Water recirculation and reutilization • Increased technical efficiency of the irrigation systems.	
				Rotterdam – Fluvial flooding	• Water storage lake Grevelingen	
				Leeds - Sustainable drainage	• Detention basins • Filter drains • Infiltration basins • Infiltration trenches	

					• Permeable paving • Rainwater harvesting • Retention ponds • Soakaways • Swales • Water butts • Wetlands	on farmland, wastewater recycling for agriculture
			(c) preventing soil erosion and improving soil management.	Alentejo Doñana	dams, farm lakes, keyline, swales, crop diversification, use of adapted species, improvement of species Technological measures: • Increased technical efficiency of the irrigation systems. • Laser leveling • Integrated production Organizational measures • Local monitoring • Accurate, accessible and useful water information at different scales Governance measures • Improve the coordination between institutions • Increase scientific research • Farmer training • Technical advice were governance options	**Agriculture** **Management:** - Improve resiliency and adaptive capacity. This can be achieved through the implementation of regional adaptation plans to enhance effectiveness of adaptation measures, improvement of monitoring and early warning - Development of innovation and technology to improve agricultural practices and to reduce costs. This can be achieved through more intensive use of agricultural machinery and development of better fertilizers, change in crops and cropping patterns to decrease economic

						risk to farmers, development of climate change resilient crops - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity.
		Art.5 comma 5 Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors, with a focus on the following areas:	a) increasing efficiency in water use by agriculture;	Kalajoki river basin - Flood risk Alentejo Cascais	A selection of potential measure types that needed further analysis: • Using agricultural land as floodplains • Extended use of regulated lakes as water storage Water retention landscape (Lakes of Tamera) • Rain water gardens • Rain water harvesting	**Agriculture** **Management:** - Improvement of water use efficiency to increase water availability. This can be achieved through investment in improved water distribution and irrigation technology improvement of water charging and trade, management practices to improve soil moisture retention capacity.

				Doñana Leeds - Sustainable drainage	Technological measures: • Water transfer from the upper basin to ensure quantity and quality • Increased technical efficiency of the irrigation systems. • Rainwater harvesting • Retention ponds	**Irrigation:** - Introduction of new irrigation areas, transforming rainfed agricultural land using available water resources - Development of additional water resources. This can be achieved through development of additional groundwater, integration of demands in conjunctive systems, increased storage through large-scale reservoirs or small-scale water reservoirs on farmland, wastewater recycling for agriculture
			(b) increasing efficiency in energy use in agriculture and food processing;			

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
Preserving and protecting the environment and promoting resource efficiency	**REGULATION (EU) No 508/2014 European Maritime and Fisheries Fund**	1) Promoting environmentally sustainable, resource–efficient, innovative, competitive and knowledge–based fisheries	(a) the reduction of the impact of fisheries on the marine environment, including the avoidance and reduction, as far as possible, of unwanted catches			
			(b) the protection and restoration of aquatic biodiversity and ecosystems	Timmendorfer Strand South Aveiro Coast	Coastal protection measure in combination with the finishing and landscaping-project. • Artificial beach nourishment • Sea walls • Groins • Detached breakwater • Palisades and walkways on the dunes • Reinforcement of dune systems	
			(c) the ensuring of a balance between fishing capacity and available fishing opportunities			
			(d) the enhancement of the competitiveness and viability of fisheries enterprises, including of small–scale coastal fleet, and the improvement of safety and working			

			conditions			
			(e) the provision of support to strengthen technological development and innovation, including increasing energy efficiency, and knowledge transfer			

Thematic Objective 7 - PROMOTING SUSTAINABLE TRANSPORT AND REMOVING BOTTLENECKS IN KEY NETWORK INFRASTRUCTURES

CFS Thematic objective	Specific fund	Priority	Actions	BASE Case Study	BASE Case Study Measures	BASE Model Measures
Promoting sustainable transport and removing bottlenecks in key network infrastructures	**European Regional Development Fund (ERDF) Regulation (EU) No 1301/2013**	Art.5 comma 7: promoting sustainable transport and removing bottlenecks in key network infrastructures	(c) developing and improving environmentally-friendly (including low-noise) and low-carbon transport systems, including inland waterways and maritime transport, ports, multimodal links and airport infrastructure, in order to promote sustainable regional and local mobility;	South Devon Coast - Railway	• Strengthening and heightening the sea wall • Stabilizing the cliffs through wire netting and bolting • Measures to mitigate the erosion of beech material • Reroute the railway	**Flood risk management (vulnerability reduction)** - Measures including land-use planning, risk zoning, and relocation of vulnerable objects.
			(d)developing and ; rehabilitating comprehensive, high quality and interoperable railway systems, and promoting noise-reduction measures;			

			(e)improving energy efficiency and security of supply through the development of smart energy distribution, storage and transmission systems and through the integration of distributed generation from renewable sources;			

5 Conclusions

This deliverable aimed to investigate ways for improving adaptation policy coherence and effectiveness across sectoral policies. Towards the achievement of this purpose the report provided operational guidance to support policy-makers, public bodies and managing authorities in pursuing synergies between adaptation actions and other relevant sectoral policies.

In meeting the deliverable aim, we carried out:

1. an analysis, for a number of key climate risks, of the linkages between climate change and the relevant EU sectoral policies;

2. a selection of a wide list of direct measures and/or typologies of measures that may be adopted to promote adaptation in the EU legislation implementation process;

3. in-depth overview of the financial mechanisms under which related expenditures may be eligible to support mainstreaming adaptation into the European sectoral legislation and critical development programs (mainly the Common Agricultural Policy and the Cohesion Policy).

The key implications of our analysis are synthesized below.

First, our analysis confirms the theoretical expectation that governance levels interact and that these interactions, together with policy coherence, are essential (D7.2) to produce different pathways that may facilitate the integration of climate change adaptation into sectoral policy making. In most cases adaptation measures are implemented locally and local decision-makers take a large number of decisions that directly or indirectly affect adaptation actions and their consequent success. Nevertheless adaptation to climate change is not just a local issue, but concerns all levels from local to global and vice versa, making all interactions among governance levels complex and multidirectional. In this regard incentives for adaptation measures are largely affected by resources and regulations decided at the national or EU level: water management and agriculture are just two examples of policy fields, crucial for adaptation, in which the general policy framework is largely decided by the European Union through relevant strategies, specific legislation and guidance documents. In order to be successfully mainstreamed and implemented, adaptation policy needs to identify the interconnections among these multiple levels of governance with the aim to enhance policy coherence among them. It is important to point out that there is no one-size-fits-all approach for mainstreaming adaptation into EU policies, because of their different nature and scope. EU agricultural and cohesion policies for instance are primarily distributive in the way they allocate funds to regions and farmers, while flood risk and water management policies are mainly regulatory in the way they set rules and standards. In general terms a more comprehensive mainstreaming of adaptation in the EU policies would require both a more effective and explicit integration of climate change adaptation objectives into other policy areas, plans and programs at different levels of governance (vertical integration), and a more consistent process to develop projects aiming at addressing climate change adaptation and sector-specific purposes (cross-sectoral coherence).

Second, political commitments stated in official strategies and plans may not be sufficient to ensure that climate change adaptation is embedded into other policies, unless they are followed up by adequate measures and instruments for implementation. A more consistent sectoral policy with adaptation to climate change materializes as concrete actions are taken and developed. In this regard there is a growing awareness that successful adaptation to climate change will depend on how adaptation will be actually implemented into other sectoral policies in the relevant fields (water, risk management, spatial planning, infrastructure etc.). This ‘mainstreaming’ process also represents one of the most important tools for the implementation of the EU Adaptation Strategy, whose approach supports flexibility in the way that Member States and subsequent hierarchical levels decide to build up opportunities to pursue synergies while implementing sectoral policies and adaptation strategies simultaneously. The reason is that a large number of development programs and normatives, which affect or are affected by adaptation, are already in place and operating, and convergences, between EU, national and local planning process as well as access to financial resources already budgeted, may be achieved.

Third, our findings on the mainstreaming processes in BASE project's case studies provide evidence that they have somehow worked in few circumstances, as a sequence of linked actions along the multi-level governance system. Yet it would be unbalanced to ascribe the planned or implemented climate adaptation actions to a legislative impetus for compliance. The main drivers for getting climate adaptation on the agenda still remain extreme events or serious impacts experienced in more recent years. Indeed, sectoral legislative frameworks will not ensure the implementation of adaptation measures unless there is an increased awareness of the issue among public bodies and managing authorities, which tend to remain more geared towards current short-term risks rather than adaptation to longer term increased future risks.

Fourth, this process to 'self-determine' the way to mainstream adaptation at national and local level may be supported, given the different levels of preparedness of managing authorities in charge of dealing with adaptation planning. More operational guidelines are needed to drive the identification, assessment and selection of measures able to bring co-benefits for other sectors: water management, agriculture, coastal protection and floodings among others. This would help to promote climate adaptation under different legislation frameworks and development programs. In this regard we have devised a process of analysis to understand how climate change adaptation can be more effectively mainstreamed into sectoral policies.

Fifth, this applied framework of analysis has allowed us to confirm that 'mainstreaming' achieves a better integration of adaptation into decision cycles when suitable 'entry points', that enable to enforce legislation while doing adaptation at the same time, are identified in the policy process. A more consistent sectoral policy with adaptation to climate change is achieved when actions, taken partly in terms of management or regulation, but mainly in the form of changed practices from target groups, are implemented at the local level. This report has attempted to deliver advice on how this could be ensured in practice and support the development of portfolios of adaptation measures coherent with the opportunities primarily provided under existing EU sectoral legislation and EU development programs. The list of measures taken into consideration is intended to provide a menu of options from which institutions, managing authorities and private stakeholders may better orient their own decisions for better adaptation mainstreaming. This list, however, does not claim to be exhaustive. These options should be considered as guiding options which in turn will drive spending priorities based on national or regional circumstances and needs in terms of vulnerability management. Sharing experiences about best practices may likely support national, regional and local authorities in improving integration and coherence processes, as more awareness and capacity building in selecting cost-effective, technically feasible and socially acceptable measures is increasingly required.

Sixth, climate change adaptation related actions are also potentially eligible for funding under different expenditure categories in several financial mechanisms and instruments supporting the EU Cohesion Policy and CAP. Budget allocation choices towards synergic or mutually supportive measures represents the leverage to act within the existing and already working European and national funding provisions. This implies that Member States and regions may not just embed climate change adaptation considerations in their sectoral and development programming processes but also ensure that a sufficient share of the projects' budget is dedicated to adaptation measures, with the aim to mainstream climate change adaptation concerns into the entire process of expenditure planning, implementation, reporting and periodic evaluation. Our findings indicate that clear interconnections exist between the good practices assessed in the BASE project's case studies and the objectives or expenditure typologies potentially fundable under European Structural and Investment Funds provisions. Managing authorities and institutions may take advantage of this empirical evidence to support their own decision-making, particularly in terms of existing strategic planning and funding instruments in the 2014-2020 programming period, which may be used to determine opportunities to allocate financial resources and promote the implementation of investments and management measures in line with adaptation strategies and plans. The EU budget can have significant multiplier effects in important policy areas such as agriculture, flood protection and spatial planning, infrastructure and can help build institutional capacity across Member States that need to ensure a larger part of the budget is dedicated to proper prevention and adaptation measures. The extent to which climate change adaptation issues will be considered, integrated and become consistent with the existing policy fields is therefore a key issue to be tackled in the future and should be increasingly encouraged and monitored, if European societies are to become low-carbon societies, with enhanced capacity and ability to adapt to a changing climate.

Finally, in writing this deliverable we developed a theoretically informed analytical framework and practical insights on how to make sectoral policies more consistent with adaptation strategies, which will

contribute to guidance for policy makers in D7.3. The policy-relevance of these findings will be highlighted in the final BASE policy brief, and will be further explored and developed with the aid of key stakeholders in the up-coming BASE policy workshop in June 2016.

ANNEX I: Overview of economic assessment related to BASE case studies (BASE project D 5.2)

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Floods (Coastal, Fluvial, Pluvial)	**Structural protection measure**	**Coastal protection measure, in combination with the finishing and landscaping-project**	**Timmendorfer Strand (Coastal)**	**30.1 – 30.3 m EUR (Min – Max climate scenario)**	**122 – 250 m EUR (Min – Max climate scenario)**	**Results for discount rate (DR) 1.5 %: NPV: 92 – 220 m EUR BCR: 4.1 – 8.2 (Min – Max climate scenario)** **DR 1%: NPV: 119 – 274 m EUR BCR: 4.9 – 10** **DR 5%: NPV: 13 – 63 m EUR BCR: 1.4 – 3.1**	**Results compared to baseline option: existing coastal protection level, no-further investment**
		Fixed structural measures, mobile measures	**Prague (Fluvial)**	**DR 1%: 196 m EUR** **DR 5%: 163 m EUR**	**DR 1%: 2,068 m EUR** **DR 5%: 762 m EUR**	**DR 3%: NPV: 918 m Euro. BCR: 6.7** **DR 1%: NPV: 1 872 m Euro. BCR: 10.6** **DR 5%: NPV: 599 m Euro. BCR: 4.7**	**Results compared to baseline option: existing flood protection, level of 2002**
		Dikes, sluices	**Copenhagen (Coastal)**	**DR 3%: NPC: 536 m EUR**	**DR 3%: NPB: 2,668 m EUR**	**DR 3%: NPV: 2,132 m EUR BCR: 5.0** **DR 1%: NPV 4,963 m EUR** **DR 6%: NPV: -142 m EUR**	**Results compared to baseline option: existing coastal protection level, no-further investment**

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Floods (coastal, fluvial, pluvial)	Structural protection measure	Wall defences, movable weirs and island cut	Leeds (Fluvial)	DR 1%: 373 m EUR DR 3.5%: 463 m EUR DR 5%: 719 m EUR	DR 1%; 7,207 m EUR DR 3.5%: 18,560 m EUR DR 5%: 114,942 m EUR	DR 1%: NPV: 6,832 m EUR BCR: 19.36 DR 3.5%: NPV: 18,096 m EUR BCR: 40.15 DR 5%: NPV: 114,216 m EUR BCR: 159.63	Results compared to baseline option: existing non-structural flood risk management measures
		Dikes	Kalajoki	Investment costs: 4.7 m EUR Costs per m: 200 EUR/m Maintenance costs: 5,000 EUR/year	PVB: 7.4 m EUR	DR 3.5%: Payback time: 23.7 years	Results compared to baseline: current flood protection standards
		Offshore dike with high water level locks	Kalundborg (Coastal)	Construction costs: 80.4 m EUR	147 m EUR	.	No discounting has been conducted in the initial study, hence, no NPV and BCR figures are available
		Offshore dike with locks and pumps	Kalundborg (Coastal)	Construction costs: 81.7 m EUR	241 m EUR	.	No discounting
		Coastal and river dikes, pumps and sluices	Kalundborg (Coastal)	Construction costs: 36.9 m EUR	241 m EUR	.	No discounting
		Combination 1: Dune reinforcement, seawall, artificial nourishment. Strong focus on nourishment	South Aveiro Coast	DR 3% decl.: PVC: 143 – 157 m EUR	DR 3% decl.: PVB: 94 – 96 m EUR	DR 3% decl.: NPV: -49 – -61 m EUR BCR: 0.61 – 0.66 DR 1% decl.: NPV: -60 – -75 m EUR BCR: 0.63 – 0.67 DR 5% decl.: NPV: -41 – -52 m EUR BCR: 0.59 – 0.64	Results compared to baseline option: Beach nourishment is used when necessary and in a responsive way to extreme events.

