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D4.7- Analysis of economic, finance and investment policies at EU/national level and in local context - Version 1

WP4 - Task 4.4

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Executive Summary

Deliverable 4.7 provides an initial analysis of economic, finance, and investment policies at the EU, national, and local levels in Europe concerning climate change adaptation and mitigation. Through eight case studies, it examines a variety of policy instruments, including market-based, public-private, financial, and regulatory tools. The analysis highlights the diverse approaches across different countries and governance levels, influenced by EU legislation and specific national priorities. While the report touches upon gender and equity considerations, it emphasises the need for more consistent integration of these aspects into climate policies. The deliverable provides a foundational understanding of the policy landscape in addressing climate change.

Keywords

Climate Change Policy; Economic Instruments; Case Studies; Climate Governance; Europe

Abbreviations and acronyms

Acronym	Description
ARC	African Risk Capacity
CCC	Climate Change Committee
CCLW	Climate Change Laws of the World
CPDB	Climate Policy Database
CSO	Civil Society Organization
DESNZ	Department for Energy Security and Net Zero
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EEA	European Environment Agency

EIB	European Investment Bank
EIT	European Institute of Innovation and Technology
ETS	Emissions Trading System
EU	European Union
FI	Financial Instrument
GDP	Gross Domestic Product
GHFA	Green Home Finance Accelerator
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
KEFM	Ministry of Climate, Energy and Utilities
KL	Local Government Denmark
MASE	Ministry of Environment and Energy Security
MARD	Ministry of Agriculture and Rural Development
MBI	Market Based Instrument
MIT	Ministry of Industry and Trade
MTECT	Ministry for Ecological Transition and Territorial Cohesion
NAP	National Adaptation Programme/Plan
NAPCM	National Action Plan for Clean Mobility
NB	National Budget
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NPE	National Programme Environment
NSP	National Strategic Plan
NZIP	Net Zero Innovation Portfolio
OPE	Operational Programme Environment

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PAID	Natural Disaster Insurance Pool (Romania)
PNACC	National Climate Change Adaptation Plan (France)
PPE	French Multiannual Energy Program
PPP	Public Private Partnership
RFI	Risk Financing Instrument
RHI	Renewable Heat Incentive
SNPA	National System for Environmental Protection (Italy)
STL	Storyline
UNFCCC	United Nations Framework Convention on Climate Change
UNHRC	United Nations Human Rights Council

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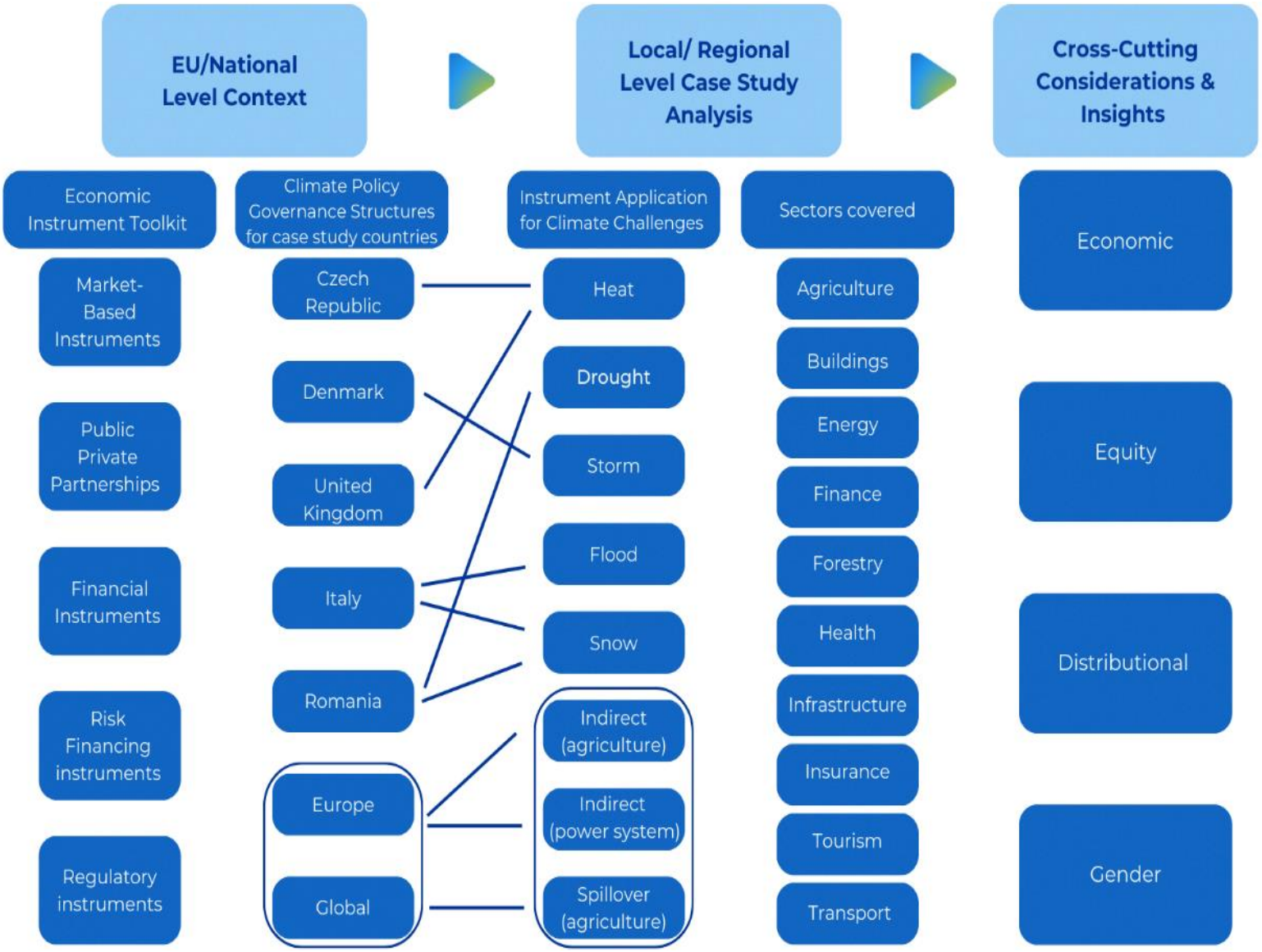
Graphical Abstract



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1. Introduction

This Deliverable 4.7 (D4.7) is produced within Work Package 4 (WP4) of the CROSSEU project. WP4 focuses on Governance analysis and recommendations for policies and investments. The purpose of this D4.7 is to provide a first draft of an analysis of economic, finance and investments policies at EU/national level and in local contexts in Europe (as mentioned in the CROSSEU Project Grant Agreement). The final version of the analysis will be in the following Deliverable 4.8- Economic instruments and measures as a framework for coping with climate challenges, due in month 30.