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Floods (coastal, fluvial, pluvial)	Structural protection measure	Combination 2: Dune reinforcement, seawall, artificial nourishment. Mix between 1 & 3	South Aveiro Coast	DR 3% decl.: PVC: 77 – 84 m EUR	DR 3% decl.: PVB: 63 – 66 m EUR	DR 3% decl.: NPV: -14 – -20 m EUR BCR: 0.76 – 0.82 DR 1% decl.: NPV: -14.2 – -21.4 m EUR BCR: 0.8 – 0.85 DR 5% decl.: NPV: -13 - -19 m EUR BCR: 0.73-0.8	Results compared to baseline option: Beach nourishment is used when necessary and in a responsive way to extreme events.
		Combination 3: Dune reinforcement, seawall, artificial nourishment. Focus on dune reinforcement, seawall & additional breakwater	South Aveiro Coast	DR 3% decl.: PVC: 54 – 55 m EUR	DR 3% decl.: PVB: 80 – 81 m EUR	DR 3% decl.: NPV: 25 – 27 m EUR BCR: 1.46 – 1.48 DR 1% decl.: NPV: 42 – 44 m EUR BCR: 1.63 – 1.68 DR 5% decl.: NPV: 14 – 16 m EUR BCR: 1.29 – 1.33	Results compared to baseline option: Beach nourishment is used when necessary and in a responsive way to extreme events.
Floods (coastal, fluvial, pluvial)	Structural protection measure	Dike reinforcement	Rotterdam	Total costs (costs of the measure & residual damage): 3,042 – 3,574 m EUR (rest and steam scenario)	(Dike reinforcement is set here as the baseline, therefore PVB is 0)	(Dike reinforcement is set here as the baseline, therefore NPV is 0)	Year of implementation: 2030 DR 5.5% (Dike reinforcement is set here as the baseline, therefore NPV is 0)
		Full closure with dams and sluices	Rotterdam	Total costs (costs of the measure & residual damage): 3,811 – 4,282 m EUR (rest and steam scenario)	.	Year of implementation: 2030 DR: 5.5%: NPV: -769 – -708	Results compared to the baseline option: dike reinforcement, rest and steam scenario

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
		Strengthening sea defences	South Devon (Coast)	.	.	NPV: -430 – -359 m EUR (1% and 5% discount rate)	Results compared to the baseline option: Maintaining existing sea defences, conducting repairs to damage to the rail infrastructure, cliffs and sea wall from storm events
		Installation of sluice gates up stream to hold back flood water	South Devon (Fluvial)	.	.	DR 1%: NPV: 1.64 m EUR DR 5%: NPV: 0.97 m EUR	Results compared to the baseline option: No intervention to protect the 50 at risk properties
	Retention & room for the river measures	Room for the River Small 1 (new and existing channels, land excavation, but in combination with dike reinforcement)	Rotterdam	Total costs (costs of the measure & residual damage): 3,033 – 3,562 m EUR (rest and steam scenario)	.	Year of implementation: 2030 DR 5.5%: NPV: 9 – 8 m EUR BCR: 1.4 – 1.6	Results compared to the baseline option: only dike reinforcement, rest and steam scenario
		Retention on agricultural land (dam & compensation of farmers)	Holstebro	Dam construction costs: 3 m EUR Payment to farmers: 250 – 447 EU/ha/yr.)	Yearly avoided damages: 93,000 EUR/yr.	DR 1%: NPV: 1.36 – 2.95 m EUR (SSP2) 3.97 – 5.56 m EUR (SSP5) DR5%: NPV: -1.4 – -2.0 m EUR (SSP2) -0.9 – -1.5 m EUR (SSP5)	Results compared to the baseline option: Current protection levels are maintained

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
		Sustainable Urban Drainage	Leeds (Fluvial)	DR 1%: 874 bn EUR DR 3.5%: 2,754 bn EUR DR 5%: 17,690 bn EUR	DR 1%: 82 bn EUR DR 3.5%: 242 bn EUR DR 5%: 1,307 bn EUR	NPV: DR 1%: -793,247 bn EUR DR 3.5%: -2,513 bn EUR DR 5%: -16,412 bn EUR BCR: DR 1%: 0.09 DR 3.5%: 0.09 DR 5%: 0.07	Results compared to baseline option: existing non-structural flood risk management measures Note: Benefits are considered incomplete as some data was unavailable.
	Private protection measures	Installation of domestic flood gates at 50 at risk properties	South Devon (Fluvial)	.	.	NPV: DR 1%: 1.66 m EUR DR 5%: 0.96 m EUR	Results compared to the baseline option: No intervention to protect the 50 at risk properties
Floods (coastal, fluvial, pluvial)		Full impermeabilization (dry flood proofing) of private buildings	Venice	PVC: 352 m EUR	PVB: DR 1%: 108 – 109 m EUR DR 5%: 52 – 54 m EUR	NPV: DR 1%: -242 – -244 m EUR DR 5%: -298 – -299 m EUR	No intangible benefits (reduction of stress caused by floods, etc. are considered among the benefits) Results compared to the baseline option: No private protection measures at all
		Punctual insulation measures like barriers and pumps (wet flood proofing), etc. to protect private buildings	Venice	PVC: 40 m EUR	PVB: DR 1%: 62 – 63 m EUR DR 5%: 30 – 31 m EUR	NPV: DR 1%: 22 – 23 m EUR DR 5%: -9 – -10 m EUR	No intangible benefits (reduction of stress caused by floods, etc. are considered among the benefits) Results compared to the baseline option: No private protection measures at all

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
	Reduction of exposure and vulnerability	**Re-routing railway line**	**South Devon (Coast)**	**.**	**.**	**NPV:** **DR 1%:** **-133 m EUR** **DR 5%:** **-250 m EUR**	**Results compared to the baseline option: Maintaining existing sea defences, conducting repairs to damage to the rail infrastructure, cliffs and sea wall from storm events**

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Heat stress, health	**Structural**	**Extensive green roof**	**Jena**	**Additional installation costs compared to tar-gravel roof cover: 15 / 20 /25 EUR/m^2** **Maintenance costs: Extensive green roof: 1 EUR/m^2 p.a. (1st year), 0.5 EUR/m^2 p.a. (following years) Tar-and-gravel roof: 0.2 EUR/m^2 p.a.** **Rehabilitation costs (removal, sealing): Extensive green roof: 55 EUR/m^2 (end of 40th year) Tar-and-gravel roof: 45 EUR/m^2 (end of 20th year), 35 EUR/m^2 (end of 40th year)** **Stormwater fee (Jena): Tar-and-gravel roof: 0.72 EUR/m^2 Green roof: 0.29 EUR/m^2 p.a.**	**Habitat creation value 0.035 EUR/m^2 p.a. (40 years, 1.5%)** **Energy cost savings: 0.25 EUR/m^2 p.a.** **Stormwater management infrastructure savings: 7.50 / 9 / 10.50 EUR/m^2** **Carbon sequestration: 0.033 EUR/m^2 p.a.**	**NPV (40 years, 1.5%, cost differences and stormwater fee savings): 0.07 – 0.32 EUR/m^2 p.a. (most to least expensive green roof)** **NPV (40 years, 1.5%, cost differences and stormwater fee savings, private stormwater management savings, energy cost savings): 0.52 – 0.70 EUR/m^2 p.a. (most to least expensive green roof)** **Public benefits are rather low** **Habitat creation: 0.03 EUR/m^2 p.a. resp. one-time 1.39 EUR/m^2 Carbon sequestration: 0.03 EUR/m^2 p.a.** **NPV (3%, CD & SFS): most expensive green roof not efficient** **NPV (5%, CD & SFS): only least expensive green roof efficient**	**Results compared to the baseline option: a typical tar-gravel roof cover**

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Heat stress, health	Structural	Green roof	Madrid	Additional costs compared to traditional roof cover (20% Green roof, SSP2) DR 2%: PVC (low): 4,072 m EUR PVC (average): 11,296 m EUR PVC (high): 19,906 m EUR DR 5%: PVC (low): 3,016 m EUR PVC (average): 9,057 m EUR PVC (high): 15,807 m EUR	Total benefits (20% Green roof, SSP2/RCP4.5) DR 2%: PVC (low): 1,747 m EUR PVC (average): 4,436 m EUR PVC (high): 8,671 m EUR DR 5%: PVC (low): 654 m EUR PVC (average): 1,669 m EUR PVC (high): 3,277 m EUR	The benefit cost ratios present a large variability for the different green roof scenarios: from almost 0 to 3.5. The profitability of green roof very uncertain.	The model is subject to thresholds and size effects.
		Light-coloured pavements	Jena	Additional investment costs compared to ordinary pavement: 1 EUR/m^2			

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
	Reduction of exposure and vulnerability	**Heat health watch warning system (Non-structural, awareness and alert)**	**Madrid**	**Total average discounted costs (2020 – 2100):** **RCP4.5, SSP2** **DR 0% – 3%:** **No acclim:** **404 – 364 in m EUR** **Acclim:** **499 – 411 in m EUR** **RCP8.5, SSP5** **DR 0% – 3%:** **No acclim:** **497 – 405** **Acclim:** **821 – 434**	**Total average discounted benefits (2020 – 2100):** **RCP4.5, SSP2** **DR 0% – 3%:** **No acclim:** **3,602 – 1,140** **Acclim:** **3,561 – 1,134** **RCP8.5, SSP5** **DR 0% – 3%:** **No acclim:** **5,968 – 1,527** **Acclim:** **6,159 – 1,512**	**Average BCR (2020 – 2100):** **RCP4.5, SSP2** **DR 0% – 3%:** **No acclim: 8.90 – 3.13** **Acclim: 7.13 – 2.76** **RCP8.5, SSP5** **DR 0% – 3%:** **No acclim: 12 – 3.77** **Acclim: 7.50 – 2.74**	**Higher costs in RCP8.5 because of more days with max daily temp>Tcrit. Higher costs with no acclimatisation because of additional days of activation of the system though not necessary.. Higher benefits in RCP8.5 because of higher health risks. BCR for all scenarios bigger than 1. Substantial health benefits expected in relation to costs.**
		Public health campaign: Awareness raising	**Cornwall**	**0.68 m EUR per year**		**Annual BCR varies between 9.4 – 751.7 (2010) and 12.8 – 1080.9 (2050) depending on assumption on effectiveness**	**It is not really known how effective the public health campaigns are. The Higher value of BCR very much an upper bound. 4 in 5 cases of skin cancer are preventable, so this is taken as the maximum possible benefit. As a lower bound it is assumed that 1 in 100 cases are avoided.**

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Heat stress, health	Nature-based	Trees	Jena	Costs per tree (incl. planting) Small-crowned: 860 EUR Large-crowned: 860 EUR Tree care costs p.a. Small-crowned: Year 1 – 5: 50 EUR Year 6 – 40: 20 EUR Large-crowned: Year 1 – 5: 50 EUR Year 6 – 45: 30 EUR Year 46 – 80: 80 EUR		Large-crowned trees slightly less costly (procurement, planting, replanting, care) than small-crowned tree in the long-term perspective NPC (82 years, 1.5%): Large-crowned tree: 2,121 EUR (onetime) resp. 25.87 EUR p.a. Small-crowned tree: 2,254 EUR (onetime) resp. 27.49 EUR p.a.	
		Façade greening	Jena	50 – 140 EUR/m^2 13 EUR/m			
Ecosystem degradation	Non-structural	Sustainable forest management	Green roof	No figures for single measures available	No figures for single measures available	Only figures for bundles of measures available	
		Peat land and water course restoration	Green roof	No figures for single measures available	No figures for single measures available	Only figures for bundles of measures available	
Ecosystem degradation	Non-structural	Enhancement of ecosystem resilience, i.e. an enlargement of core protection zones	Green roof	No figures for single measures available	No figures for single measures available	Only figures for bundles of measures available	

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Water quality		**Buffer zones (different slopes)** **Small constructed wetlands (different % of fields)** **Medium constructed wetlands (different % of fields)** **Large constructed wetlands (different % of fields)** **Winter time vegetation cover (different slopes)** **Perennial grass (different slopes)** **Controlled drainage** **Optimal fertilization**	**Kalajoki river basin**			**All measures will become more cost effective in future due to expected higher input load. In 2021-2030 costs for reduce the phosphorus load will decrease by 6% and in 2051-2060 by 22%. Cost-effectiveness of so-called field measures (buffer zones, winter time vegetation and perennial grass) decreases and for wetlands, controlled drainage and optimal fertilization increase compared to now for Little and Moderate adaptation scenarios.**	

Primary risks	Type of measure	Specific Adaptation measures	Case study	Costs	Benefits	NPV, BCR	Comments
Water scarcity	1. **Technological** 2. **Organizational** 3. **Governance**	1. **Water recirculation, flow meters, laser levelling, change of varieties, additional water infrastructure.** 2. **Reduction of cultivated surface, increase monitoring of water use, setting irrigation turns** 3. **Improve transparency, increase coordination between institutions, increase scientific research**	**Doñana**	**200 m EUR**	**20% of projected avoided damage on the environment were not estimated**		

ANNEX II. Relevant legal references for climate change and adaptation

Agriculture

Council Regulation (EC) No 74/2009

References to climate change are reported in Box 3.

Box 3. Key points extracted from the Regulation

[…]

(1) *In the assessment of the implementation of the Common Agricultural Policy (CAP) reform of 2003,* ***climate change****, renewable energies, water management, biodiversity and dairy restructuring were identified as crucial new challenges for European agriculture*.

(3) *The Community, as party to the Kyoto Protocol, has been called upon to implement and/or further elaborate policies and measures in accordance with their national circumstances, such as the promotion of sustainable forms of agriculture in the light of climate change considerations. Furthermore, the Kyoto Protocol obliges parties to formulate, implement, publish and regularly update national and, where appropriate, regional programs containing measures to mitigate climate change and* ***measures to facilitate adequate adaptation to climate change****. Such programs would, inter alia, concern* ***agriculture and forestry*** […].

(4) *Following serious problems related to* ***water scarcity and droughts****, the Council, in its Conclusions on Water Scarcity and Drought' of 30 October 2007, considered that water management issues, including water quality, should be further addressed in the relevant CAP instruments. It is essential for European agriculture to have sustainable water management, in order to improve efficiency as regards the quantity of water used for agriculture and in order to better protect the quality of water. In the context of the* ***climatic changes expected****, drought-affected areas are likely to increase in extent and frequency*.

(5) *Furthermore, the Council has emphasized in its Conclusions on Halting the Loss of Biodiversity of 18 December 2006, that* ***protecting biodiversity*** *remains a major challenge, which is further increased by* ***climate change and water demand*** […].

(7) *Innovation can, in particular, contribute to the development of new technologies, products and processes and will therefore underpin the efforts* ***to tackle climate change****, renewable energies, water management and biodiversity. Specific support for innovation should be provided with reference to these challenges, in order to increase the effectiveness of the respective operation.*

Art. 1. *Regulation (EC) No 1698/2005 is hereby amended as follows: 3) The following Article shall be inserted: Article 16a Specific operations related to certain priorities 1. From 1 January 2010, Member States shall provide in their rural development programs, in accordance with their specific needs, for types of operations having the following priorities as described in the Community strategic guidelines and specified further in the national strategy plans: (a)* ***climate change****, (b) renewable energies, (c)* ***water management****....'.*

Regulation (EU) No 1303/2013 of the European Parliament and of the Council

References to climate change are reported in Box 4.

Box 4. Key points extracted from the Regulation

[…]

(14) *The objectives of the ESI Funds should be pursued in the framework of sustainable development and the Union's promotion of the aim of preserving, protecting and improving the quality of the environment as set out in Articles 11 and 191(1) TFEU, taking into account the polluter pays principle. To this end, the Member States should provide information on the support for* ***climate change objectives****, in line with the ambition to devote at least 20 % of the budget of the Union to those objectives* […].

(127) […] *Those implementing acts relate to setting out the methodology for providing information on the support for* ***climate***

change objectives […].

[…]

Art. 8. Sustainable development

*The objectives of the ESI Funds shall be pursued in line with the principle of sustainable development and with the Union's promotion of the aim of preserving, protecting and improving the quality of the environment, as set out in Article 11 and Article 191(1) TFEU, taking into account the polluter pays principle. The Member States and the Commission shall ensure that environmental protection requirements, resource efficiency, **climate change mitigation and adaptation**, biodiversity, **disaster resilience**, and risk prevention and management are promoted in the preparation and implementation of Partnership Agreements and programs.....Member States shall provide information on the **support for climate change objectives** using a methodology based on the categories of intervention, focus areas or measures, as appropriate, for each of the ESI Funds. That methodology shall consist of assigning a specific weighting to the support provided under the ESI Funds at a level which reflects the extent to which such **support makes a contribution to climate change mitigation and adaptation goals**. The specific weighting assigned shall be differentiated on the basis of whether the support makes a significant or a **moderate contribution towards climate change objective**.*

STRATEGIC APPROACH CHAPTER I. Thematic objectives for the ESI Funds and Common Strategic Framework

[…]

Art. 9. Thematic objectives

*In order to contribute to the Union strategy for smart, sustainable and inclusive growth as well as the Fund-specific missions pursuant to their Treaty-based objectives, including economic, social and territorial cohesion, each ESI Fund shall support the following thematic objectives: (1) strengthening research, technological development and innovation; (2) enhancing access to, and use and quality of, ICT; (3) enhancing the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of the fishery and aquaculture sector (for the EMFF); (4) supporting the shift towards a low-carbon economy in all sectors; (5) promoting climate change adaptation, risk prevention and management; (6) **preserving and protecting the environment and promoting resource efficiency**;*

[…].