The main objective of this D4.7 is to understand the economic, finance, and investment policies/ instruments at the EU/national level and in local contexts in the 8 case studies (details of these case studies are in Deliverable 2.1). In addressing the main objective, D4.7 contributes to understanding existing policy instruments in the 8 case studies and assesses the alignment of these policies with national climate strategies and plans, evaluate the economic, equity, and distributional considerations of the chosen policy instruments, if any, and explore alternative approaches and provide recommendations for enhancing policy effectiveness and impact. Additionally, though the focus of this D4.7 is the analysis of climate policy instruments, the importance of gender and equity considerations is acknowledged, and these factors are integrated into the discussion wherever pertinent.

The findings and recommendations presented in this report will be useful to policymakers, researchers, and practitioners involved in climate adaptation (and mitigation) efforts, contributing to the development of more effective and equitable climate policies.

The structure of D4.7 is as follows:

- Section 2: Contextualise the importance of national-level climate policy analysis, define the policy instruments, explain the methodology for data collection, describe the governance context in case study countries.
- Section 3: Focuses on case study specific local-level policy instruments (economic/ finance or investment), delving into their importance, mechanism, economic and equity considerations, and potential alternatives for improvements.
- Section 4: Discusses cross-cutting concepts like gender and equity considerations in climate policy.
- Section 5: Presents the conclusion, summarising the key findings and recommendations.

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2. Policy Analysis at National Level: Instruments and Governance structure

2.1. Setting the context

The urgency and complexity of climate change demand robust and well-informed policy responses at all levels of governance. Recognising this critical need, recent literature highlights the critical need for policy interventions, particularly at the national and sub national level (IPCC, 2024), to avert the most severe consequences of climate change. Callaghan et al. (2024) mentions that even under Paris Agreement warming levels, many climate-sensitive sectors will face irreversible and detrimental changes. This demands the urgent need for national-level policies that go beyond incremental adjustments and drive transformative adaptation and mitigation. Furthermore, the national/sub-national governments play a central role in steering financial flows and investments towards climate-resilient and low-carbon pathways. Building on this foundation, Callaghan et al. (2024) not only emphasises the urgency, but also provides a structured approach for policy instrument analysis by delivering a typology of climate policy instrument types derived by coding 84990 papers on climate policy research using machine learning (Figure 1). This paper builds on two existing typologies in two main climate policy databases: Climate Change Laws of the World (CCLW) and the Climate Policy Database by the New Climate Institute (CPDB)

D4.7 directly contributes to understanding the policy landscape by analysing existing cost-effective economic, finance, and investment policies. It provides crucial information and identifies potential gaps in addressing the escalating risks. By systematically categorising (see subsection 2.4 for details) and analysing these instruments (Market Based Instruments, Public Private Partnerships, Financial Instruments, Risk Financing Instruments, and Regulatory Policies), the deliverable provides a framework for governments to understand which instruments are currently being employed, their sectoral focus, and the identification of best practices.

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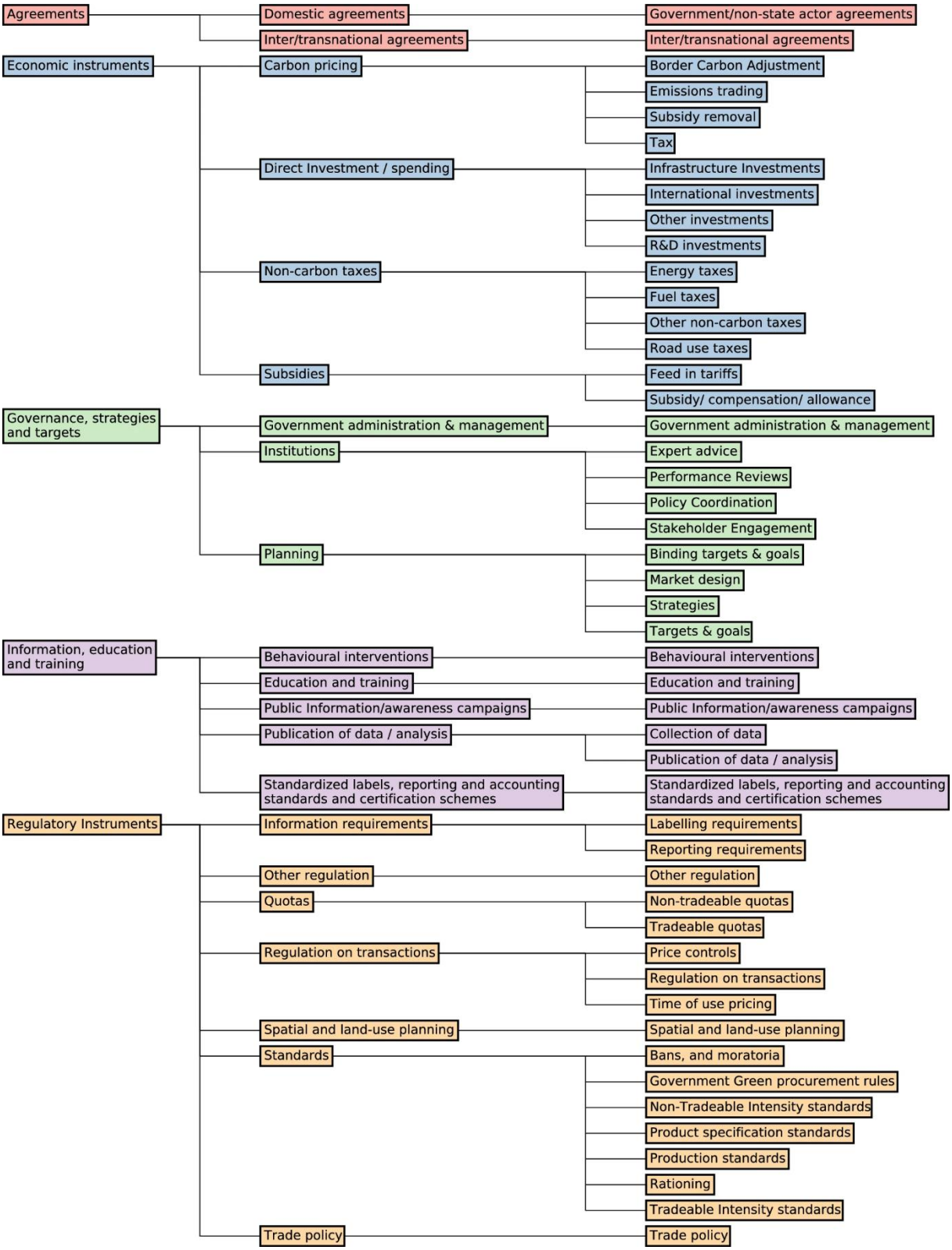

Figure 1 Typology of climate policy instrument types, Callaghan et al., (2024)

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2.2. Elaboration of various economic, finance and investment instruments

This subsection provides a concise overview of the various policy instruments employed in this deliverable, along with their merits, demerits and examples from real world implementation. The policy instruments analysed in this deliverable are chosen from various sources, including the literature (e.g., Callaghan et al., 2024; Bräuninger et al. 2011) and climate policy databases (e.g., CCLW, CPDB), to ensure relevance and comprehensiveness. For ease of categorising, the instruments are grouped into Market Based Instruments, Public Private Partnerships, Financial Instruments, Risk Financing Instruments, and Regulatory Policies following Bräuninger et al. (2011). The description of the instruments below has been summarised from multiple sources (e.g., Hanley et al., 2019; Pearce and Turner, 1990)

2.2.1 Market Based Instruments (MBIs)

Policies that use market signals to incentivise desired behaviours (e.g., emissions reduction, adaptation actions) are classified as MBIs. The core principle behind MBIs is to internalise the negative externality (environmental costs) associated with climate change, such as greenhouse gas emissions, or to reward actions (positive externality) that promote adaptation and resilience. By putting a price on pollution or creating a value for positive externality, MBIs encourage more efficient and cost-effective solutions compared to command-and-control regulations alone.