Art. 15. Content of the Partnership Agreement 1

*The Partnership Agreement shall set out: (a) arrangements to ensure alignment with the Union strategy for smart, sustainable and inclusive growth as well as the Fund-specific missions pursuant to their Treaty-based objectives, including economic, social and territorial cohesion, including (iv) the indicative allocation of support by the Union by thematic objective at national level for each of the ESI Funds, as well as the total indicative amount of support **envisaged for climate change objectives** […].*

Art. 27. Content of programs

*6. Each program, except those where technical assistance is undertaken under a specific program, shall set out the indicative amount of support to be used for **climate change objectives**, based on the methodology referred to in Article 8.*

TITLE II. PROGRAMMING CHAPTER I General provisions on the Funds

[…]

Art. 96. Content, adoption and amendment of operational programs under the Investment for growth and jobs goal.

*7. Each operational program, except those where technical assistance is undertaken under a specific operational program, shall, subject to the Member State's duly justified assessment of their relevance to the content and objectives of the operational programs, include a description of: (a) the specific actions to take into account environmental protection requirements, resource efficiency, **climate change mitigation and adaptation, disaster resilience** and risk prevention and management, in the selection of operations.*

[…]

Art. 101. Information necessary for the approval of a major project

*Before a major project is approved, the managing authority shall ensure that the following information is available: […] (f) an analysis of the environmental impact, taking into account **climate change adaptation and mitigation needs**, and **disaster resilience.***

ANNEX I. COMMON STRATEGIC FRAMEWORK

[…]

4.5 Program for the Environment and Climate Action (LIFE) (1) and the environmental acquis

*1. Member States and the Commission shall, through a stronger thematic focus in programs and the application of the principle of sustainable development in accordance with Article 8, seek to exploit synergies with Union policy instruments (both funding and non-funding instruments) serving **climate change mitigation and adaptation**, environmental protection and resource*

efficiency.

[…]

5.2 Sustainable development

1. Managing authorities shall undertake actions throughout the program lifecycle, to avoid or reduce environmentally harmful effects of interventions and ensure results in net social, environmental and climate benefits. Actions to be undertaken may include the following: […] (b) avoiding investments that may have a significant negative environmental or ***climate impact****, and supporting actions* ***to mitigate any remaining impacts****.*

2. Member States shall take into consideration the ***climate change mitigation and adaptation potential of investments*** *made with the support of the ESI Funds, in accordance with Article 8, and ensure that they are resilient to the impact of climate change and natural disasters such as* ***increased risks of flooding, droughts, heat waves, forest fires and extreme weather events.***

[…]

5.6 Climate change mitigation and adaptation*: In accordance with Article 8,* ***climate change mitigation and adaptation****, and* ***risk prevention*** *shall be integrated in the preparation and implementation of Partnership Agreements and programs.*

ANNEX XI Ex ante conditionalities

PART I: Thematic ex ante conditionalities

Thematic objectives 5. ***Promoting climate change adaptation, risk prevention and management*** *(****Climate change target****) (referred to in point (5) of the first paragraph of Article 9) Investment priorities: ERDF + Cohesion Fund: — Promoting investment to address specific* ***risks****, ensuring* ***disaster resilience and developing disaster management systems***

Ex ante conditionality 5.1: ***Risk prevention and risk management****: the existence of national or regional risk assessments for disaster management, taking into account* ***climate change adaptation***

Criteria of fulfillment: A national or regional risk assessment with the following elements shall be in place: — a description of the process, methodology, methods, and non-sensitive data used for risk assessment as well as of the risk-based criteria for the prioritization of investment; — a description of single-risk and multi-risk scenarios; — ***taking into account, where appropriate, national climate change adaptation strategies****.*

Regulation (EU) No 1305/2013 of the European Parliament and of the Council

References to climate change are reported in Box 5.

Box 5. Key points extracted from the Regulation

[…]

(4) […] In doing so, account should be taken of the diversity of the situations that affect rural areas with different characteristics or different categories of potential beneficiaries and of the cross-cutting objectives of innovation, environment and ***climate change mitigation and adaptation*** *[…].*

(13) Farm advisory services help farmers, young farmers, forest holders, other land managers and SMEs in rural areas to improve the sustainable management and overall performance of their holding or business. […] Specific advice may also be provided on ***climate change mitigation and adaptation****, biodiversity, the protection of water, the development of short supply chains, organic farming and health aspects of animal husbandry.*

Art. 5. Union priorities for rural development

The achievement of the objectives of rural development, which contribute to the Europe 2020 strategy for smart, sustainable and inclusive growth, shall be pursued through the following six Union priorities for rural development, which reflect the relevant Thematic Objectives of the CSF: 1) fostering knowledge transfer and innovation in agriculture, forestry, and rural areas […];

2) enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests […];

3) promoting food chain organization, including processing and marketing of agricultural products, animal welfare and risk management in agricultural […];

4) restoring, preserving and enhancing ecosystems related to agriculture and forestry […];

5) promoting resource efficiency and supporting the shift towards a low carbon and ***climate resilient economy in agriculture, food and forestry sectors*** *[…];*

All those priorities shall contribute to the cross-cutting objectives of innovation, environment and ***climate change mitigation and adaptation*** *[…].*

TITLE II PROGRAMMING CHAPTER I Programming content

Art. 7. Thematic sub-programs

1. *With the aim of contributing to the achievement of the Union priorities for rural development, Member States may include within their rural development programs thematic sub-programs that address specific need. Such thematic sub-programs may, inter alia, relate to:* ***(f) climate change mitigation and adaptation and biodiversity****.*

An indicative list of measures and types of operations of particular relevance to each thematic sub-program is set out in Annex IV […].

3. The support rates laid down in Annex II may be increased by 10 additional percentage points for operations supported in the framework of thematic sub-programs concerning small farms and short supply chains, ***climate change mitigation and adaptation*** *and biodiversity.*

Art 8. Content of rural development programs

1. In addition to the elements referred to in Article 27 of Regulation (EU) No 1303/2013, each rural development program shall include: […] (b) a SWOT analysis of the situation and an identification of the needs that have to be addressed in the geographical area covered by the program; (c) a description of the strategy which demonstrates that […]; (c) […] an appropriate approach towards innovation with a view to achieving the Union priorities for rural development, including the EIP for agricultural productivity and sustainability, towards the environment, including the specific needs of Natura 2000 areas, and towards ***climate change mitigation and adaptation*** *is integrated into the program; […]*

[…]

Art. 15. Advisory services, farm management and farm relief services:

4) […] Advice may also cover other issues and in particular the information related to ***climate change mitigation and adaptation****, biodiversity and the protection of water as laid down […].*

[…]

Art. 21. Investments in forest area development and improvement of the viability of forests

1. Support under this measure shall concern: […] (c) prevention and restoration of damage to forests from forest fires, natural disasters and catastrophic events, including pest and disease outbreaks, and ***climate related threats****;*

[…]

Art. 25 Investments improving the resilience and environmental value of forest ecosystems *[…] 2. Investments shall be aimed at the achievement of commitments for environmental aims, for the provision of ecosystem services and/or for the enhancement of the public amenity value of forest and wooded land in the area concerned or* ***the improvement of the climate change mitigation potential of ecosystems****, without excluding economic benefits in the long term.*

[…]

Art. 28 Agri-environment-climate

1. Member States shall make support under this measure available throughout their territories, in accordance with their national, regional or local specific needs and priorities. This measure shall aim to preserve and promote the necessary changes to agricultural practices that make a ***positive contribution to the environment and climate*** *[…].*

[…]

Art. 34 Forest-environmental and climate services and forest conservation

1. Support under this measure shall be granted per hectare of forest to public and private forest-holders and other private law and public bodies and their associations who undertake, on a voluntary basis, to carry out operations consisting of one or more forest-environment and ***climate commitments****. In the case of state owned forests, support may only be granted if the body managing such a forest is a private body or a municipality.*

[…]

Art. 35 Co-operation:

2. Co-operation under paragraph 1 shall relate, in particular, to the following […] (f) joint action undertaken with a view to ***mitigating or adapting to climate change****.*

TITLE IV EIP FOR AGRICULTURAL PRODUCTIVITY AND SUSTAINABILITY

Art. 55. Aims

1. The EIP for agricultural productivity and sustainability shall: […] (c) improve processes to preserve the environment, ***adapt to climate change*** *and mitigate it.*

Regulation (EU) No 1306/2013 of the European Parliament and of the Council

References to climate change are reported in Box 6.

Box 6. Key points extracted from the Regulation

[…]

*(10) In order to help beneficiaries to become more aware of the relationship between agricultural practices and management of farms on the one hand, and standards relating to the environment, **climate change**, good agricultural condition of land, food safety, public health, animal health, plant health and animal welfare on the other, it is necessary for Member States to establish a comprehensive farm advisory system offering advice to beneficiaries.*

*(54) That cross-compliance system incorporates in the CAP basic standards concerning the environment, **climate change**, good agricultural and environmental condition of land, public health, animal health, plant health and animal welfare. The cross-compliance system forms an integral part of the CAP and should therefore be maintained.*

Art. 2. Terms used in this Regulation

*2. For the purposes of the financing, management and monitoring of the CAP, "force majeure" and "exceptional circumstances" may, in particular, be recognized in the following cases: .....(c) **a severe natural disaster gravely affecting the holding**; (e) **an epizootic or a plant disease affecting part or all of the beneficiary's livestock or crops respectively**; […].*

TITLE III FARM ADVISORY SYSTEM

Art. 12. Principle and scope

*3. The farm advisory system may also cover, in particular: (a) the promotion of conversions of farms and the diversification of their economic activity; (b) **risk management and the introduction of appropriate preventive actions to address natural disasters**, **catastrophic events and animal and plant diseases**; (c) the minimum requirements established by national law, as referred to in Article 28(3) and 29(2) of Regulation (EU) No 1305/2013; (d) **the information related to climate change mitigation and adaptation, biodiversity and protection of water, as set out in Annex I to this Regulation.***

[…]

Art. 93. Rules on cross-compliance

*1. The rules on cross-compliance shall consist of the statutory management requirements under Union law and the standards for good agricultural and environmental condition of land established at national level as listed in Annex II, relating to the following areas: (a) environment, **climate change** and good agricultural condition of land.*

ANNEX I. Information in the field of climate change mitigation and adaptation, biodiversity and the protection of water as laid down in point (d) of Article 12(3)

ANNEX II. Rules on cross-compliance pursuant to Art. 93

*- Environment, **climate change**, good agricultural condition of land […].*

Regulation (EU) No 1307/2013 of the European Parliament and of the Council

References to climate change are reported in Box 7.

Box 7. Key points extracted from the Regulation

[…]

*(37) One of the objectives of the new CAP is the enhancement of environmental performance through a **mandatory "greening " component of direct payments which will support agricultural practices beneficial for the climate and the environment** applicable throughout the Union […]. Those practices should take the form of simple, generalized, non-contractual and annual actions that go beyond cross-compliance and that are linked to agriculture, such as **crop diversification, the maintenance of permanent grassland, including traditional orchards where fruit trees are grown in low density on grassland, and the establishment of ecological focus areas** […].*

*(40) In order to accommodate the diversity of agricultural systems and the different environmental situations across the Union, it is justified to recognize, in addition to the three greening practices established in this Regulation, **practices covered by agri-environment-climate measures or certification schemes that are similar to greening and that yield an equivalent or higher level of benefit for the climate and the environment** […].*

(45) […] When adding other types of ecological focus area, the Commission should ensure that they aim to improve the general

environmental performance of the holding, in particular as regards biodiversity, the improvement of soil and water quality, the preservation of landscape and meeting the ***climate change mitigation and adaptation objectives****.*

CHAPTER 3. Payment for agricultural practices beneficial for the climate and the environment Art. 43. General rules

2. The ***agricultural practices beneficial for the climate*** *and the environment shall be the following: (a) crop diversification; (b) maintaining existing permanent grassland; and (c) having ecological focus area on the agricultural area.*

3. The equivalent practices shall be those which include similar practices that yield an equivalent or higher level of benefit for the climate and the environment compare to one or several of the practices referred to in paragraph 2. […] and shall be covered by any of the following: […] (b) national or regional environmental certification schemes, including those for the certification of compliance with national environmental legislation, going beyond the relevant mandatory standards established pursuant to Chapter I of Title VI of Regulation (EU) No 1306/2013, which aim to meet objectives relating to soil and water quality, biodiversity, landscape preservation, and ***climate change mitigation and adaptation****.*

Art. 46. Ecological focus area

5. […] The aim of the designation of areas and obligations shall be to underpin the implementation of Union policies on the ***environment, climate and biodiversity****.*

Regulation (EU) No 1308/2013 of the European Parliament and of the Council

References to climate change are reported in Box 8.

Box 8. Key points extracted from the Regulation

[…]

(38) The production and marketing of fruit and vegetables should fully ***take into account environmental concerns****, including cultivation practices, management of waste materials and disposal of products withdrawn from the market, in particular as regards* ***protection of water, quality, maintenance of biodiversity and the upkeep of the countryside****.*

Art. 3. Definitions

5 (b) ***adverse climatic event which can be assimilated to a natural disaster" means weather conditions such as frost, hail, ice, rain or drought which destroy more than 30 % of the average annual production*** *of a given farmer in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and lowest entry.*

[…]

Art. 33. Operational programs

1. Operational programs in the fruit and vegetables sector shall have a minimum duration of three years and a maximum duration of five years. They shall have at least two of the objectives referred to in point c of Art. 152(1) or two of the following objectives: […] (e) ***environmental measures, particularly those relating to water, and methods of production respecting the environment, including organic farming****; (f)* ***crisis prevention and management****.*

3. Crisis prevention and management referred to in point (f) of the first subparagraph of paragraph 1 shall be related to avoiding and dealing with crises on the fruit and vegetable markets and shall cover in this context: […] (b) training measures and exchanges of best practices; (c) promotion and communication, whether for prevention or during a crisis period; […] (h) harvest insurance. Support for harvest insurance shall contribute to safeguarding producers' incomes where there are losses as a consequence of ***natural disasters, adverse climatic events, diseases or pest infestations****. Insurance contracts shall require that beneficiaries undertake necessary risk prevention measures […].*

Art. 49. Harvest insurance

1. Support for harvest insurance shall contribute to safe guarding producers' incomes where there are ***losses as a consequence of natural disasters, adverse climatic events, diseases or pest infestations****. Insurance contracts shall require that beneficiaries undertake necessary risk prevention measures […].*

CHAPTER III. Producer organizations and associations and interbranch organizations

[…]

Art. 152. Producer organizations

1. Member States may, on request, recognize producer organizations, which: […] (c) pursue a specific aim which may include at least one of the following objectives: […] (iii) optimizing production costs and returns on ***investments in response to environmental and animal welfare standards****, and stabilizing producer prices; (iv) carrying out research and developing initiatives on* ***sustainable production methods****, innovative practices, economic competitiveness and market developments; (v) promoting, and providing technical assistance for, the use of* ***environmentally sound cultivation practices and production techniques****, and sound animal welfare practices and techniques; (viii) contributing to a* ***sustainable use of natural resources and to climate change mitigation****.*

[…]

Art. 157. Interbranch organizations

1. Member States may, on request, recognize interbranch organizations in a specific sector listed in Article 1(2) which […] (c) pursue a specific aim taking account of the interests of their members and of consumers, which may include, in particular, one of the following objectives […] vii) providing the information and carrying out the research necessary to innovate, rationalize, improve and adjust production and, where applicable, the processing and marketing, towards products more suited to market requirements and consumer tastes and expectations, in particular with regard to product quality, including the specific characteristics
of products with a protected designation of origin or a protected geographical indication, and protection of the environment; (viii) seeking ways of restricting the use of animal-health or plant protection products, better managing other inputs, ensuring product quality and soil and water conservation, promoting food safety, in particular through traceability of products, and improving animal health and welfare; (ix) developing methods and instruments for improving product quality at all stages of production and, where applicable, of processing and marketing; (x) taking all possible actions ***to uphold, protect and promote organic farming and designations of origin, quality labels and geographical indications****; (xi) promoting and carrying out research into* ***integrated, sustainable production or other environmentally sound production methods****; (xii) encouraging* ***healthy and responsible consumption*** *of the products on the internal market and/or informing about the harm linked to hazardous consumption patterns.*

Water

Council Directive concerning urban waste water treatment (91/271/EEC)

References to climate change or adaptation are reported in Box 9.