A wide range of instruments falls under the MBI umbrella. For example,

- *Subsidies, tax reductions and grants:* Financial support provided by governments to incentivise specific climate-friendly activities, such as renewable energy deployment, energy efficiency improvements, sustainable agriculture practices, or climate adaptation measures. Subsidies can reduce the upfront costs and risks associated with adopting these technologies or practices. Offering tax breaks or exemptions for environmentally preferable products, services, or investments. This can stimulate demand for cleaner technologies and practices and make them more economically attractive.
- *Taxes and fees:* Directly pricing goods (land, water, energy) or bads (emission) can alter behaviour. This increases the cost, encouraging businesses and consumers to switch to other alternatives, for example, imposing carbon tax would incentivise investing in energy efficiency, and reduce their carbon footprint. Revenue generated through this can be recycled back to the economy or used to fund climate action initiatives.
- *Licenses, permits and variations:* This includes tradable permits, project-based offsets, adaptation market mechanism, advance market commitments. Tradable Permits and Certificates create

markets for specific environmental attributes, such as renewable energy certificates or water use permits. These instruments allow for flexible allocation and trading of environmental resources, promoting efficiency. Emissions Trading Systems (ETS), also known as cap-and-trade, set a limit (cap) on total emissions within a defined sector or economy. Emission allowances are then created, which can be traded among participants. Entities that reduce their emissions below their allocated allowances can sell surplus allowances, creating an incentive for emission reductions while allowing flexibility in achieving them.

Project-Based Offsets are mechanisms that allow entities to compensate for their negative environmental impacts by investing in projects that generate positive environmental benefits elsewhere. In the context of climate adaptation, project-based offsets could involve investments in ecosystem restoration, flood mitigation infrastructure, or community-based adaptation initiatives (Davis, 2009). Adaptation Market Mechanism is a broader concept that encompasses various market-based approaches to incentivise climate adaptation. It could involve creating markets for adaptation goods and services, such as drought-resistant crops, flood-proof building materials, or climate risk insurance. Advance Market Commitments are agreements to guarantee a future market for a product or service that does not yet exist or is not yet widely available. In the context of climate adaptation, AMCs could be used to incentivise the development of new technologies or solutions for climate resilience, such as drought-resistant crops, early warning systems, or climate-resilient infrastructure (Kremer et al., 2020).

- *Payments for Ecosystem Services*: Rewarding resource owners for maintaining or enhancing ecosystem services that are beneficial for climate change adaptation or mitigation, such as carbon sequestration in forests, flood protection through wetlands, or water regulation.

Table 1 Different Market Based Instruments with their merits, demerits and illustrative examples.

Instrument	Merits	Demerits	Example
Subsidies	Incentivise adoption of adaptation measures, support vulnerable groups.	Costly, distort markets, and create dependency. Requires careful targeting to avoid unintended consequences.	The UK's Renewable Heat Incentive (RHI) provides subsidies to households and businesses that install renewable heating systems, such as heat pumps and biomass boilers (UK Government, 2023).
Taxes and fees	Discourage harmful activities, generate revenue for adaptation, and	Can be politically unpopular, regressively impact low-income groups,	France's carbon tax applies to fossil fuels used in transportation, heating, and industry, aiming to

	internalise environmental costs.	and may require complex administration.	reduce greenhouse gas emissions and generate revenue for climate action (Rocamora, 2017).
Licenses and permits	Regulate access to resources, create markets, and promote efficient allocation of resources.	Can be complex to administer, create barriers to market entry, and may require robust monitoring and enforcement.	The EU Emissions Trading System (EU ETS) caps greenhouse gas emissions from certain industries and allows companies to trade emission allowances, creating a market-based incentive for emission reductions (European Commission, 2020).
Payments for ecosystem services	Incentivise conservation and restoration of ecosystems, provide multiple benefits, and engage local communities.	Difficult to quantify and value ecosystem services, may require complex institutional arrangements, and raise concerns about commodification of nature.	The EU's LIFE program funds projects that promote nature conservation and biodiversity, including payments for ecosystem services schemes (European Climate, Infrastructure and Environment Executive Agency, 2025).
Water markets	Facilitate efficient water allocation during droughts, incentivise water conservation, and generate revenue for water management.	Can exacerbate inequalities in water access, raise concerns about privatisation of water resources, and may require complex infrastructure and institutions.	Spain's water trading system allows for the transfer of water rights between users, facilitating water allocation during droughts (Garrido et al., 2021).
Habitat banking	Can compensate for habitat loss, promote biodiversity conservation, and create economic opportunities.	Can be difficult to ensure ecological equivalence between impacted and restored habitats, raise concerns about offsetting rather than avoiding impacts, and may require complex regulations.	Germany's habitat banking system allows developers to offset habitat destruction by purchasing credits from landowners who have restored or conserved habitat elsewhere (Tucker, 2022)

From a macroeconomic perspective, climate change mitigation policies can be categorised into three primary types: economic incentives (such as carbon taxes), regulations (including bans on fossil fuels), and institutional approaches (such as mandatory disclosures); each of these categories is likely to impact both the demand and supply sides of the economy. These mitigation policies may reduce the overall cost of energy (through deployment of renewable generation) potentially leading to an overall decreased inflation. However, the effect on the productive capacity of the

economy and aggregate demand remains ambiguous, largely depending on how the carbon tax revenues are utilized, for example, recycled to increase economic activity and alleviate the negative direct impacts on GDP driven by carbon pricing (Yamazaki, 2017). Identically, policies that subsidise research and development of green technologies are more likely to enhance productivity and economic growth. Evidence suggests that a reduction in carbon credits, alongside market-driven carbon pricing, may lead to increased inflation and diminished economic growth (Bilal and Kaenzig, 2024). In contrast, multiple studies indicate that establishing a carbon price via carbon taxes (with recycling of revenues) tends to have a largely neutral effect on inflation and output, particularly at lower carbon pricing levels (Konradt and Weder di Mauro, 2022).

2.2.2 Public Private Partnerships (PPPs)

Collaborative arrangements between public and private entities to finance and deliver adaptation or mitigation activities. They can take various forms, including public contracts, service concessions, and joint technology initiatives. PPPs can leverage the expertise and resources of both the public and private sectors to implement adaptation projects more effectively.

Table 2 Different PPPs with their merits, demerits and illustrative examples

Instrument	Merits	Demerits	Example
Public contracts	Can leverage private sector expertise and resources, transfer risk to the private sector, and promote innovation.	Complex to negotiate and manage, raise concerns about transparency and accountability, and may lead to cost overruns or delays.	The construction of flood defences in the Netherlands often involves PPPs, where private companies design, build, and operate the infrastructure under contract to the government (European Investment Bank, n.d.).
Joint technology initiatives	Accelerate the development and deployment of adaptation technologies, leverage the expertise of both sectors, and share research and development costs.	Challenging to align public and private sector interests, raise intellectual property concerns, and may require significant coordination efforts.	The European Institute of Innovation and Technology (EIT) Climate-KIC is a joint technology initiative that supports the development and deployment of climate innovation (Climate-KIC, 2024).

2.2.3 Financial instruments (FIs)

FIs focus on increasing the accessibility of funding for climate adaptation projects. Loans can provide upfront capital for investments in adaptation measures, while guarantees can reduce the risk for private investors. FIs can play a crucial role in mobilising private sector finance for adaptation.

Table 3 Different Financial Instruments with their merits, demerits and illustrative examples

Instrument	Merits	Demerits	Example
Loans	Provide upfront capital for adaptation/mitigation investments, offer flexible repayment terms, and leverage private sector finance.	Can increase debt burdens, require collateral or creditworthiness, and may not be accessible to all borrowers.	The European Investment Bank (EIB) provides loans for climate adaptation projects, such as flood protection infrastructure and drought mitigation measures (European Investment Bank, 2025).
Guarantees	Reduce risk for private investors, mobilise private sector finance, and support innovative climate projects.	Can be costly for governments, require complex risk assessments, and may create moral hazard.	The European Commission's InnovFin program provides guarantees to financial intermediaries to support innovative projects, including those related to climate action (European Commission, 2025).

2.2.4 Risk financing instruments (RFIs)

RFIs help to compensate for losses through pre-arranged risk-sharing and pooling mechanisms. Insurance can provide financial protection against climate-related damages, while catastrophe bonds and weather derivatives can transfer risk to capital markets. RFIs can help to manage the financial impacts of extreme weather events and promote proactive adaptation.

Table 4 Different Risk financing Instruments with their merits, demerits and illustrative examples

Instrument	Merits	Demerits	Example
Insurance	Provide financial protection against climate-related losses, promote risk awareness, and incentivise proactive adaptation.	Can be expensive, may not cover all risks, and can create moral hazard if not carefully designed.	The UK's Flood Re scheme is a government-backed reinsurance program that makes flood insurance more affordable for homeowners in high-risk areas (UK Government, 2023).
Catastrophe bonds	Can transfer risk to capital markets, provide large-scale coverage, and diversify risk portfolios.	Can be complex to structure, may not be suitable for all risks, and can be sensitive to market conditions.	The African Risk Capacity (ARC) is a specialized agency of the African Union that issues catastrophe bonds to provide drought insurance to African countries (African Risk Capacity, 2024).
Weather derivatives	Hedge against weather-related risks, provide customized coverage, and	Can be complex to price and trade, may not be suitable for	Energy companies in Europe use weather derivatives to hedge against the risk of lower

facilitate risk management.	all risks, and can be subject to basis risk.	energy demand due to mild winters (Institute and Faculty of Actuaries, 2024).

2.2.5 Regulatory instruments

Regulatory instruments involve policies and rules implemented by governments or regulatory bodies to control or influence economic activities, protect public health and safety, and ensure environmental sustainability. They can take various forms, including legal frameworks, guidelines, command-and-control regulations, performance standards, bans and restrictions, and land-use planning and zoning. Regulatory instruments can provide a clear framework for adaptation actions and ensure that they are aligned with broader societal goals.
Information and awareness campaigns aim to educate and inform the public about climate risks and promote behavioural changes that support adaptation efforts. They can use various channels, such as public service announcements, educational programs, and community outreach initiatives. Information and awareness campaigns can play a crucial role in empowering individuals and communities to take action on climate adaptation.

Various regulatory measures may be implemented to discourage carbon-intensive production or mandate reductions in carbon inputs. Although from a macroeconomic perspective, the economic literature on this subject is limited, such regulatory measures may increase costs and consumer prices in the short-term, driving higher inflation rates (Bilal and Kaenzig, 2024; Konradt and Weder di Mauro, 2022).

Table 5 Different Regulatory Instruments with their merits, demerits and illustrative examples

Instrument	Merits	Demerits	Example
Legal frameworks, guidelines	Provide a clear framework for adaptation, ensure consistency and coordination, and promote legal certainty.	Can be inflexible, slow to adapt to changing circumstances, and may stifle innovation.	The EU's Water Framework Directive establishes a framework for the management of water resources, including measures to adapt to climate change impacts on water availability (European Commission, 2024).
Command-and-control regulations	Enforce specific adaptation/ mitigation measures, ensure compliance, and provide clear standards.	Costly and inefficient, stifle innovation, and may not be appropriate for all contexts.	Building codes in many European countries mandate the use of energy-efficient materials and appliances, contributing to climate adaptation by reducing energy consumption and greenhouse gas emissions.

			They also detail requirements that all construction work must meet with regards to fire, safety and health (International Code Council, 2024).
Performance standards	Set clear targets for adaptation/ mitigation, promote efficiency, and allow flexibility in implementation.	Can be difficult to monitor and enforce, may not address all risks, and can create perverse incentives.	The EU's Energy Efficiency Directive sets targets for reducing energy consumption, which can contribute to climate adaptation by lowering greenhouse gas emissions and improving energy security (European Commission, 2020).
Bans and restrictions	Prevent harmful activities, protect vulnerable areas, and promote sustainable practices.	Can restrict economic activity, limit individual freedoms, and may be difficult to enforce.	Several European countries have implemented bans or restrictions on the use of certain pesticides that are harmful to pollinators, which can contribute to climate adaptation by protecting biodiversity and ecosystem services (Food and Agriculture Organization, 2024).
Land-use planning and zoning	Guide development away from high-risk areas, promote sustainable land use, and protect ecosystems.	Can restrict property rights, limit development opportunities, and may require complex planning processes.	Many European countries have zoning regulations that restrict development in floodplains or coastal areas, reducing the risk of flood damage and protecting valuable ecosystems (Global Facility for Disaster Reduction and Recovery, 2014).
Public service announcements, educational programs, community outreach	Raise awareness of climate risks, promote behavioural changes, and empower communities to take action.	Can be costly, may not reach all audiences and therefore may not be sufficient to drive significant climate action.	The European Commission's "Climate-ADAPT" platform provides information and resources on climate adaptation, including case studies, best practices, and guidance documents (European Environment Agency, 2024).