Box 9. Key points extracted from the Directive

Art. 10. *Member States shall ensure that the urban waste water treatment plants built to comply with the requirements of Art. 4, 5, 6 and 7 are designed, constructed, operated and maintained to ensure* ***sufficient performance under all normal local climatic conditions****. When designing the plants, seasonal variations of the load shall be taken into account.*

[…]

Art. 12.1. *Treated waste water shall be reused whenever appropriate. Disposal routes shall minimize the adverse effects on the environment.*

[…]

Annex I. Requirements for urban waste water

A. Collecting systems: Collecting systems shall take into account waste water treatment requirements. ***The design construction and maintenance of collecting systems shall be undertaken in accordance with the best technical knowledge not entailing excessive cost, notably regarding: volume and characteristics of urban waste water, prevention of leaks, limitation of pollution of receiving waters due to storm water overflows****.*

Council Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)

References to adaptation are reported in Box 10.

Box 10. Key points extracted from the Directive

Art. 2.2. *Member States shall, within a two-year period following the notification of this Directive, designate as vulnerable zones all known areas of land in their territories which drain into the waters identified according to paragraph 1 and which contribute to pollution […].*

Art. 4.1. *With* ***the aim of providing for all waters a general level of protection against pollution****, Member States shall, within a two-year period following the notification of this Directive: (a)* ***establish a code or codes of good agricultural practice****, to be implemented by farmers on a voluntary basis, which should contain provisions covering at least the items mentioned in Annex II A; (b) set up where necessary a program, including the provision of training and information for farmers, promoting the application of the code(s) of good agricultural practice.*

[…]

Art. 4.3. *Action programs shall take into account: (a) available scientific and technical data, mainly with reference to respective nitrogen contributions originating from agricultural and other sources; (b) environmental conditions in the relevant regions of the Member State concerned.*

[…]

Art. 5.1. *Within a two-year period following the initial designation referred to in Art. 3(2) or within one year of each additional designation referred to in Art. 3 (4), Member States shall, or the purpose of realizing the objectives specified in Art. 1 , establish action programs in respect of designated vulnerable zones.*

Annex II code(s) of good agricultural practice A.

A code or codes of good agricultural practice with the objective of reducing pollution by nitrates and taking account of conditions in the Different regions of the Community should certain provisions covering the following items, in so far as they are relevant:

1. periods when the land application of fertilizer is inappropriate;

2. the land application of fertilizer to steeply sloping ground ;

3. ***the land application of fertilizer to water- saturated, flooded, frozen or snow-covered ground****;*

4. the conditions for land application of fertilizer near water courses;

5. ***the capacity and construction of storage vessels for livestock manures , including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage****.*

6. ***procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that will maintain nutrient losses to water at an acceptable level****.*

Annex II code(s) of good agricultural practice B.

Member States may also include in their code(s) of good agricultural practices the following items: 7 . land use management, including the use of ***crop rotation systems*** *and the proportion of the land area devoted to permanent crops relative to annual tillage crops;* ***8. the maintenance of a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from soil that could otherwise cause nitrate pollution of water; 9. the establishment of fertilizer plans on a farm-by-farm basis and the keeping of records on fertilizer use; 10. the prevention of water pollution from run-off and the downward water movement beyond the reach of crop roots in irrigation systems.***

Annex III measures to be included in action program as referred to in Art. 5 (4) (a)

1. The measures shall include rules relating to: […] 3. limitation of the land application of fertilizers , consistent with good agricultural practice and taking into account the characteristics of the vulnerable zone concerned, in particular : (a) soil conditions, soil type and slope; (b) ***climatic conditions, rainfall and irrigation****.*

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy

Box 11 illustrates some relevant key points with respect to adaptation to climate change.

Box 11. Key points extracted from the Directive

Art. 1. Purpose

The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which: […] (b) ***promotes sustainable water use based on a long-term protection of available water resources;*** *[…] (e) contributes to mitigating the effects of floods and droughts and thereby contributes to: - the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use, - a significant reduction in pollution of groundwater, - the protection of territorial and marine waters […].*

Art. 2. Definitions

13. River basin means the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta. […]

15. River basin district means the area of land and sea, made up of one or more neighboring river basins together with their associated groundwaters and coastal waters, which is identified under Article 3(1) as the main unit for management of river basins.

[…]

Art. 3. Coordination of administrative arrangements within river basin districts

1. Member States shall ***identify the individual river basins*** *lying within their national territory, and, for the purposes of this Directive, shall* ***assign them to individual river basin districts*** *[…].*

Art. 4. Environmental objectives

[…] 6. Temporary deterioration in the status of bodies of water shall not be in breach of the requirements of this Directive if this is the result of circumstances of natural cause or force majeure ***which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged droughts, or the result of circumstances due to accidents which could not reasonably have been foreseen****, when all of the following conditions have been met: [...] (b)* ***the conditions under which circumstances that are exceptional or that could not reasonably have been foreseen may be declared, including the adoption of the appropriate indicators*** *[…].*

[…]

Art. 9. Recovery of costs for water services

1. […] Member States shall ensure by 2010: that ***water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive*** *[…].*

[…]

Art. 11. Program of measures

1. Each Member State shall ensure the establishment for ***each river basin district****, or for the part of an international river basin*

district within its territory, of a program of measures, taking account of the results of the analyses required under Article 5, in order to achieve the objectives established under Article 4 […].

3. Basic measures are the minimum requirements to be complied with and shall consist of: […] (c) ***measures to promote an efficient and sustainable water use in order to avoid compromising the achievement of the objectives*** *specified in Article 4; (l)* ***any measures required to prevent significant losses of pollutants from technical installations, and to prevent and/or to reduce the impact of accidental pollution incidents for example as a result of floods including through systems to detect or give warning of such events including, in the case of accidents which could not reasonably have been foreseen, all appropriate measures to reduce the risk to aquatic ecosystems****.*

[…]

Art. 13. River basin management plans

1. Member States shall ensure that a river basin management plan is produced for each river basin district lying entirely within their territory.

[…]

Annex VI lists of measures to be included within the programs of measures

Part B

The following is a non-exclusive list of supplementary measures which Member States within each river basin district may choose to adopt as part of the program of measures required under Article 11(4): (i) legislative instruments (ii) administrative instruments (iii) ***economic or fiscal instruments*** *(iv) negotiated environmental agreements (v) emission controls (vi) codes of good practice (vii) recreation and restoration of wetlands areas (viii) abstraction controls (ix)* ***demand management measures, inter alia, promotion of adapted agricultural production such as low water requiring crops in areas affected by drought (x) efficiency and reuse measures, inter alia, promotion of water-efficient technologies in industry and water-saving irrigation techniques (xi) construction projects (xii) desalination plants (xiii) rehabilitation projects (xiv) Artificial recharge of aquifers (xv) educational projects (xvi) research, development and demonstration projects (xvii) other relevant measures****.*

Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks

The Directive includes specific references to climate change (Box 12).

Box 12. Key points extracted from the Directive

(2) **Floods** are natural phenomena which cannot be prevented. However, **some human activities (such as increasing human settlements and economic assets in floodplains and the reduction of the natural water retention by land use) and climate change contribute to an increase in the likelihood and adverse impacts of flood events**.

[…]

(4) Directive 2000/60/EC […] establishing a framework for Community action in the field of water policy requires river basin management plans to be developed for each river basin district in order to achieve good ecological and chemical status, and it will contribute to mitigating the effects of floods.

[…]

(14) Flood risk management plans should focus on prevention, protection and preparedness. […] they should consider where possible the maintenance and/or restoration of floodplains, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity. **The elements of flood risk management plans should be periodically reviewed and if necessary updated, taking into account the likely impacts of climate change on the occurrence of floods**.

[…]

Art. 7. Flood risk management plans

3. Flood risk management plans shall take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of Art. 4 of Directive 2000/60/EC, soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure […].

Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems […]. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.

Art. 14. Reviews, reports and final provisions

4. **The likely impact of climate change on the occurrence of floods shall be taken into account in the reviews** referred to in paragraphs 1 and 3.

Coastal protection

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

No specific reference to climate change are included in the Directive (Box 13).

Box 13. Key points extracted from the Directive

Art. 2.1.

The aim of this Directive shall be to contribute towards ensuring bio-diversity through the ***conservation of natural habitats and of wild fauna and flora*** *in the European territory of the Member States to which the Treaty applies.*

Art. 2.2.

Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna of Community interest.

Conservation of natural habitats and habitats of species

Art. 3.1.

A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall enable the natural habitat types and the species 'habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range.

ANNEX I. Natural habitat types of community interest whose conservation requires the designation of special areas of conservation

Coastal and halophytic habitats

Open sea and tidal areas; Sea cliffs and shingle or stony beaches; Atlantic and continental salt marshes and salt meadows; Mediterranean and thermo- Atlantic salt marshes and salt meadows; Salt and gypsum continental steppes

Coastal sand dunes and continental dunes

[…] Sea dunes of the Mediterranean coast; Continental dune, old and decalcified

Freshwater habitats

Standing water; running water (sections of water courses with natural, or semi-natural dynamics (minor, average and major beds) where the water quality shows o significant deterioration)

ANNEX II. Animal and plant species of community interest whose conservation requires the designation of special areas of conservation

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy

Box 14 lists the relevant key points of the Directive with respect to adaptation to climate change.

Box 14. Key points extracted from the Directive

(17) An effective and coherent water policy must take account of the ***vulnerability of aquatic located near the coast and estuaries or in gulfs or relatively closed seas, as their equilibrium is strongly influenced by the quality of inland waters flowing into them****. Protection of water status within river basins will provide economic benefits by contributing towards the protection of fish populations,* ***including coastal fish populations****.*

(34) For the purposes of environmental protection there is a need for a greater integration of qualitative and quantitative aspects of both surface waters and groundwaters, ***taking into account the natural flow conditions of water within the hydrological***

***cycle**.*

Art. 1. Purpose

*(b) **promotes sustainable water use based on a long-term protection of available water resources** (e) contributes to mitigating the effects of floods and droughts and thereby contributes to: the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use, a significant reduction in pollution of groundwater, the protection of territorial and marine waters, [...].*

Art. 2. Definitions

13. River basin means the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth estuary or delta.

15. River basin district means the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters, which is identified under Art. 3(1) as the main unit for management of river basins.

[…]

Art. 3. Coordination of administrative arrangements within river basin districts

*1. Member States shall **identify the individual river basins** lying within their national territory and for the purposes of this Directive, shall **assign them to individual river basin districts**.*

[…]

Art. 4. Environmental objectives

1.[…] (b) for groundwater

*ii. Member States shall protect, enhance and restore all bodies of groundwater, **ensure a balance between abstraction and recharge of groundwater** […].*

Art. 5. Characteristics of the river basin district, review of the environmental impact of human activity and economic analysis of water use

*1. Each Member State shall ensure that for each river basin district or for the portion of an international river basin district falling within its territory: - an analysis of its characteristics, - **a review of the impact of human activity on the status of surface waters and on groundwater**, and - an economic analysis of water use.*

Art. 6. Register of protected areas

1. Member States shall ensure the establishment of a register or registers of all areas lying within each river basin district which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water […].

[…]

Art. 9. Recovery of costs for water services

*1. […] Member States shall ensure by 2010: that **water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive** […].*

Art. 11. Program of measures

*1. Each Member State shall ensure the establishment for **each river basin district**, or for the part of an international river basin district within its territory, of a program of measures, taking account of the results of the analyses required under Art. 5, in order to achieve the objectives established under Art. 4 […].*

3. "Basic measures" are the minimum requirements to be complied with and shall consist of:

*[...] (c) **measures to promote an efficient and sustainable water use in order to avoid compromising the achievement of the objectives** specified in Art. 4;*

(e) controls over the abstraction of fresh surface water and groundwater, and impoundment of fresh surface water, including a register or registers of water abstractions and a requirement of prior authorization for abstraction and impoundment […];

*(l) **any measures required to prevent significant losses of pollutants from technical installations, and to prevent and/or to reduce the impact of accidental pollution incidents for example as a result of floods including through systems to detect or give warning of such events including, in the case of accidents which could not reasonably have been foreseen, all appropriate measures to reduce the risk to aquatic ecosystems**.*

5. Where monitoring or other data indicate that the objectives set under Art. 4 for the body of water are unlikely to be achieved, the Member State shall ensure that: the causes of the possible failure are investigated […].

[…]

Art. 13. River basin management plans

1. Member States shall ensure that a river basin management plan is produced for each river basin district lying entirely within their territory.

ANNEX II.

2. Groundwaters

2.4 Review of the impact of changes in groundwater levels

Member States shall also identify those bodies of groundwater for which lower objectives are to be specified under Art. 4 including as a result of consideration of the effects of the status of the body on: (i) surface water and associated terrestrial ecosystems; (ii) ***water regulation, flood protection and land drainage****; (iii) human development.*

[…]

ANNEX VI. Lists of measures to be included within the programs of measures

PART A: Measures required under the following Directives:

(i) The Bathing Water Directive (76/160/EEC);

(ii) The Birds Directive (79/409/EEC) (1);

(iii) The Drinking Water Directive (80/778/EEC) as amended by Directive (98/83/EC);

(iv) The Major Accidents (Seveso) Directive (96/82/EC) (2);

(v) The Environmental Impact Assessment Directive (85/337/EEC) (3);

(vi) The sewage Sludge Directive (86/278/EEC) (4);

(vii) The Urban Waste-water Treatment Directive (91/271/EEC);

(viii) The Plant Protection Products Directive (91/414/EEC);

(ix) The Nitrates Directive (91/676/EEC);

(x) The Habitats Directive (92/43/EEC) (5);

(xi) The Integrated Pollution Prevention Control Directive (96/61/EC).

PART B: The following is a non-exclusive list of supplementary measures which Member States within each river basin district may choose to adopt as part of the program of measures required under Art. 11(4): (i) legislative instruments (ii) administrative instruments (iii) ***economic or fiscal instruments*** *(iv) negotiated environmental agreements (v) emission controls (vi) codes of good practice (vii) recreation and restoration of wetlands areas (viii) abstraction controls (ix)* ***demand management measures, inter alia, promotion of adapted agricultural production such as low water requiring crops in areas affected by drought (x) efficiency and reuse measures, inter alia, promotion of water-efficient technologies in industry and water-saving irrigation techniques (xi) projects (xii) desalination plants (xiii) rehabilitation projects (xiv) Artificial recharge of aquifers (xv) educational projects (xvi) research, development and demonstration projects (xvii) other relevant measures****.*

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

Specific reference to climate change are included in the Directive (Box 15).

Box 15. Key points extracted from the Directive

(2) Floods are natural phenomena which cannot be prevented. However, some human activities ***(such as increasing human settlements and economic assets in floodplains and the reduction of the natural water retention by land use) and climate change contribute to an increase in the likelihood and adverse impacts of flood events****.*

[…]

(4) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy ***requires river basin management plans*** *to be developed for each river basin district in order to achieve good ecological and chemical status, and* ***it will contribute to mitigating the effects of floods*** *[…].*

[…]

(10) Throughout the Community different types of floods occur, such as river floods, flash floods, urban floods and ***floods from the sea in coastal areas****. The damage caused by flood events may also vary across the countries and regions of the Community. Hence, objectives regarding the management of flood risks should be determined by the Member States themselves and should be based on local and regional circumstances.*

[…]

(14) Flood risk management plans should focus on prevention, protection and preparedness. With a view to giving rivers more space, they should consider where possible the maintenance and/or restoration of floodplains, as well as measures to prevent

and reduce damage to human health, the environment, cultural heritage and economic activity. ***The elements of flood risk management plans should be periodically reviewed and if necessary updated, taking into account the likely impacts of climate change on the occurrence of floods****.*

CHAPTER I. General provisions

Art. 2.

1. 'flood' means the temporary covering by water of land not normally covered by water. This shall include floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and ***floods from the sea in coastal areas****, and may exclude floods from sewerage systems.*

[…]

Art. 3. *[…] However, for the implementation of this Directive, Member States may: [...] b) identify certain coastal areas or individual river basins and assign them to a unit of management different from those assigned pursuant to Article 3 (1) of Directive 2000/60/EC.*

[…]

CHAPTER II. Preliminary flood risk assessment

Art. 4.

2. Based on available or readily derivable information, such as records and studies on long term developments, in particular ***impacts of climate change on the occurrence of floods, a preliminary flood risk assessment shall be undertaken to provide an assessment of potential risks****. The assessment shall include at least the following: (a) maps of the river basin district at the appropriate scale including the borders of the river basins, sub-basins and, where existing, coastal areas, showing topography and land use, […].*

[…]

CHAPTER IV. Flood risk management plans

Art. 7.3. *Flood risk management plans shall include measures for achieving the objectives established in accordance with paragraph 2 and shall include the components set out in Part A of the Annex.* ***Flood risk management plans shall take into account relevant aspects such as costs and benefits, flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of Article 4 of Directive 2000/60/EC, soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure****.*

Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems *and taking into account the characteristics of the particular river basin or sub-basin. Flood risk management plans may also* ***include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event****.*

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

No specific reference to climate change are included in the Directive (Box 16).