A diverse range of policy instruments can be used to promote climate action. The choice of instruments depends on the specific context, including the nature of climate risks, the socioeconomic conditions, and the policy priorities. By carefully considering the merits and challenges of different

instruments, policymakers design effective and equitable adaptation strategies that enhance resilience to climate change impacts.

2.3 Case Studies Overview

This sub-section provides an overview of the 8 case studies examined in this Deliverable across different nations, highlighting key characteristics and policy instruments relevant to climate adaptation (and mitigation) focusing on the climate challenges mentioned in the Grant Agreement. The case studies cover a range of climate challenges, including heat waves, droughts, storms, floods, snow and ice, and indirect and spillover effects of climate change (Table 6). Specifically, the CROSSEU case studies investigates (1) Health sectors in the United Kingdom and Czech Republic, (2) Multiyear drought on agriculture and food security in Central and South-Eastern Europe, (3) Storm damages in South Western Denmark and Northern Germany, (4) Valuation of social benefits of floods and flash floods adaptation and mitigation in Northeastern Italy, (5) Snow-related hazard risks in the European Alps and Carpathians, (6) Risks for socio-ecological systems in the Lower Danube, (7) Concurrent climate hazards on energy systems in Europe, and (8) Transboundary effects on agriculture and labour productivity.

Table 6 Case study overview

Case Study	Country/Region	Climate Challenge	Focus Sub-Sectors
1 STL HEAT	Czech Republic, United Kingdom	Heat waves	Human health, urban areas
2 STL DROUGHT	Romania	Droughts	Agriculture, water resources
3 STL STORM	Denmark	Storm surges	Coastal zones, infrastructure
4 STL FLOOD	Italy	Floods	Urban areas, infrastructure, agriculture, forestry
5 STL SNOW	Romania and Italy	Snow hazards	Mountain regions, tourism, forestry, transport
6 STL INDIRECT	Lower Danube	Indirect effects of climate change on agriculture	Agriculture, forestry
7 STL INDIRECT	Europe	Indirect effects of climate change on power systems	Electricity production, transmission, and consumption
8 STL SPILLOVER	Global	Spillover effects of climate change impacts on agriculture	Agriculture

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2.4 Climate policy Governance structure in case study countries

2.4.1 Czech Republic

The Czech Republic's climate policy governance is characterised by a strong influence of EU legislation and a lack of a formalised national framework. This presents both opportunities and challenges. While the EU's guidance and support might have driven significant progress in reducing GHG emissions, the absence of a comprehensive national strategy and a dedicated scientific advisory body may have hindered the country's ability to effectively address the complexities of climate change (European Parliamentary Research Service, 2024)

The Ministry of the Environment is the primary body responsible for climate policy, collaborating with an inter-ministerial working group on climate change issues (Ministry of the Environment of the Czech Republic, 2017)

In addition to the Ministry of the Environment, several other entities play a role in climate policy governance. While these entities contribute to climate policy development and implementation, the absence of a dedicated independent scientific advisory council and a comprehensive climate law poses challenges to effective governance (European Parliamentary Research Service, 2024)

Table 7 Different climate entities in Czech Republic

Entity	Role
Commission for Climate Action	Advises policymakers on climate-related research and development funding. This commission has been abolished in 2023 (Rada pro výzkum, vývoj a inovace, 2023)
Government Council for Sustainable Development	Inter-ministerial roundtable focused on environment and sustainable development issues, including climate change.
Ministry of Industry and Trade (MIT)	Plays a role in shaping energy and climate policies.

Regional governments play a crucial role in climate policy implementation in the Czech Republic. They are responsible for adapting to climate change at the local level and implementing measures to reduce emissions and promote sustainability. This is reflected in the Czech Republic's Adaptation Strategy, which emphasises cooperation between the government, local governments, and organisations providing public services to reduce the country's vulnerability to climate change. The National Action Plan on Adaptation to Climate Change further supports this strategy by outlining specific measures to address climate change impacts (Ministry of the Environment of the Czech Republic, 2015). The city of Prague provides a prime example of local climate action. Prague has developed its own Climate Change Adaptation Strategy, which focuses on enhancing

resilience to climate change impacts through nature-based solutions and other measures (City of Prague, 2020).

Civil society organizations (CSOs) and non-governmental organizations (NGOs) play an important role in shaping and implementing climate policy in the Czech Republic. They contribute to raising awareness, advocating for policy changes, and monitoring the government's progress in meeting its climate commitments. The involvement of CSOs and NGOs is crucial for ensuring transparency, accountability, and public participation in climate policy governance. Public awareness and individual behaviour change are also crucial for achieving climate targets. In the Czech Republic, a majority of citizens (54%) expect the national government to tackle climate change, while 46% see it as a task for business and industry. The EIB Climate Survey reveals that a majority of Czechs (59%) are in favour of stricter government measures to impose a change in personal behaviour to tackle climate change, with this support even higher among young people (75% of those under 30) (European Investment Bank, 2023).

Moving forward, the Czech Republic should prioritise the development of a comprehensive climate law, the establishment of an independent scientific advisory council, and the strengthening of public participation mechanisms. These steps will enhance the country's climate governance framework and enable it to effectively address the challenges and opportunities of the green transition.

2.4.2 Denmark

Denmark's climate policy governance is characterised by a long-standing commitment to green transition, building upon a strong political consensus and increasingly formalised structure. It can be characterised by a collaborative approach involving various stakeholders, ensuring that climate action is integrated across government levels (Gram-Hanssen et al., 2023). While Denmark operates within the EU climate policy framework and adheres to EU directives, the major element is a strong national and sub national framework with distinct entities playing crucial roles in shaping and implementing its ambitious climate agenda. This highlights both the benefits of EU-level coordination and the importance of tailored national responses within a shared European context.

Table 8 Different climate entities in Denmark

Entity	Role
Ministry of Climate, Energy and Utilities (KEFM)	Holds the primary responsibility for developing and implementing Denmark's climate, energy, and utilities policies. This is only related to mitigation policies.
Ministry of Environment (MIM)	Has the overall responsibility for climate adaptation in Denmark and coordinates the national work. Additionally, the Ministry also coordinates and collaborates with other EU countries on climate adaptation.
The Environmental	Manage decision making on adaptation to climate change by ensuring that adaptation is integrated into environmental legislation and guidelines. EPA is part of MIM

Protection Agency (EPA)	
The Danish Coastal Authority (DCA)	National authority which is integrated in the EPA with respect to the implementation of adaptation along coastlines by the state and otherwise serves in an advisory role to the municipalities.
Local Governments and the interest association (KL)	Association of 98 Danish municipalities and play a crucial role in implementing climate action at the local level. They are responsible for areas such as local energy planning, building regulations, public transportation, waste management, and climate adaptation measures within their geographical areas. KL acts as the interest organisation and voice of the municipalities, facilitating knowledge sharing and coordinated action.

Danish CSOs and NGOs are highly active in the climate policy space. They play a vital role in public awareness campaigns, advocacy for ambitious climate policies, monitoring government actions, and engaging citizens in the green transition. Such organisations are prominent voices, often contributing to public debate and holding government and businesses accountable.

2.4.3 Italy

Italy operates within the European Union's climate policy framework and maintains a national structure for climate action, characterised by a multi-level governance approach involving various stakeholders. However, further formalising the roles and responsibilities within a clear legal and institutional framework could strengthen governance. This might involve specific climate laws that clearly define the roles of different levels of government and establish mechanisms for coordination and accountability.
Regions and autonomous provinces in Italy hold significant legislative and administrative power, particularly in areas like environmental protection, land use planning, and energy. Municipalities are at the forefront of implementing climate action on the ground. They are responsible for local urban planning, sustainable mobility, building energy efficiency in municipal buildings, local waste management, and implementing local climate adaptation measures. Provinces, where they still hold significant functions, can play a coordinating role across municipalities within their territory, especially in areas like water resource management and broader land planning impacting climate resilience.

Italian environmental organisations and NGOs are also highly active and vocal in the climate policy space. They play a vital role in raising public awareness, advocating for more ambitious climate policies, monitoring government and corporate actions, and engaging citizens in the green transition. They participate in public debates, conduct research, and often work at the local level to promote sustainable practices and hold authorities accountable.

Table 9 Different climate entities in Italy

Entity	Role
Ministry of Environment and Energy Security (Ministero dell'Ambiente e della Sicurezza Energetica - MASE)	Holds the primary responsibility for developing and implementing Italy's national climate, energy, and environmental policies
The National System for Environmental Protection (Sistema Nazionale per la Protezione dell'Ambiente - SNPA)	Acts as the technical and scientific body supporting environmental policymaking and implementation.
Provinces and Municipalities (Province e Comuni)	Responsible for local urban planning, sustainable mobility

2.4.4 Romania

Romania's climate governance is characterized by a multi-level approach, with key responsibilities distributed across national ministries, agencies, and local authorities (Paton, 2023). The governance structure is still developing, with ongoing efforts to enhance coordination, strengthen institutional capacity, and increase stakeholder engagement in climate policymaking. While, historically less formalized than some Western European counterparts, Romania is strengthening its climate governance framework to align with EU directives and meet its national targets for emissions reduction and climate resilience. Romania's governance operates within the broader EU climate policy framework and is significantly shaped by EU regulations and directives. However, it is developing its national architecture to translate the commitments into concrete action within the Romanian context.

Table 10 Different climate entities in Romania

Entity	Role
Ministry of Environment, Waters and Forests	Leads on national climate strategy development, greenhouse gas emissions reporting (under EU regulations), adaptation planning, biodiversity conservation, and international climate negotiations participation.
Inter-Ministerial Committee on Climate Change	A coordinating body involving representatives from various ministries. aims to ensure horizontal policy coherence and coordination across sectors on climate change issues. It facilitates inter-ministerial collaboration in implementing climate strategies and addressing cross-sectoral climate challenges.

Funded by the European Union

Romanian municipalities and counties are responsible for urban planning, local energy efficiency initiatives, public transport, waste management, and implementing climate adaptation measures at the local level. The National Union of County Councils of Romania and the Association of Romanian Municipalities act as representative bodies for local governments in climate and sustainability discussions. Romanian CSOs and NGOs are becoming increasingly active in advocating for stronger climate policies, raising public awareness, and monitoring government actions. NGOs contribute to public discourse, participate in consultations, and engage in project implementation related to climate action and environmental protection.

2.4.5 United Kingdom

The UK's climate policy governance is characterised by a robust and formalised structure, built upon a strong legal framework and dedicated institutions. At the heart of this system is a legally binding net-zero target, enshrined in the Climate Change Act 2008 (amended 2019). This Act not only sets ambitious emissions reduction targets but also mandates independent scrutiny and expert advice that is provided through the Climate Change Committee (CCC). The Climate Change Act 2008 covers both mitigation and adaptation. In terms of adaptation, there is a continuous 5-year cycle beginning with a UK Climate Change Risk Assessment (CCRA), formally led by the Department for Environment, Food & Rural Affairs (Defra), which informs the National Adaptation Programme aimed at responding to key climate-related risks. The CCRA is informed by evidence from the CCC's Independent Assessment of UK Climate Risk Report.

The UK's climate governance landscape features a diverse set of players, each playing a crucial role in shaping and implementing climate action (Climate Change Committee, n.d.; Department for Energy Security and Net Zero, n.d.). The involvement of devolved administrations (Scotland, Wales, Northern Ireland), local authorities, Metro Mayors and Combined Authorities (e.g. Greater London and Manchester) ensures that climate action is integrated across all levels of government (Torrance, 2024). This allows for tailored approaches to regional challenges while contributing to national goals (Fankhauser, 2023). Post-Brexit, the UK has developed its own independent policies, Emissions Trading Scheme (ETS) and regulatory frameworks, no longer formally following the EU climate policy cycle. However, although the UK no longer follows the EU climate policy cycle, EU policies continue to influence the UK through trade agreements, environmental standards, and shared international commitments such as the Paris Agreement. This highlights the interconnectedness of climate action across Europe.

Table 11 Different climate entities in United Kingdom

Entity	Role
UK Parliament	Legislates climate policy, Climate Change Act.

Department for Energy Security and Net Zero (DESNZ)	Holds primary responsibility for developing and implementing climate change mitigation (UK's NetZero strategy and carbon budget). Established in 2023, it replaced the Department for Business, Energy & Industrial Strategy (BEIS) and signifies a focused approach to energy security alongside net-zero goals.
Department for Environment, Food & Rural Affairs	Responsible for Adaptation policy. Leads the UKs Climate Change Risk Assessment and National Adaptation Programme. Lead for the Adaptation Reporting Power, a mechanism to encourage organisations to assess and report on their risks and adaptation actions.
Climate Change Committee (CCC)	The CCC provides expert advice to the government, scrutinizes existing policies, and monitors progress towards national climate targets, ensuring transparency and accountability. The CCC's Adaptation Committee provide the independence evidence report to inform the UKs CCRA.
Devolved Administrations	Recognizing the importance of regional nuances, the UK system empowers Scotland, Wales, and Northern Ireland to develop and implement their own climate policies and governance structures. This allows for tailored approaches while contributing to national targets.
Combined Authority Mayors (Metro Mayors)	Mayors (Greater Manchester, London, West Midlands) have powers over regional transport, development, and energy allowing them to set and implement regional climate targets.

Local Authorities act as crucial implementers and policymakers in climate action. They translate national policies into tangible local initiatives. This includes planning for climate adaptation, promoting energy efficiency in buildings and transport, and supporting renewable energy projects. Local authorities also develop their own climate plans, many have set their own NetZero targets and lead local climate initiatives, and CSOs and NGOs play a vital role in raising public awareness, advocating for policy changes, and holding the government accountable for its climate commitments (Local Government Association, 2024; WWF, 2024). Their active participation ensures broader societal engagement in climate action.