Box 16. Key points extracted from the Directive

Art. 1.

1. This Directive relates to the ***conservation of all species*** *of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies. It covers the protection, management and control of these species and lays down rules for their exploitation.*

2. It shall apply to birds, their eggs, nests and habitats.

Art. 2.

Member States shall take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level.

Art. 3.

1. In the light of the requirements referred to in Article 2, Member States shall take the requisite measures ***to preserve, maintain***

or re-establish a sufficient diversity and area of habitats for all the species of birds *referred to in Article 1.*

2. The preservation, maintenance and re-establishment of biotopes and habitats shall include primarily the following measures: (a) creation of protected areas; b) upkeep and management in accordance with the ecological needs of habitats inside and outside the protected zones; (c) re-establishment of destroyed biotopes; (d) creation of biotopes.

Art. 4.

2. Member States shall take similar measures for regularly occurring migratory species not listed in Annex I, bearing in mind ***their need for protection in the geographical sea and land area*** *where this Directive applies, as regards their breeding, moulting and wintering areas and staging posts along their migration routes. To this end, Member States shall pay particular attention to the protection of wetlands and particularly to wetlands of international importance.*

[…]

4. In respect of the protection areas referred to in paragraphs 1 and 2, Member States shall take appropriate steps to avoid ***pollution or deterioration of habitats*** *or any disturbances affecting the birds, in so far as these would be significant having regard to the objectives of this Article. Outside these protection areas, Member States shall also strive to avoid pollution or deterioration of habitats.*

[…]

Art. 10.

1. Member States shall encourage research and any work required as a basis for the protection, management and use of the population of all species of bird referred to in Article 1. Particular attention shall be paid to research and work on the subjects listed in Annex V.

ANNEX V.

(a) National lists of species in danger of extinction or particularly endangered species, taking into account their geographical distribution.

(b) Listing and ecological description of areas particularly important to migratory species on their migratory routes and as wintering and nesting grounds.

(c) Listing of data on the population levels of migratory species as shown by ringing.

(d) Assessing the influence of methods of taking wild birds on population levels.

(e) Developing or refining ecological methods for preventing the type of damage caused by birds. (f) Determining the role of certain species as indicators of pollution.

(g) Studying the adverse effect of chemical pollution on population levels of bird species.

Council Regulation (EC) No 74/2009 of 19 January 2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

Specific references to climate change are included in the Regulation (Box 17).

Box 17. Key points of interest extracted from the Regulation

(1) In the assessment of the implementation of the Common Agricultural Policy (CAP) reform of 2003, climate change, renewable energies, water management, biodiversity and dairy restructuring were identified as crucial new challenges for European agriculture.

[…]

(3) **The Community, as party to the Kyoto Protocol has been called upon to implement and/or further elaborate policies and measures in accordance with their national circumstances, such as the promotion of sustainable forms of agriculture in the light of climate change considerations** […].

(4) Following serious problems related to water scarcity and droughts, the Council, in its Conclusions on 'Water Scarcity and Drought' of 30 October 2007, considered that water management issues, including water quality, should be further addressed in the relevant CAP instruments. **It is essential for European agriculture to have sustainable water management, in order to improve efficiency as regards the quantity of water used for agriculture and in order to better protect the quality of water. In the context of the climatic changes expected, drought-affected areas are likely to increase in extent and**

frequency.

(5) Furthermore, the Council has emphasized in its Conclusions on Halting the Loss of Biodiversity of 18 December 2006, that protecting biodiversity remains a major challenge, **which is further increased by climate change and water demand**, and that, while important progress has been made, the attainment of the Community's biodiversity target for 2010 will require additional efforts. European agriculture has a key role to play in protecting biodiversity.

[…]

(7) **Innovation can, in particular, contribute to the development of new technologies, products and processes and will therefore underpin the efforts to tackle climate change**, renewable energies, water management and biodiversity […].

Art. 1.

(3) The following Article shall be inserted:

'Article 16a. Specific operations related to certain priorities

1. From 1 January 2010 Member States shall provide in their rural development programs, in accordance with their specific needs, for types of operations having the following priorities as described in the Community strategic guidelines and specified further in the national strategy plans: (a) **climate change**, (b) renewable energies, (c) water management, (d) biodiversity, […].

ANNEXII Indicative list with types of operations and potential effects related to priorities referred to in Article 16a.

Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006

Specific references to climate change are included in the Regulation (Box 18).

Box 18. Key points of interest extracted from the Regulation

[…]

(14) The objectives of the ESI Funds should be pursued in the framework of sustainable development and the Union's promotion of the aim of preserving, protecting and improving the quality of the environment as set out in Articles 11 and 191(1) TFEU, taking into account the polluter pays principle. To this end, the Member States should ***provide information on the support for climate change objectives****, in line with the ambition to devote at least 20 % of the budget of the Union to those objectives, using a methodology based on the categories of intervention […].*

(127) [...] Those implementing acts relate to setting out the methodology for ***providing information on the support for climate change objectives*** *[…].*

[…]

Art. 8. Sustainable development

The objectives of the ESI Funds shall be pursued in line with the principle of sustainable development and with the Union's promotion of the aim of preserving, protecting and improving the quality of the environment, as set out in Article 11 and Article 191(1) TFEU, taking into account the polluter pays principle. The Member States and the Commission shall ensure that environmental protection requirements, resource efficiency, ***climate change mitigation and adaptation****, biodiversity, disaster resilience, and risk prevention and management are promoted in the preparation and implementation of Partnership Agreements and programs. Member States shall* ***provide information on the support for climate change objectives*** *using a methodology based on the categories of intervention, focus areas or measures, as appropriate, for each of the ESI Funds. That methodology shall consist of assigning a specific weighting to the support provided under the ESI Funds at a level which reflects the extent to which such support makes a* ***contribution to climate change mitigation and adaptation goals****. The specific weighting assigned shall be differentiated on the basis of whether the support makes a significant or a moderate contribution* ***towards climate change objectives****. Where the support does not contribute towards those objectives […].*

TITLE II. Strategic approach

CHAPTER I. Thematic objectives for the ESI Funds and Common Strategic Framework

Art. 9. Thematic objectives

[…] each ESI Fund shall support the following thematic objectives: […] 5) ***promoting climate change adaptation, risk prevention and management****; […].*

[…]

Art. 11. Content

The CSF shall establish: […] (e) arrangements to address the key territorial challenges for urban, rural, coastal and fisheries areas, the demographic challenges of regions or specific needs of geographical areas which suffer from severe and permanent natural or demographic handicaps as referred to in Article 174 TFEU, and the specific challenges of outermost regions within the meaning of Article 349 TFEU.

[…]

Art. 15. Content of the Partnership Agreement

1. The Partnership Agreement shall set out: (a) arrangements to ensure alignment with the Union strategy for smart, sustainable and inclusive growth as well as the Fund-specific missions pursuant to their Treaty-based objectives, including economic, social and territorial cohesion, including: [...] (iv) the indicative allocation of support by the Union by thematic objective at national level for each of the ESI Funds, as well as the total indicative amount of support envisaged for ***climate change objectives****.*

[…]

Art. 27. Content of programs

6. Each program, except those where technical assistance is undertaken under a specific program, shall set out the indicative amount of support to be ***used for climate change objectives****, based on the methodology referred to in Art. 8.*

[…]

Art. 55. Ex ante evaluation

4. Ex ante evaluations shall incorporate, where appropriate, the requirements for strategic environmental assessment set out in Directive 2001/42/EC of the European Parliament and of the Council (1) ***taking into account climate change mitigation needs****.*

TITLE II. PROGRAMMING

CHAPTER I. General provisions on the Funds

Art. 96. Content, adoption and amendment of operational programs under the Investment for growth and jobs goal

7. Each operational program, except those where technical assistance is undertaken under a specific operational program, shall, subject to the Member State's duly justified assessment of their relevance to the content and objectives of the operational programs, include a description of: (a) the specific actions to take into account environmental protection requirements, resource efficiency, ***climate change mitigation and adaptation****, disaster resilience and risk prevention and management, in the selection of operations; […].*

[…]

Art. 101. Information necessary for the approval of a major project

Before a major project is approved, the managing authority shall ensure that the following information is available: (f) an ***analysis of the environmental impact, taking into account climate change adaptation and mitigation needs****, and disaster resilience; […].*

ANNEX I. COMMON STRATEGIC FRAMEWORK

3. Integrated approach to and arrangements for the use of the ESI funds

3.3 Encouraging integrated approaches

4. Member States shall promote, in accordance with their institutional and legal framework and with Article 32 the development of local and sub-regional approaches. Community-led local development shall be implemented in the context of a strategic approach to ensure that the 'bottom-up' definition of local needs takes account of priorities set at a higher level. Member States shall therefore define the approach to community-led local development in the EAFRD and, where appropriate, in the ERDF, the ESF or the EMFF in accordance with Article 15(2) and shall indicate in the Partnership Agreement the main challenges to be tackled in this way, the main objectives and priorities for community-led local development, the types of territories to be covered, the specific role to be attributed to local action groups in the delivery of strategies and the role envisaged for the EAFRD and where appropriate for the ERDF, the ESF or the EMFF in implementing community-led local development strategies in different types of territories such as rural, urban and coastal areas and the corresponding co-ordination mechanisms.

[…]

4. Coordination and synergies between ESI funds and other union policies and instruments

4.2 Coordination with the Common Agricultural Policy and the Common Fisheries Policy

The EMFF aims to achieve the objectives of the reformed Common Fisheries Policy and of the Integrated Maritime Policy.

Member States shall therefore make use of the EMFF to support efforts to improve data collection and strengthen control, and ensure that synergies are also sought in support of the priorities of Integrated Maritime Policy, such as marine knowledge, maritime spatial planning, integrated coastal zone management, integrated maritime surveillance, the protection of the marine environment and of biodiversity, and the adaptation to the adverse ***effects of climate change on coastal areas****.*

4.5 Program for the Environment and Climate Action (LIFE) (1) and the environmental acquis 1. Member States and the Commission shall, through a stronger thematic focus in programs and the application of the principle of sustainable development in accordance with Article 8, seek to exploit synergies with Union policy instruments (both funding and non-funding instruments) ***serving climate change mitigation and adaptation, environmental protection and resource efficiency****.*

[…]

5. Horizontal principles referred to in Articles 5, 7 and 8 and cross-cutting policy objectives

5.2 Sustainable development

Member States shall take into consideration the climate change mitigation and adaptation potential of investments made with the support of the ESI Funds, in accordance with Article 8, and ensure that they are resilient to the ***impact of climate change and natural disasters such as increased risks of flooding, droughts, heat waves, forest fires and extreme weather events****.*

[…]

5.6 ***Climate change mitigation and adaptation****: In accordance with Article 8, climate change mitigation and adaptation, and risk prevention shall be integrated in the preparation and implementation of Partnership Agreements and programs.*

6. Arrangements for addressing key territorial challenges

6.5 In order to take into account the objective of territorial cohesion, the Member States and regions shall, in particular, ensure that the overall approach to promoting smart, sustainable and inclusive growth in the areas concerned: (a) reflects the role of cities, urban and rural areas, fisheries and coastal areas, and areas facing specific geographical or demographic handicaps; […].

Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005

Specific references to climate change are included in the Regulation (Box 19).

Box 19. Key points of interest extracted from the Regulation

[…]

(4) […] In doing so, account should be taken of the diversity of the situations that affect rural areas with different characteristics or different categories of potential beneficiaries and of the cross-cutting objectives of innovation, environment and **climate change mitigation and adaptation**. Mitigation action should relate both to limiting emissions in agriculture and forestry from key activities such as livestock production, fertilizer use and to preserving carbon sinks and enhancing carbon sequestration with regard to land use, land use change and the forestry sector […].

(13) Farm advisory services help farmers, young farmers, forest holders, other land managers and SMEs in rural areas to improve the **sustainable management** and overall performance of their holding or business. […] Specific advice may also be provided on **climate change mitigation and adaptation**, biodiversity, the protection of water, the development of short supply chains, organic farming and health aspects of animal husbandry […].

(22) Agri-environment-climate payments should continue to play a prominent role **in supporting the sustainable development of rural areas and in responding to society's increasing demands for environmental services**. They should further encourage farmers and other land managers to serve society as a whole by introducing or continuing to apply agricultural practices that contribute to **climate change mitigation and adaptation** [...].

Art. 5. Union priorities for rural development

[…] (1) fostering knowledge transfer and innovation in agriculture, forestry, and rural areas with a focus on the following areas: (3) **promoting food chain organization, including processing and marketing of agricultural products, animal welfare and risk management in agriculture** […]; (4) **restoring, preserving and enhancing ecosystems related to agriculture and forestry** […]; (5) **promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors** […]; (6) **promoting social inclusion, poverty reduction and economic development in rural areas** […]. All those priorities shall contribute to the cross-cutting objectives of innovation, environment and climate change mitigation and adaptation […].

TITLE II. Programming

CHAPTER I. Programming content

Art. 7. Thematic sub-programs

1. With the aim of contributing to the achievement of the Union priorities for rural development, Member States may include within their rural development programs thematic sub-programs that address specific needs. Such thematic sub-programs may, inter alia, relate to: (f) **climate change mitigation and adaptation and biodiversity**.

[…]

3. The support rates laid down in Annex II may be increased by 10 additional percentage points for operations supported in the framework of thematic sub-programs concerning small farms and short supply chains, **climate change mitigation and adaptation and biodiversity** […].

[…]

Art. 8. Content of rural development programs

1. In addition to the elements referred to in Article 27 of Regulation (EU) No 1303/2013, each rural development program shall include: [...] b) a SWOT analysis of the situation and an identification of the needs that have to be addressed in the geographical area covered by the program […]; (c) a description of the strategy which demonstrates that: [...] (v) an appropriate approach towards innovation with a view to achieving the Union priorities for rural development, including the EIP for agricultural productivity and sustainability, towards the environment, including the specific needs of Natura 2000 areas, and towards **climate change mitigation and adaptation** is integrated into the program.

[…]

Art. 15. Advisory services, farm management and farm relief services

1. […] Advice may also cover other issues and in particular the information related to climate **change mitigation and adaptation, biodiversity and the protection of water** as laid down in Annex I to Regulation (EU) N. 1307/2013 […].

[…]

Art. 21. Investments in forest area development and improvement of the viability of forests

1. Support under this measure shall concern: [...] (c) **prevention and restoration of damage to forests from forest fires, natural disasters and catastrophic events, including pest and disease outbreaks, and climate related threats** […].

[…]

Art. 24. Prevention and restoration of damage to forests from forest fires and natural disasters and catastrophic events

1. Support under point (c) Article 21(1) shall be granted to private and public forest- holders and other private law and public bodies and their associations and shall cover the costs for: […] d) **restoring forest potential damaged from fires and other natural disasters including pests, diseases as well as catastrophic events and climate change related events**.

2. Investments shall be aimed at the achievement of commitments for environmental aims, for the provision of ecosystem services and/or for the enhancement of the public amenity value of forest and wooded land in the area concerned or the **improvement of the climate change mitigation potential of ecosystems**, without excluding economic benefits in the long term.

[…]

Art. 28. Agri-environment-climate

1. Member States shall make support under this measure available throughout their territories, in accordance with their national, regional or local specific needs and priorities. This measure shall aim **to preserve and promote the necessary changes to agricultural practices that make a positive contribution to the environment and climate**. Its inclusion in rural development programs shall be compulsory at national and/or regional level.

[…]

Art. 32. Designation of areas facing natural and other specific constraints

4. Areas other than those referred to in paragraphs 2 and 3 shall be eligible for payments under Article 31 if they are affected by specific constraints and if it is necessary for land management to be continued in order to conserve or improve the environment, to maintain the countryside, to preserve the tourist potential of the area or to protect the coastline.

[…]

Art. 34. Forest-environmental and climate services and forest conservation

1. Support under this measure shall be granted per hectare of forest to public and private forest-holders and other private law and public bodies and their associations who undertake, on a voluntary basis, to carry out operations consisting of one or more forest-environment and climate commitments. In the case of state owned forests, support may only be granted if the body managing such a forest is a private body or a municipality. […]

Art. 35. Co-operation

2. Co-operation under paragraph 1 shall relate, in particular, to the following: […] (f) joint action undertaken with a view to **mitigating or adapting to climate change**;

TITLE IV. EIP for agricultural productivity and sustainability

Art. 55. Aims

1. The EIP for agricultural productivity and sustainability shall: […] (c) improve processes to **preserve the environment, adapt to climate change and mitigate it**.