Funded by the European Union

3. Case Studies: Policy Analysis at Local Level

3.1 Steps for Collating Data/Information in the Case Studies

A template for data collection is designed to guide case study leads in collating and documenting relevant economic, finance, and investment policies/instruments (section 2) related to climate change within their respective case study contexts. This template aids in having a structured approach, ensuring consistency and comparability across the case studies.

Step 1: Preparation and Understanding the Context

Objective Clarification: The template begins by clearly stating the objective of the deliverable, which is to understand the existing economic, finance, and investment policies and instruments at the National and local levels in the context of climate change. This includes how these policies/instruments address:

- Climate Change Adaptation: Policies aimed at adjusting to actual or expected future climate and its effects.
- Climate Change Mitigation: Policies focused on reducing or preventing greenhouse gas emissions.
- Sustainable Development: Policies that integrate economic, social, and environmental considerations for long-term well-being.
- Social Cohesion: Policies that aim to maintain and strengthen social bonds and equity in the face of climate change.
- Gender Equity: Policies that specifically consider and address gender disparities in relation to climate change impacts and solutions.

Step 2: Policy and Instrument Identification & Categorisation: This includes the following:

Policy/Instrument - Naming: The name of the instrument is written for each identified policy or instrument relevant to the chosen extreme event and case study context.

Policy/Instrument – Description: The identified policies/instruments are briefly described.

Policy/Instrument Type Selection: The policy/instrument type (Callaghan et al., 2024; Bräuninger et al., 2011) are selected from the provided dropdown list. The list contains the following categories (see subsection 2.2 for details):

- Market Based Instruments (MBIs), which can promote proactive adaptation through monetary incentives.
- Public Private Partnerships (PPPs), which can cover contracts between public and private entities to finance adaptive activities or cover losses.
- Financial instruments (FIs), which include increased accessibility of loans for adaptation activities in the private and public sector.
- Risk Financing Instruments (RFIs), which compensate losses through pre-arranged risk sharing and pooling mechanisms, may help with coping with the additional burdens imposed by climate change and may incentivise proactive adaptation.

Funded by the European Union

- Regulatory: policies or rules implemented by governments or regulatory bodies to control or influence economic activities, protect public health and safety, and ensure environmental sustainability. They can take various forms, including setting a framework/guidelines/binding targets, command-and-control regulations, performance standards, bans and restrictions, and land-use planning and zoning.
    - Sector identification: The sector most relevant to the policy/instrument is identified. The sectors include the following as per the CROSSEU Project Grant Agreement:
        - Agriculture/Food Security
        - Biodiversity
        - Energy
        - Finance
        - Forestry
        - Health
        - Insurance
        - Migration
        - Social Justice
        - Tourism
        - Transport
        - Water
        - Industry
        - Buildings
        - Infrastructure (coastal management, water management, Nature-Based Solutions - NB)
        - All, multiple and NA are included to provide for instruments with broad, cross-cutting impacts, those affecting several sectors, and those not directly applicable to predefined sectors, respectively.
    - Climate Change Focus - Adaptation, Mitigation, or Both: Here the primary climate change focus of the policy/instrument is listed. The dropdown has the following options:
        - Adaptation: Primarily focused on adapting to climate change impacts.
        - Mitigation: Primarily focused on reducing greenhouse gas emissions.
        - Both: Addresses both adaptation and mitigation.
    - Level of Government - Governance Level: Here the level of government primarily responsible for implementing the policy/instrument are identified. The list includes:
        - EU (European Union)
        - National
        - Regional
        - Local

3.2 Descriptive statistics of collated Data/Information across case studies

Table 1e 12 presents a summary of the policy instruments identified and analysed across the eight case studies. A total of 101 policies, strategies and instruments were identified across all case studies. The top row of the table indicates the total number of policies and strategies listed for each case study, providing a sense of the scope of the policy landscape examined.

Table 12 Summary of the policy instruments identified and analysed across the eight case studies.

Items	Case Study	HEAT_CZ	HEAT_UK	DROUGHT_RO	STORM_DK	FLOOD_IT	SNOW_RO	INDIRECT	INDIRECT_Energy	SPILLOVER_Agriculture	Total
Total policies/strategies listed		18	8	13	17	11	13	14	3	4	101
Policy type/Instrument	MBIs	7	0	2	2	0	0	0	0	0	11
	PPPs	0	0	0	1	0	0	0	0	0	1
	FI	0	0	0	0	0	0	0	0	0	0
	RFI	0	0	0	2	3	1	1	0	0	7
	Regulatory instruments	11	8	11	12	8	12	13	3	4	82
Sector	Agriculture/Food security	0	0	5	0	0	0	3	0	4	12
	Biodiversity	2	0	0	0	0	0	1	0	0	3
	Energy	3	0	0	0	0	0	0	2	0	5
	Finance	0	0	0	5	0	0	0	0	0	5
	Forestry	0	0	1	0	1	1	1	0	0	4
	Health	1	2	0	0	0	0	0	0	0	3
	Insurance	0	0	0	0	0	0	1	0	0	1
	Migration	0	0	0	0	0	0	0	0	0	0
	Social justice	0	0	0	0	0	0	0	0	0	0
	Tourism	0	0	0	0	0	1	0	0	0	1
	Transport	2	0	0	0	0	0	1	0	0	3
	Water	1	0	0	0	1	0	1	0	0	3
	Industry	1	0	0	0	0	0	0	0	0	1
	Buildings	1	3	0	1	1	0	0	0	0	6
	Infrastructure- coastal management/	1	0	0	6	4	0	0	0	0	11
	NA	0	3	7	5	4	10	6	0	0	35
	All	1	0	0	0	0	0	0	0	0	1
	Multiple	5	0	0	0	0	1	0	1	0	7
Climate Change Focus	Adaptation	5	6	7	13	8	7	6	0	2	54
	Mitigation	8	0	1	0	0	0	2	1	0	12
	both	5	2	5	4	3	6	6	2	2	35
Level of Governance	National	16	8	13	9	6	10	13	2	0	77
	Local	0	0	0	7	3	1	0	0	4	15
	Regional	1	0	0	0	2	1	1	0	0	5
	EU	1	0	0	0	0	2	0	1	0	4

The "Policy Type/Instrument" section details the distribution of policy types: Market-Based Instruments (MBIs), Public-Private Partnerships (PPPs), Financial Instruments (FIs), Risk Financing Instruments (RFIs), and Regulatory Instruments. Regulatory instruments are the most prevalent across the case studies, with a total of 82, highlighting a common reliance on legal and administrative frameworks. MBIs show a limited presence in some case studies, while RFIs are used in STORM_DK, FLOOD_IT, SNOW_RO, INDIRECT_Energy, INDIRECT, and SPILLOVER_Agriculture, suggesting a focus on financial risk management in these contexts. PPPs and FIs are minimally represented, with PPPs appearing only once (STORM_DK) and FIs not at all.