[…]

ANNEX IV. Indicative list of measures and operations of particular relevance to thematic sub-programs referred to in Art. 7

Regulation (EU) No 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008

References to climate change are reported in Box 20.

Box 20. Key points of interest extracted from the Regulation

[…]

(10) In order to help beneficiaries to become more aware of the relationship between agricultural practices and management of farms on the one hand, and standards relating to the environment, **climate change**, good agricultural condition of land, food safety, public health, animal health, plant health and animal welfare on the other, it is necessary for Member States to establish a comprehensive farm advisory system offering advice to beneficiaries […].

[…]

(54) That cross-compliance system incorporates in the CAP basic standards concerning the environment, **climate change**, good agricultural and environmental condition of land, public health, animal health, plant health and animal welfare [...]. The cross-compliance system forms an integral part of the CAP and should therefore be maintained [...].

Art. 2. Terms used in this Regulation

2. For the purposes of the financing, management and monitoring of the CAP, "force majeure" and "exceptional circumstances" may, in particular, be recognized in the following cases: [...] (c) **a severe natural disaster gravely affecting the holding**; (e) an epizootic or a plant disease affecting part or all of the beneficiary's livestock or crops respectively [...].

[…]

TITLE III. FARM ADVISORY SYSTEM

Art. 12. Principle and scope

3. The farm advisory system may also cover, in particular: (a) the promotion of conversions of farms and the diversification of their economic activity; (b) risk management and the introduction of appropriate preventive actions to address **natural disasters, catastrophic events and animal and plant diseases**; (c) the minimum requirements established by national law, as referred to in Article 28(3) and 29(2) of Regulation (EU) No 1305/2013; (d) **the information related to climate change mitigation and adaptation, biodiversity and protection of water, as set out in Annex I to this Regulation**.

[…]

Art. 93. Rules on cross-compliance

1. The rules on cross-compliance shall consist of the statutory management requirements under Union law and the standards for good agricultural and environmental condition of land established at national level as listed in Annex II, relating to the following areas: (a) environment, climate change and good agricultural condition of land […].

ANNEX I. Information in the field of climate change mitigation and adaptation, biodiversity and the protection of water as laid down in point (d) of Article 12(3)

Climate change mitigation and adaptation:

— Information on the prospective impact of climate change in the relevant regions, of the green house gas emissions of the relevant farming practices and on the contribution of the agricultural sector to mitigation through improved farming and agroforestry practices and through the development of renewable energy projects on farm and energy efficiency improvement on

farm.

— Information helping farmers to plan how best to invest in "climate-proofing" their farm systems, and which Union funds they can use to do so; and in particular, information on adapting farmland to climatic fluctuations and longer term changes and information on how to adopt practical agronomic measures to increase the resilience of farming systems to floods and droughts as well as information on how to improve and optimize soil carbon levels.

Biodiversity:

— Information on the positive correlation between biodiversity and agro-ecosystem resilience, and the spreading of risk, and also the link between monocultures and susceptibility to crop failure/damage from pests and extreme climatic events

— Information on how to best prevent the spread of alien invasive species and why this is important for the effective functioning of the ecosystem and for its resilience to climate change, including information on access to funding for eradication schemes where additional costs are implied;

General:

— Exchange of best practice, training and capacity building (applicable to Climate change mitigation and adaptation, Biodiversity and Protection of water as mentioned above in this Annex).

ANNEX II. Rules on cross-compliance pursuant to Art. 93

Environment, climate change, good agricultural condition of land (see the Annex).

Regulation (EU) No 1307/2013 of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009

References to climate change are included in Box 21.

Box 21. Key points of interest extracted from the Regulation

[…]

(37) One of the objectives of the new CAP is the enhancement of environmental performance through a mandatory "greening" ***component of direct payments which will support agricultural practices beneficial for the climate and the environment applicable throughout the Union*** *[…]. Those practices should take the form of simple, generalized,* ***non-contractual and annual actions that go beyond cross-compliance and that are linked to agriculture, such as crop diversification, the maintenance of permanent grassland, including traditional orchards where fruit trees are grown in low density on grassland, and the establishment of ecological focus areas*** *[…].*

(40) In order to accommodate the diversity of agricultural systems and the different environmental situations across the Union, it is justified to recognize, ***in addition to the three greening practices established in this Regulation, practices covered by agri-environment-climate measures or certification schemes that are similar to greening and that yield an equivalent or higher level of benefit for the climate and the environment*** *[…].*

(45) […] When adding other types of ecological focus area, the Commission should ensure that they aim to improve the general environmental performance of the holding, ***in particular as regards biodiversity, the improvement of soil and water quality, the preservation of landscape and meeting the climate change mitigation and adaptation objectives****.*

CHAPTER 3. Payment for agricultural practices beneficial for the climate and the environment

Art. 43. General rules

1. Farmers entitled to a payment under the basic payment scheme or the single area payment scheme shall observe, on all their eligible hectares within the meaning of Art. 32(2) to (5), the agricultural practices beneficial for the climate and the environment referred to in paragraph 2 of this Article or the equivalent practices referred to in paragraph 3 of this Art..

2. The agricultural practices beneficial for the climate and the environment shall be the following: (a) crop diversification; (b) maintaining existing permanent grassland; and (c) having ecological focus area on the agricultural area.

3. The equivalent practices shall be those which include similar practices that yield an equivalent or higher level of benefit for the climate and the environment compare to one or several of the practices referred to in paragraph 2 […]. […] and shall be covered by any of the following: […] (b) ***national or regional environmental certification schemes****, including those for the certification of compliance with national environmental legislation, going beyond the relevant mandatory standards established pursuant to Chapter I of Title VI of Regulation (EU) No 1306/2013, which aim to meet objectives relating to soil and water quality, biodiversity, landscape preservation, and* ***climate change mitigation and adaptation*** *[…].*

Art. 46. Ecological focus area

5. […] The aim of the designation of areas and obligations shall be to underpin the implementation of Union policies on the ***environment, climate and biodiversity****.*

ANNEX I. List of support schemes

Sectors: [...] Payment for agricultural practices beneficial for the climate and the environment.

Regulation (EU) No 1308/2013 of the European Parliament and of the Council establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007

References to climate change are reported in Box 22.

Box 22. Key points of interest extracted from the Regulation

[…]

(38) The production and marketing of fruit and vegetables should fully take into account environmental concerns, including cultivation practices, management of waste materials and disposal of products withdrawn from the market, in particular as regards ***protection of water, quality, maintenance of biodiversity and the upkeep of the countryside****.*

Art. 3. Definitions

5 (b): ***adverse climatic event which can be assimilated to a natural disaster" means weather conditions such as frost, hail, ice, rain or drought which destroy more than 30 % of the average annual production*** *of a given farmer in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and lowest entry.*

[…]

Art. 33. Operational programs

1. Operational programs in the fruit and vegetables sector shall have a minimum duration of three years and a maximum duration of five years. They shall have at least two of the objectives referred to in point (c) of Article 152(1) or two of the following objectives:

(a) planning of production, including production and consumption forecasting and follow-up; (b) improvement of product quality, whether in a fresh or processed form; (c) boosting products' commercial value; (d) promotion of the products, whether in a fresh or processed form; (e) ***environmental measures, particularly those relating to water, and methods of production respecting the environment, including organic farming****; (f)* ***crisis prevention and management****.*

[…]

3. Crisis prevention and management referred to in point (f) of the first subparagraph of paragraph 1 shall be related to avoiding and dealing with crises on the fruit and vegetable markets and shall cover in this context: [...] (b) training measures and exchanges of best practices; (c) promotion and communication, whether for prevention or during a crisis period; […] (h) harvest insurance. Support for harvest insurance shall contribute to safeguarding producers' incomes where there are losses as a consequence of ***natural disasters, adverse climatic events, diseases or pest infestations****. Insurance contracts shall require that beneficiaries undertake necessary risk prevention measures.*

[…]

Art. 38. Implementing powers in accordance with the examination procedure

The Commission may adopt implementing acts laying down measures concerning: […] i) promotion, communication and training measures in case of crisis prevention and management; (j) the implementation of withdrawal operations, green harvesting, non-harvesting and harvest insurance measures; (k) the application, authorization, payment and reimbursement of the national financial assistance […].

[…]

Art. 48. Mutual funds

1. *(wine sector) Support for the setting up of mutual funds shall provide assistance to producers seeking to insure themselves against market fluctuations.*

2. Support for the setting up of mutual funds may be granted in the form of temporary and degressive aid to cover the administrative costs of the funds.

[…]

Art. 49. Harvest insurance *(wine sector)*

1. Support for harvest insurance shall contribute to safe guarding producers' incomes where there are ***losses as a consequence of natural disasters, adverse climatic events, diseases or pest infestations****. Insurance contracts shall require that beneficiaries undertake necessary risk prevention measures […].*

2. Support for harvest insurance may be granted in the form of a Union financial contribution which shall not exceed (a) 80% of the cost of the insurance premiums paid for by producers for insurance against losses resulting from adverse climatic events which can be assimilated to natural disasters; (b) 50% of the cost of the insurance premiums paid for by producers for insurance: (i) against losses referred to in point (a) and against other losses caused ***by adverse climatic events****; (ii) against losses caused by animals, plant diseases or pest infestations.* […]

Art. 50. Investments

1. Support may be granted for tangible or intangible investments in processing facilities and winery infrastructure, as well as marketing structures and tools. Those investments shall be intended to improve the overall performance of the enterprise and its adaptation to market demands, as well as to increase its competitiveness, and shall concern the production or marketing of grapevine products referred to in Part II of Annex VII, including with a view to improving energy savings, global energy efficiency and sustainable processes.

CHAPTER III. Producer organizations and associations and interbranch organizations

Section 1. Definition and recognition

Art. 152. Producer organizations

1. Member States may, on request, recognize producer organizations, which: […] (c) pursue a specific aim which may include at least one of the following objectives: […] (iii) optimizing production costs and returns on investments in response to environmental and animal welfare standards, and stabilizing producer prices; (iv) carrying out research and developing initiatives on sustainable production methods, innovative practices, economic competitiveness and market developments; (v) promoting, and providing technical assistance for, the use of environmentally sound cultivation practices and production techniques, and sound animal welfare practices and techniques; (vi) promoting, and providing technical assistance for, the use of production standards, improving product quality and developing products with a protected designation of origin, with a protected geographical indication or covered by a national quality label; (vii) ***the management of by-products and of waste in particular to protect the quality of water, soil and landscape and preserving or encouraging biodiversity****; (viii)* ***contributing to a sustainable use of natural resources and to climate change mitigation*** *[…].*

[…]

Art. 157. Interbranch organizations

1. Member States may, on request, recognize interbranch organizations in a specific sector listed in Article 1(2) which [...] (c) pursue a specific aim taking account of the interests of their members and of consumers, which may include, in particular, one of the following objectives [...] vii) providing the information and carrying out the research necessary to innovate, rationalize, improve and adjust production and, where applicable, the processing and marketing, towards products more suited to market requirements and consumer tastes and expectations, in particular with regard to product quality, including the specific characteristics of products with a protected designation of origin or a protected geographical indication, and protection of the environment; (viii) ***seeking ways of restricting the use of animal-health or plant protection products, better managing other inputs, ensuring product quality and soil and water conservation, promoting food safety, in particular through traceability of products, and improving animal health and welfare****; (ix) developing methods and instruments for improving product quality at all stages of production and, where applicable, of processing and marketing; (x)* ***taking all possible actions to uphold, protect and promote organic farming and designations of origin, quality labels and geographical indications****; (xi)* ***promoting and carrying out research into integrated, sustainable production or other environmentally sound production methods****; (xii) encouraging healthy and responsible consumption of the products on the internal market and/or informing about the harm linked to hazardous consumption patterns […].*

[…]

Art. 225. Reporting obligation of the Commission

The Commission shall present a report to the European Parliament and to the Council [...] (b) by 30 June 2014 and also by 31 December 2018, on the development of the market situation in the milk and milk products sector, and in particular on the operation of Articles 148 to 151, Article 152(3) and Article 157(3), assessing in particular the effects on milk producers and milk production in disadvantaged regions in connection with the general objective of maintaining production in such regions, and covering potential incentives to encourage farmers to enter into joint production agreements, together with any appropriate proposals.

Energy

Directive 2005/89/EC of the European Parliament and of the Council "concerning measures to safeguard security of electricity supply and infrastructure investment"

The Directive does not include any specific reference to climate change. However, there are some points of interest with respect to adaptation to climate change (Box 23).

Box 23. Key points extracted from the Directive

[…]

(8) The main intention of the relevant technical rules and recommendations, such as those contained in the Union for the Coordination of Transmission of Electricity (UCTE) Operation handbook, [...] is to provide support for the technical operation of the interconnected network, thus contributing to meeting the need for continued operation of the network in the ***event of system failure at an individual point or points in the network*** *and minimizing the costs related to mitigating such supply disruption.*

[…]

(15) Transmission and distribution system operators need an appropriate and stable regulatory framework for investment, and for maintenance and renewal of the networks.

Art. 3. General provisions

1. Member States shall ensure a ***high level of security of electricity supply*** *by taking the necessary measures to facilitate a stable investment climate and by defining the roles and responsibilities of competent authorities, including regulatory authorities where relevant, and all relevant market actors and publishing information thereon. The relevant market actors include, inter alia, transmission and distribution system operators, electricity generators, suppliers and final customers.*

2. In implementing the measures referred to in paragraph 1, Member States shall take account of: (a) the importance of ***ensuring continuity of electricity supplies****; […] (c) the internal market and the possibilities for cross-border cooperation in relation to security of electricity supply; (d) the need for regular maintenance and, where necessary, renewal of the transmission and distribution networks to maintain the performance of the network; (f) the need to ensure sufficient transmission and generation reserve capacity for stable operation;*

3. In implementing the measures referred to in paragraph 1, Member States may also take account of: (a) the degree of diversity in electricity generation at national or relevant regional level; (b) the importance of reducing the long-term effects of the growth of electricity demand; (c) the importance of ***encouraging energy efficiency and the adoption of new technologies****, in particular demand management technologies, renewable energy technologies and distributed generation; (d) the importance of removing administrative barriers to investments in infrastructure and generation capacity.*

Art. 4. Operational network security

1. (a) Member States or the competent authorities shall ensure that transmission system operators set the minimum operational rules and obligations on network security.

[…]

Art. 5. Maintaining balance between supply and demand

1. Member States shall take appropriate ***measures to maintain a balance between the demand for electricity and the availability of generation capacity*** *[…].*

*2. [...] Member States may also take additional measures, including but not limited to the following: […] (b) removal of barriers that prevent the use of interruptible contracts (*an operator controls the variation of the load. He commands the detachment of electricity consumption in use to those users who have entered into contracts under which they accept this disconnection*); […] (c) removal of barriers that prevent the conclusion of contracts of varying lengths for both producers and customers; (d) encouragement of the adoption of real-time demand management technologies such as advanced metering systems; (e) encouragement of energy conservation measures […].*

Art. 6. Network investment

1. Member States shall establish a regulatory framework that: (a) provides investment signals for both the transmission and distribution system network operators to develop their networks in order to meet foreseeable demand from the market; and (b) facilitates maintenance and, where necessary, renewal of their networks.

2. Without prejudice to Regulation (EC) No 1228/2003, Member States may allow for merchant investments in interconnection. Member States shall ensure that decisions on investments in interconnection are taken in close cooperation between relevant transmission system operators.

Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings

Specific reference to climate change are reported in Box 24.

Box 24. Key points extracted from the Directive

[…]

Whereas:

(3) Buildings account for 40% of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions. Together with an increased use of energy from renewable sources, measures taken to reduce energy consumption in the Union would allow the Union to comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), and to honour both its long term commitment to maintain the global temperature rise below 2°C, and its commitment to reduce, by 2020, overall greenhouse gas emissions by at least 20% below 1990 levels, and by 30% in the event of an international agreement being reached. Reduced energy consumption and an increased use of energy from renewable sources also have an important part to play in promoting security of energy supply, technological developments and in creating opportunities for employment and regional development, in particular in rural areas.

[…]

(8) Measures to improve further the energy performance of buildings should take into account climatic and local conditions as well as indoor climate environment and cost-effectiveness. These measures should not affect other requirements concerning buildings such as accessibility, safety and the intended use of the building.

[…]

(11) The objective of cost-effective or cost-optimal energy efficiency levels may, in certain circumstances, for example in the light of climatic differences, justify the setting by Member States of cost-effective or cost- optimal requirements for building elements that would in practice limit the installation of building products that comply with standards set by Union legislation, provided that such requirements do not constitute an unjustifiable market barrier.

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Reference to climate change are present in the Directive although in terms of mitigation (Box 25).

Box 25. Key points extracted from the Directive

[…]

(1) The control of European energy consumption and the increased use of energy from renewable sources, together with energy savings and increased energy efficiency, constitute important parts of the package of ***measures needed to reduce greenhouse gas emissions and comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change*** *[…].*

(17) The improvement of ***energy efficiency*** *is a key objective of the Community, and the aim is to achieve a 20 % improvement in energy efficiency by 2020. That aim [...] has a critical role to play in ensuring that the climate and energy objectives are being achieved at least cost […].*

(25) […] One important means to achieve the aim of this Directive is to guarantee the proper functioning of national support schemes, […] in order to maintain investor confidence and allow Member States to design effective national measures for target compliance. In order to ensure the effectiveness of both measures of target compliance, i.e. national support schemes and cooperation mechanisms, it is essential that Member States are able to determine if and to what extent their national support schemes apply to energy from renewable sources produced in other Member States and to agree on this by applying the cooperation mechanisms provided for in this Directive.

[…]

(42) For the benefit of rapid deployment of energy from renewable sources, […] Member States should, […] take into account the contribution of renewable energy sources towards meeting ***environmental and climate change objectives****, in particular when compared to non-renewable energy installations.*

[…]

(44) The coherence between the objectives of this Directive and the Community's other environmental legislation should be

ensured. In particular, during the assessment, planning or licensing procedures for renewable energy installations, Member States should take account of all Community environmental legislation and the contribution made by renewable energy sources towards meeting environmental and climate change objectives, in particular when compared to non-renewable energy installations.

Art. 3. Mandatory national overall targets and measures for the use of energy from renewable sources

1. [...] In order to achieve the targets laid down in this Art. more easily, each Member State shall promote and encourage ***energy efficiency*** *and* ***energy saving****.*

[…]

3. In order to reach the targets set in paragraphs 1 and 2 of this Art. Member States may, inter alia, apply the following measures: (a) support schemes; (b) measures of cooperation between different Member States and with third countries [...].

Art. 4. National renewable energy action plans

1. Each Member State shall adopt a ***national renewable energy action plan****. The national renewable energy action plans shall set out Member States' national targets for the share of energy from renewable sources consumed in transport, electricity and heating and cooling in 2020 […].*

[…]

Art. 13. Administrative procedures, regulations and codes

3. Member States shall recommend to all actors, in particular local and regional administrative bodies to ensure equipment and systems are installed for the use of electricity, heating and cooling from renewable energy sources and for district heating and cooling when planning, designing, building and renovating industrial or residential areas. Member States shall, in particular, encourage local and regional administrative bodies to include heating and cooling from renewable energy sources in the planning of city infrastructure, where appropriate.

4. Member States shall introduce in their building regulations and codes appropriate measures in order to increase the share of all kinds of energy from renewable sources in the building sector.

5. Member States shall ensure that new public buildings, and existing public buildings that are subject to major renovation, at national, regional and local level fulfill an exemplary role in the context of this Directive from 1 January 2012 onwards. Member States may, inter alia, allow that obligation to be fulfilled by complying with standards for zero energy housing, or by providing that the roofs of public or mixed private-public buildings are used by third parties for installations that produce energy from renewable sources.

[…]

Art. 14. Information and training

6. Member States, with the participation of local and regional authorities, shall develop suitable information, awareness-raising, guidance or training programs in order to inform citizens of

the benefits and practicalities of developing and using energy from renewable sources.

[…]

Art. 16. Access to and operation of the grids

1. Member States shall take the appropriate steps to develop transmission and distribution grid infrastructure, intelligent networks, storage facilities and the electricity system, in order to allow the secure operation of the electricity system as it accommodates the further development of electricity production from renewable energy sources, including interconnection between Member States and between Member States and third countries. Member States shall also take appropriate steps to accelerate authorization procedures for grid infrastructure and to coordinate approval of grid infrastructure with administrative and planning procedures.

2. Subject to requirements relating to the maintenance of the

reliability and safety of the grid, based on transparent and non-discriminatory criteria defined by the competent national authorities: (a) Member States shall ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources;

(b) Member States shall also provide for either priority access or guaranteed access to the grid-system of electricity produced from renewable energy source […].

Directives 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

Key references are reported in Box 26.

Box 26. Key points extracted from the Directive

[…]

(5) A secure supply of electricity is of vital importance for the development of European society, the implementation of a sustainable climate change policy, and the fostering of competitiveness within the internal market. To that end, cross-border interconnections should be further developed in order to secure the supply of all energy sources at the most competitive prices to consumers and industry within the Community.

[…]

(27) Member States should encourage the modernization of distribution networks, such as ***through the introduction of smart grids, which should be built in a way that encourages decentralized generation and energy efficiency****.*

[…]

(43) […] Member States should ensure the possibility to contribute to security of supply through the launching of a tendering procedure or an equivalent procedure in the event that sufficient electricity generation capacity is not built on the basis of the authorization procedure. Member States should have the possibility, in the interests of environmental protection and the promotion of new infant technologies, of tendering for new capacity on the basis of published criteria. ***Such new capacity includes, inter alia, electricity from renewable energy sources and combined heat and power****.*

[…]

(50) […] key aspect of supplying customers is ***access to objective and transparent consumption data****. Thus, consumers should have access to their consumption data and associated prices and services costs so that they can invite competitors to make an offer based on those data. Consumers should also have the right to be properly informed about their energy consumption. Prepayments should reflect the likely consumption of electricity and different payment systems should be non-discriminatory.* ***Information on energy costs provided to consumers frequently enough will create incentives for energy savings because it will give customers direct feedback on the effects of investment in energy efficiency and change of behaviour*** *[…].*

(53) […] In any event, Member States should ensure the necessary energy supply for vulnerable customers. In doing so, an integrated approach, such as in the framework of social policy, could be used and ***measures could include social policies or energy efficiency improvements for housing*** *[…].*

Art. 1. Subject matter and scope

This Directive establishes common rules for the generation, transmission, distribution and supply of electricity, together with consumer protection provisions, with a view to improving and integrating competitive electricity markets in the Community. It lays down the rules relating to the organization and functioning of the electricity sector, open access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorizations and the operation of systems. It also lays down universal service obligations and the rights of electricity consumers and clarifies competition requirements.

Art. 2. Definitions

(29) energy efficiency/demand-side management: means a global or integrated approach aimed at influencing the amount and timing of electricity consumption in order ***to reduce primary energy consumption and peak loads*** *by giving precedence to investments in* ***energy efficiency measures, or other measures, such as interruptible supply contracts, over investments to increase generation capacity****, if the former are the most effective and economical option, taking into account the positive environmental impact of reduced energy consumption and the security of supply and distribution cost aspects related to it.*

Art. 3. Public service obligations and customer protection

2. Having full regard to the relevant provisions of the Treaty, in particular Art. 86 thereof, Member States may impose on undertakings operating in the electricity sector, in the general economic interest, public service obligations which may relate to ***security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency, energy from renewable sources and climate protection*** *[…].*

[…]

8. Member States shall take appropriate measures, such as formulating national energy action plans, providing benefits in social security systems to ensure the necessary electricity supply to vulnerable customers, or providing for support for energy efficiency improvements, to address energy poverty where identified, including in the broader context of poverty […].

[…]

10. Member States shall implement measures to achieve the objectives of social and economic cohesion and environmental protection, which shall include ***energy efficiency/demand-side management measures and means to combat climate change****, and security of supply, where appropriate.* ***Such measures may include, in particular, the provision of adequate economic incentives****, using, where appropriate, all existing national and Community tools,* ***for the maintenance and construction of the necessary network infrastructure, including interconnection capacity****.*

11. ***In order to promote energy efficiency****, Member States or, where a Member State has so provided, the regulatory authority shall strongly recommend that electricity undertakings optimize the use of electricity, for example* ***by providing energy management services, developing innovative pricing formulas, or introducing intelligent metering systems or smart grids****, where appropriate.*

Art. 8. Tendering for new capacity

3. Details of the tendering procedure for means of generating capacity and energy efficiency/demand-side management measures […].

[…]

Art. 36. General objectives of the regulatory authority

[…] the regulatory authority shall take all reasonable measures in pursuit o the following objectives within the framework of their duties and powers as laid down in Art. 37, in close consultation with other relevant national authorities including competition authorities, as appropriate, and without prejudice to their competencies: […] (d) helping to achieve, in the most cost-effective way, the development of secure, reliable and efficient non-discriminatory systems that are consumer oriented, and promoting system adequacy and, in line ***with general energy policy objectives, energy efficiency as well as the integration of large and small-scale production of electricity from renewable energy sources and distributed generation in both transmission and distribution networks****; (e) facilitating access to the network for new generation capacity, in particular removing barriers that could* ***prevent access for new market entrants and of electricity from renewable energy sources****.*

Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

References to climate change are reported in Box 27.

Box 27. Key points extracted from the Directive

[…]

(26) Member States should take concrete measures to assist the wider use of biogas and gas from biomass […].

[…]

(39) Member States or, where a Member State has so provided, the regulatory authority, should ***encourage the development of interruptible supply contracts****.*

[…]

(47) […] Information on energy costs provided to consumers frequently enough will create ***incentives for energy savings because it will give customers direct feedback on the effects of investment in energy efficiency and change of behaviour****.*

[…]

(50) Energy poverty is a growing problem in the Community […]. An integrated approach, such as in the framework of social policy, could be used and measures could include social policies or ***energy efficiency improvements for housing****. At the very least, this Directive should allow national policies in favour of vulnerable customers.*

Art. 3. Public service obligations and customer protection

2. Member States may impose on undertakings operating in the gas sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies, and ***environmental protection, including energy efficiency, energy from renewable sources and climate protection****.*

[…]

7. Member States shall implement appropriate measures to achieve the objectives of social and economic cohesion and ***environmental protection, which may include means to combat climate change****, and security of supply. Such measures may include, in particular, the provision of adequate* ***economic incentives****, using, where appropriate, all existing national and Community tools,* ***for the maintenance and construction of necessary network infrastructure, including interconnection capacity****.*

8. In order to promote energy efficiency, Member States or, where a Member State has so provided, the regulatory authority shall strongly recommend that natural gas undertakings optimize the use of gas, for example by providing energy management services, ***developing innovative pricing formulas or introducing intelligent metering systems or smart grids where appropriate****.*

Art. 6. Regional solidarity

1. In order to safeguard a secure supply on the internal market in natural gas, Member States shall cooperate in order to promote regional and bilateral solidarity.

[…]

Art. 40. General objectives of the regulatory authority

*(f) ensuring that system operators and system users are granted **appropriate incentives**, in both the short and the long term, to **increase efficiencies in system performance** and foster market integration.*

Art. 41. Duties and powers of the regulatory authority

*(8) In fixing or approving the tariffs or methodologies and the balancing services, the regulatory authorities shall ensure that transmission and distribution system operators are granted appropriate incentive, over both the short and long term, **to increase efficiencies**, foster market integration and security of supply and support the related research activities.*

Regulation (EC) No 714/2009 of the European Parliament and of the Council on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003

Relevant points with respect to climate change adaptation are reported in Box 28.

Box 28. Key points extracted from the Regulation

[…]

Art. 8. Tasks of the ENTSO for Electricity

3. The ENTSO for Electricity shall adopt:

(a) common network operation tools to ensure coordination of network operation in normal and emergency conditions, including a common incidents classification scale, and research plans;

(b) a non-binding Community-wide ten-year network development plan, (Community-wide network development plan), including a European generation adequacy outlook, every two years […];

[…]

*6. The network codes referred to in paragraphs 1 and 2 shall cover the following areas, taking into account, if appropriate, regional specificities: (a) **network security and reliability rules** including rules for technical transmission reserve capacity for operational network security (b) network connection rules; (c) third-party access rules; (d) data exchange and settlement rules; (e) interoperability rules; (f) operational **procedures in an emergency**; (g) capacity-allocation and congestion-management rules; (h) **rules for trading related to technical and operational provision of network access services and system balancing**; (i) transparency rules; (j) balancing rules including network-related reserve power rules; (k) rules regarding harmonized transmission tariff structures including locational signals and inter-transmission system operator compensation rules; and (i) **energy efficiency regarding electricity networks**.*

[…]

Art. 12. Regional cooperation of transmission system operators

*2. Transmission system operators shall promote operational arrangements in order to ensure the optimum management of the network and shall promote the development of energy exchanges, the coordinated allocation of cross-border capacity through non-discriminatory market-based solutions, paying due attention to the specific merits of implicit auctions for short-term allocations, and **the integration of balancing and reserve power mechanisms**.*

[…]

Art. 16. General principles of congestion management

1. Network congestion problems shall be addressed with non-discriminatory market-based solutions which give efficient economic signals to the market participants and transmission system operators involved […].

[…]

*6. Any revenues resulting from the allocation of interconnection shall be used for the following purposes: (a) **guaranteeing the actual availability of the allocated capacity; and/or (b) maintaining or increasing interconnection capacities through network investments, in particular in new interconnectors** […].*

Regulation (EU) No 994/2010 of the European Parliament and of the Council concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC

Relevant points with respect to climate change adaptation are reported in Box 29.

Box 29. Key points extracted from the Regulation

[…]

*(3) Given the importance of gas in the energy mix of the Union, this Regulation aims at demonstrating to gas customers that all the necessary measures are being taken to ensure their continuous supply, **particularly in case of difficult climatic conditions** and in the event of disruption. It is recognized that these objectives should be achieved through the most cost-efficient measures in order not to affect the relative competitiveness of this fuel compared to other fuels.*

[…]

*(7) The diversification of gas routes and of sources of supply for the Union is essential for improving the security of supply of the Union as a whole and its Member States individually. Security of supply will depend in the future on the evolution of the fuel mix, the development of production in the Union and in third countries supplying the Union, **investments in storage facilities** and in the diversification of gas routes and of sources of supply within and outside the Union [...].*

[…]

*(14) […] **Demand-side measures** such as fuel switching may have a valuable role to play in ensuring energy security where they can be applied quickly and reduce demand appreciably to react to a supply disruption. **The efficient use of energy should be further promoted, in particular where demand-side measures are needed**. The environmental impact of the proposed demand and supply-side measures should be taken into due account and preference should be given as far as possible to measures with the least impact on the environment while taking into account security of supply aspects.*

*(15) Investments in new gas infrastructure should be strongly promoted […]. Such new infrastructure should enhance the security of gas supply while ensuring the proper functioning of the internal market in gas. Investments should as a matter of principle be made by undertakings and be based on economic incentives. Due account should be taken of the need to facilitate the **integration of gas from renewable energy sources into the gas network infrastructure** […].*

[…]

*(20) This Regulation should enable natural gas undertakings and customers to rely on market mechanisms for as long as possible when coping with disruptions. It should also provide for emergency mechanisms to be used when markets alone are no longer able to deal adequately with a gas supply disruption. **Even in an emergency, market-based instruments should be given priority to mitigate the effects of the supply disruption**.*

[…]

*(23) […] Moreover, customers using gas for electricity generation or industrial purposes may also have an important role to play in security of gas supply through their ability to respond to a crisis with demand-side measures, for instance **interruptible contracts** and fuel switching, as this directly impacts on the supply/demand balance.*

Art. 4. Establishment of a Preventive Action Plan and an Emergency Plan

*1. The Competent Authority of each Member State, after consulting the natural gas undertakings, the relevant organizations representing the interests of household and industrial gas customers and the national regulatory authority, where it is not the Competent Authority, shall, without prejudice to paragraph 3, establish at national level: (a) a Preventive Action Plan containing the measures needed to remove or mitigate the risks identified, **in accordance with the risk assessment undertaken** pursuant to Article 9; and (b) an Emergency Plan containing the measures to be taken to remove or mitigate the impact of a gas supply disruption in accordance with Art. 10.*

[…]

Art. 9. Risk assessment

*1. By 3 December 2011, each Competent Authority shall make a **full assessment**, on the basis of the following common elements, **of the risks affecting the security of gas supply** in its Member State by […] (b) taking into account all relevant national and regional circumstances, in particular market size, network configuration, actual flows, including outflows from Member States concerned, the possibility of physical gas flows in both directions including the potential need for consequent reinforcement of the transmission system, the presence of production and storage and the role of gas in the energy mix, in particular with respect to district heating and electricity generation and for the operation of industries […]; (c) running various scenarios of exceptionally high gas demand and supply disruption, such as failure of the main transmission infrastructures, storages or LNG terminals, and disruption of supplies from third country suppliers, taking into account the history, probability, season, frequency and duration of their occurrence as well as, where appropriate, geopolitical risks, and assessing the likely consequences of these scenarios.*

Annex II – List of market-based security of gas supply measures

Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives2004/8/EC and 2006/32/EC

Relevant points with respect to climate change adaptation are reported in Box 30.

Box 30. Key points extracted from the Directive

[…]

(1) The Union is facing unprecedented challenges resulting from increased dependence on energy imports and ***scarce energy resources****, and the* ***need to limit climate change*** *and to overcome the economic crisis.* ***Energy efficiency*** *is a valuable means to address these challenges.* ***It improves the Union's security of supply by reducing primary energy consumption and decreasing energy imports****. It helps to reduce greenhouse gas emissions in a cost-effective way and thereby* ***to mitigate climate change****. Shifting to a more energy-efficient economy should also accelerate the spread of innovative technological solutions and improve the competitiveness of industry in the Union, boosting economic growth and creating high quality jobs in several sectors related to energy efficiency.*

[…]

(16) […] Member States should establish a long-term strategy beyond 2020 for mobilizing investment in the ***renovation of residential and commercial buildings with a view to improving the energy performance of the building stock****. That strategy should address cost-effective deep renovations which lead to a refurbishment that reduces both the delivered and the final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance. Such deep renovations could also be carried out in stages.*

(17) The rate of building renovation needs to be increased, as the existing building stock represents the single biggest potential sector for energy savings […]. Buildings owned by public bodies account for a considerable share of the building stock and have high visibility in public life […]. ***The obligation to renovate central government buildings in this Directive complements that Directive, which requires Member States to ensure that when existing buildings undergo major renovation their energy performance is upgraded so that they meet minimum energy performance requirement****. It should be possible for Member States to take alternative cost-effective measures to achieve an equivalent improvement of the energy performance of the buildings within their central government estate […].*

[…]

(19) With regard to the purchase of certain products and services and the purchase and rent of buildings, central governments which conclude public works, supply or service contracts should lead by example and make energy-efficient purchasing decisions […].

[…]

(37) It is appropriate for Member States to encourage the introduction of measures and procedures to promote cogeneration installations with a total rated thermal input of less than 20 MW in order ***to encourage distributed energy generation****.*

[…]

(44) ***Demand response*** *is an important instrument for improving energy efficiency, since it significantly increases the opportunities for consumers or third parties nominated by them* ***to take action on consumption and billing information and thus provides a mechanism to reduce or shift consumption****, resulting in energy savings in both final consumption and, through the more optimal use of networks and generation assets, in energy generation, transmission and distribution.*

EFFICIENCY IN ENERGY USE

Art. 4. Building renovation

Member States shall establish a long-term strategy for mobilizing investment in the renovation of the national stock of residential and commercial buildings, both public and private. This strategy shall encompass: […] (b) ***identification of cost-effective approaches to renovations relevant to the building type and climatic zone****; (c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations; (d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; (e) an evidence-based estimate of expected energy savings and wider benefits.*

Art. 5. Exemplary role of public bodies' buildings

6. […] Member States may opt for an alternative approach to paragraphs 1 to 5 of this Article, whereby they ***take other cost effective measures, including deep renovations and measures for behavioural change of occupants****, to achieve, by 2020, an amount of energy savings in eligible buildings owned and occupied by their central government that is at least equivalent to that required in paragraph 1, reported on an annual basis.*

7. Member States shall encourage public bodies, including at regional and local level, and social housing bodies governed by public law, with due regard for their respective competences and administrative set-up, to: (a) ***adopt an energy efficiency plan, freestanding or as part of a broader climate or environmental plan, containing specific energy saving and efficiency***

objectives and actions *[…].*

Art. 6. Purchasing by public bodies

1. Member States shall ensure that central governments purchase only products, ***services and buildings with high energy-efficiency performance****, insofar as that is consistent with cost-effectiveness, economical feasibility, wider sustainability, technical suitability, as well as sufficient competition […].*

Art. 7. Energy efficiency obligation schemes

1. Each Member State shall set up an energy efficiency obligation scheme […].

[…]

9. […] The policy measures referred to in the first subparagraph may include, but are not restricted to, the following policy measures or combinations thereof:

(a) ***energy or CO2 taxes that have the effect of reducing end-use energy consumption****;*

(b) ***financing schemes and instruments or fiscal incentives that lead to the application of energy-efficient technology or techniques and have the effect of reducing end-use energy consumption****;*

(c) ***regulations or voluntary agreements that lead to the application of energy-efficient technology or techniques and have the effect of reducing end-use energy consumption****;*

(d) ***standards and norms that aim at improving the energy efficiency of products and services, including buildings and vehicles, except where these are mandatory and applicable in Member States under Union law****;*

(e) ***energy labelling schemes, with the exception of those that are mandatory and applicable in the Member States under Union law****;*

(f) ***training and education, including energy advisory programs, that lead to the application of energy efficient technology or techniques and have the effect of reducing end-use energy consumption****.*

[…]

Art. 12. Consumer information and empowering program

1. Member States shall take appropriate ***measures to promote and facilitate an efficient use of energy by small energy customers, including domestic customers****. These measures may be part of a national strategy.*

2. For the purposes of paragraph 1, these measures shall include one or more of the elements listed under point (a) or (b):

(a) ***a range of instruments and policies to promote behavioural change which may include: (i) fiscal incentives****; (ii) access to finance, grants or subsidies; (iii) information provision; (iv) exemplary projects; (v) workplace activities;*

(b) ways and means to engage consumers and consumer organizations during the possible roll-out of smart meters through communication of: (i) cost-effective and easy-to-achieve changes in energy use; (ii) ***information on energy efficiency measures****.*

[…]

Art. 14. Promotion of efficiency in heating and cooling

1. By 31 December 2015, Member States shall carry out and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling […].

3. For the purpose of the assessment referred to in paragraph 1, Member States shall carry out a ***cost-benefit analysis covering their territory based on climate conditions, economic feasibility and technical suitability*** *in accordance with Part 1 of Annex IX. The cost-benefit analysis shall be capable of facilitating the identification of the most resource-and cost-efficient solutions to meeting heating and cooling needs […].*

[…]

Art. 15. Energy transformation, transmission and distribution

5. Member States shall ensure that rules relating to the ranking of the different access and dispatch priorities granted in their electricity systems are clearly explained in detail and published. When providing priority access or dispatch for high-efficiency cogeneration, Member States may set rankings as between, and within different types of, renewable energy and high-efficiency cogeneration and shall in any case ensure that priority access or dispatch for energy from variable renewable energy sources is not hampered.

HORIZONTAL PROVISIONS

Art. 16. Availability of qualification, accreditation and certification schemes

3. […] Member States shall take ***appropriate measures to make consumers aware of the availability of qualification and/or certification schemes*** *in accordance with Article 18(1).*

[…]

ANNEX XI. Energy efficiency criteria for energy network regulation and for electricity network tariffs

3. Network or retail tariffs may support dynamic pricing for demand response measures by final customers, such as:

(a) time-of-use tariffs: (b) critical peak pricing; (c) real time pricing; and (d) peak time rebates.

Regulation (EU) No 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009

Relevant points with respect to climate change adaptation are reported in Box 31.

Box 31. Key points extracted from the Regulation

[…]

(7) Accelerating the refurbishment of existing energy infrastructure and the deployment of new energy infrastructure is vital to achieve the Union's energy and climate policy objectives, consisting of completing the internal market in energy, guaranteeing security of supply, in particular for gas and oil, reducing greenhouse gas emissions by 20% (30% if the conditions are right), increasing the share of renewable energy in final energy consumption to 20% and achieving a 20% increase in energy efficiency by 2020 [...]. This Regulation should therefore also be able to accommodate possible ***future Union energy and climate policy objectives****.*

(8) […] provide for an internal market in energy, the market remains fragmented due to insufficient interconnections between national energy networks and to the suboptimal utilization of existing energy infrastructure. However, Union-wide integrated networks and deployment of smart grids are vital for ***ensuring a competitive and properly functioning integrated market, for achieving an optimal utilization of energy infrastructure, for increased energy efficiency and integration of distributed renewable energy sources and for promoting growth, employment and sustainable development****.*

(9) The Union's energy infrastructure should be upgraded in order to prevent technical failure and to increase its resilience against such failure, natural or man-made disasters, adverse effects of climate change and threats to its security, in particular as regards European critical infrastructures as set out in Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection.

[…]

(17) This Regulation lays down rules for the timely development and interoperability of trans-European energy networks in order to achieve the energy policy objectives of the Treaty on the Functioning of the European Union (TFEU) to ensure the functioning of the internal energy market and security of supply in the Union, ***to promote energy efficiency and energy saving and the development of new and renewable forms of energy, and to promote the interconnection of energy networks*** *[…].*

ANNEX I. ENERGY INFRASTRUCTURE PRIORITY CORRIDORS AND AREAS

4. PRIORITY THEMATIC AREAS

(10) ***Smart grids deployment****: adoption of smart grid technologies across the Union to efficiently integrate the behaviour and actions of all users connected to the electricity network, in particular the generation of large amounts of electricity from renewable or distributed energy sources and demand response by consumers […].*

ANNEX IV. RULES AND INDICATORS CONCERNING CRITERIA FOR PROJECTS OF COMMON INTEREST

(2) Concerning projects falling under the categories set out in Annex II.1(a) to (d), the criteria listed in Article 4 shall be evaluated as follows: […] (c) Security of supply, interoperability and secure system operation shall be measured in line with the analysis made in the latest available 10-year network development plan in electricity, notably by assessing the impact of the project on the loss of load expectation for the area of analysis as defined in Annex V.10 in terms of generation and transmission adequacy for a set of characteristic load periods, taking into account expected changes in climate-related extreme weather events and their impact on infrastructure resilience. Where applicable, the impact of the project on independent and reliable control of system operation and services shall be measured.

ANNEX IV. RULES AND INDICATORS CONCERNING CRITERIA FOR PROJECTS OF COMMON INTEREST

(3) Concerning projects falling under the categories set out in Annex II.2, the criteria listed in Article 4 shall be evaluated as follows: [...] (d) Sustainability shall be measured as the contribution of a project to reduce emissions, to support the back-up of renewable electricity generation or power-to-gas and biogas transportation, ***taking into account expected changes in climatic conditions****.*

ANNEX IV. RULES AND INDICATORS CONCERNING CRITERIA FOR PROJECTS OF COMMON INTEREST

(4) Concerning projects falling under the category set out in Annex II.1(e), each function listed in Article 4 shall be evaluated against the following criteria: […] (d) Security and quality of supply: this criterion shall be measured by assessing the ratio of

reliably available ***generation capacity and peak demand, the share of electricity generated from renewable sources, the stability of the electricity system, the duration and frequency of interruptions per customer, including climate related disruptions, and the voltage quality performance****.*

ANNEX V. ENERGY SYSTEM-WIDE COST-BENEFIT ANALYSIS

The methodology for a harmonized energy system-wide cost-benefit analysis for projects of common interest shall satisfy the following principles laid down in this Annex.

(6) ***For electricity transmission and storage****, the cost-benefit analysis shall at least take into account the impact and compensations resulting from the application of Article 13 of Regulation (EC) No 714/2009, the impacts on the indicators defined in Annex IV, and the following impacts: […] (d)* ***system resilience, including disaster and climate resilience, and system security****, notably for European critical infrastructures as defined in Directive 2008/114/EC;*

(7) For gas, the cost-benefit analysis shall at least take into account the results of market testing the impacts on the indicators defined in Annex IV and the following impacts: (a) ***disaster and climate resilience****, and system security, notably for European critical infrastructures as defined in Directive 2008/114/EC […].*

Directive 2013/30/EU of the European Parliament and of the Council on safety of offshore oil and gas operations and amending Directive 2004/35/EC

Explicit references to climate change and adaptation are illustrated in Box 32.

Box 32. Key points extracted from the Directive

[…]

(33) The report on major hazards should, inter alia, take into account risks to the environment, ***including the impact of climatic conditions and climate change on the long term resilience of the installations*** *[…].*

[…]

(52) The Arctic waters are a neighboring marine environment of particular importance for the Union, and play an important role in mitigating climate change. The serious environmental concerns relating to the Arctic waters require special attention to ensure the environmental protection of the Arctic in relation to any offshore oil and gas operation, including exploration, taking into account the ***risk of major accidents*** *and the need for effective response. Member States who are members of the Arctic Council are encouraged to actively promote the highest standards with regard to* ***environmental safety*** *in this vulnerable and unique ecosystem, such as through the creation of international instruments on prevention, preparedness and response to Arctic marine oil pollution, and through building, inter alia, on the work of the Task Force established by the Arctic Council and the existing Arctic Council Offshore Oil and Gas Guidelines.*

CHAPTER II. PREVENTION OF MAJOR ACCIDENTS RELATING TO OFFSHORE OIL AND GAS OPERATIONS

Art. 3. General principles of risk management in offshore oil and gas operations

1. Member States shall require operators to ensure that all suitable measures are taken to prevent major accidents in offshore oil and gas operations.

[…]

Art. 4. Safety and environmental considerations relating to licenses

6. When assessing the technical and financial capabilities of an applicant for a license, special attention shall be paid to any environmentally ***sensitive marine and coastal environments, in particular ecosystems which play an important role in mitigation and adaptation to climate change****, such as salt marshes and sea grass beds, and marine protected areas, such as special areas of conservation pursuant to the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora […].*

[…]

Art. 12. Report on major hazards for a production installation

1. Member States shall ensure that the operator prepares a report on major hazards for a production installation […].

[…]

Art. 14. Internal emergency response plans

1. Member States shall ensure that operators or owners, as appropriate, prepare internal emergency response plans to be submitted pursuant to point (g) of Article 11(1). The plans shall be prepared in accordance with Article 28 taking into account the major accident risk assessment undertaken during preparation of the most recent report on major hazards. The plan shall include an analysis of the oil spill response effectiveness.

CHAPTER IV. PREVENTION POLICY

Art. 19. Major accident prevention by operators and owners

1. Member States shall require operators and owners to prepare a document setting out their corporate major accident prevention policy which is to be submitted […].

[…]

3. Member States shall ensure that operators and owners prepare a document setting out their safety and environmental management system […].

[…]

Art. 29. External emergency response plans and emergency preparedness

1. Member States shall prepare external emergency response plans covering all offshore oil and gas installations or connected infrastructure and potentially affected areas within their jurisdiction. Member States shall specify the role and financial obligation of licensees and operators in the external emergency response plans.

Health

Directive 2003/99/EC of the European Parliament and of the Council on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/117/EEC

Box 33. Key points extracted from the Directive

1. Member States shall ensure that data on the occurrence of zoonoses and zoonotic agents and antimicrobial resistance related thereto are collected, analyzed and published without delay in accordance with the requirements of this Directive and of any provisions adopted pursuant to it.

2. Each Member State shall designate a competent authority or competent authorities for the purposes of this Directive and notify the Commission thereof.

3. Each Member State shall ensure that effective and continuous cooperation based on free exchange of general information and, where necessary, of specific data, is established between the competent authority or authorities designated for the purposes of this Directive and: (a) the competent authorities for the purposes of Community legislation on animal health; (b) the competent authorities for the purposes of Community legislation on feed; (c) the competent authorities for the purposes of Community legislation on food hygiene.

Regulation (EU) No 282/2014 of the European Parliament and of the Council on the establishment of a third Program for the Union's action in the field of health (2014-2020) and repealing Decision No 1350/2007/EC Text with EEA relevance

References to climate change are reported in Box 34.

Box 34. Key points extracted from the Regulation

*(16) It should be possible for action under the Program to also cover cross-border **health threats** caused by biological and chemical incidents, environment and **climate change**. As stated in the Commission's Communication "A Budget for Europe 2020", the Commission has committed to mainstreaming climate change into overall Union spending programs and to direct at least 20 % of the Union budget to climate- related objectives. Spending in the Program under the specific objective related to serious cross-border health threats should contribute in a general manner to those objectives by addressing health threats associated with **climate change**. The Commission should provide information on climate change expenditure within the Program.*

[…]

The third EU health program is the main instrument the European Commission uses to implement the EU health strategy. It is implemented by means of annual work plans which set out priority areas and the criteria for funding actions under the program. The total budget for the program is € 449.4 million.

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