Funded by the European Union

The "Sector" section illustrates the sectoral focus of the policies. DROUGHT_RO policies are concentrated in Agriculture/Food Security and Finance, reflecting the direct impact of drought on these areas. HEAT_CZ and HEAT_UK policies focus on Health and Buildings, indicating an emphasis on addressing heat-related impacts in human health and the built environment. STORM_DK policies are heavily oriented towards Finance and Infrastructure-coastal management, addressing the economic and physical vulnerabilities to storm events. SNOW_RO policies have some focus on Forestry, Transport and Insurance. INDIRECT policies show a spread across Agriculture/Food Security, Biodiversity, Forestry and Water. Note that policies related to migration and social justice are included in Tasks 4.2 and 4.3 and are considered in D4.3, D4.4, D4.5 and D4.6

The "Climate Change Focus" section reveals that Adaptation is the primary focus across the case studies, with 54 policies categorized as such. However, some case studies also include a significant number of Mitigation policies, most notably HEAT_CZ (8), and some case studies show policies addressing both Adaptation and Mitigation.

Finally, the "Level of Governance" section shows the distribution of responsibility for the policies. National-level policies are predominant across most case studies, with a total of 77, indicating a centralized approach. Local-level policies are more prominent in DROUGHT_RO and STORM_DK, suggesting a more decentralized approach in these contexts. Regional and EU-level policies have a smaller presence.

The appendix provides a brief description of the 101 policies, strategies and instruments identified across all case studies. This appendix is available for further review in the project's internal folder.

3.3 STL HEAT

3.3.1 Czech Republic´s Boiler replacement scheme

Importance and alignment with national policy

Environmental pollution belongs among the key indicators determining the regional differences in the quality of life in the Czech Republic (Hájek 2017, Hůnová et al. 2021, Machaczka et al. 2023). While short-term exposure to high levels of air pollution (e.g. particulate matter) can lead to reduced lung function, respiratory infections and aggravated asthma, long-term exposure to air pollution has been associated with an increased person's risk for non-communicable diseases including stroke, heart disease, chronic obstructive pulmonary disease and cancer (WHO 2025). Since the presence of chronic cardiovascular and respiratory illnesses belong to the main factors increasing the risk of heat-related mortality risk (Davídkovová et al. 2014), long-term exposure to air pollution also increases the impact of heat waves on mortality.

The aims to reduce local air pollution have been mentioned in national climate policies as part of the mitigation and adaptation strategies (MIT

2024a). While Czech Republic has made notable progress in improving air quality since 1991, local air pollution (i.e. from individual heating sources) remains a key health issue, especially in small municipalities with the prevalence of family houses with individual heating systems (IEA 2021).

The boiler replacement scheme called "Kotlíková dotace" (Státní fond životního prostředí ČR., n.d.) has been operating since 2014 under the Operational Programme Environment (Státní fond životního prostředí ČR, 2021). Since 2024, the scheme has been included into the "Nová zelená úsporám" (New Green Savings, n.d.) subsidy programme. The main aim of these programmes is to motivate the owners of residential properties to replace the old, high-emission and low-efficient coal-based boilers with modern more efficient alternatives. This measure aims to contribute to both the improvement of air quality during winter months at the municipality level and reduction of GHG emissions.

How it works?

The government has provided grants and interest-free loans for the replacement of inefficient solid fuel boilers in single-family houses. The programme was open for applications from 2014 and resulted in the replacement of over 82,000 boilers by 2020 (IEA 2021). The programme had five phases. While in the initial phase (from 2014 to 2015) subsidies for replacing inefficient coal boilers with highly efficient coal-fired boilers were still eligible, subsequent phases gradually limited the support to high-efficiency and low-emission boilers, such as heat pumps, gas condensing boilers and biomass boilers. The public has shown strong interest in the programme and the allocated financial resources under the programme have been almost completely exhausted (IEA 2021).

The financial subsidies have been accompanied with regulatory and legal measures. The sale of high emission boilers (Class 1 and Class 2 out of a total of five classes) was banned on 1 January 2014. The sale of Class 3 boilers was banned on 1 January 2018. And finally, since 1 January 2020, only Class 5 (the lowest emission class) can be sold in Czechia. Moreover, the 2019 amendment of the Air Protection Act (No. 201/2012) prohibits the use of Class 1 and Class 2 boilers after September 2024. This legislation affects approximately 450 000 boilers in the country that need to be replaced (IEA 2021)

Economic, Equity and Distributional Considerations

The last two phases of the boiler subsidy programme (after 2020) had a special focus on the replacement of low-efficiency heaters for the elderly and low-income households (as defined in the Energy Efficiency Directive – EU/2023/1791). The "Kotlíková dotace" programme ended in August 2024. Nonetheless, the replacement of non-compliant solid fuel boilers has still been possible under the programmes "Nová zelená úsporám" and "Nová zelená usporám Light". These programmes subsidise not only the boiler

replacement scheme, but also other measures to increase the energy efficiency of Czech households. Nová zelená usporám Light, which focuses on elderly and low-income households, aims to pre-finance the replacement of boilers by means of soft loans that can be up to 100% of the replacement costs (NZU 2025). In addition, the programme provides the services of a boiler exchange specialist to provide the household with comprehensive advisory services (IEA 2021).

Alternative approaches and Recommendations

According to the IEA review report, taxation of heating fuels in the Czech Republic is low compared with other EU countries, particular for individual carbon fuel-based heating systems that do not fall under the ETS (IEA 2021). The report therefore recommends introducing a carbon tax to provide incentives for reducing carbon intensity, and to create a level playing field between fuels used in different heating systems.

3.3.2 Low-emission mobility programme in Czech Republic

Importance and alignment with national policy

Traffic has been the main source of air pollution in big cities like Prague and Brno (Magistrát hlavního města Prahy, n.d.). Moreover, GHG emissions for the transport sector have been increasing (in the contrary to other sectors), due to the increasing vehicle fleet and oil consumption, and the lack of financial instruments to reverse this trend (IEA 2021). Consequently, the Czech Republic has been off the track to reach the target for the use of renewables in the transport sector currently. This situation has been reflected in the updates of the Nation Energy and Climate Plan (NECP, MIT 2024a) and the National Action Plan for Clean Mobility (NAPCM, MIT 2024b). According to the latter document, the country aims to have between 220,000 and 500,000 battery-only and/or plug-in hybrid vehicles in Czechia by 2030 (compared to about 6 000 vehicles in 2020) (IEA 2021). In 2022, the Parliament has approved the Low-emission Mobility Act (No. 360/2022) that sets the minimum share of no-/low-emission transport vehicles purchased in public tenders (i.e. by municipalities, government, public institutions, etc.) between 2025 and 2030.

How it works?

In accordance with the national low-emission mobility targets, several subsidy programmes to facilitate the purchase of low emission vehicles and development of the required infrastructure (MoE 2023). The most important call was launched in December 2022 under the Integrated Regional Operational Programme (Ministerstvo pro místní rozvoj ČR, n.d.). The special call 6.1 for Low-emission and emission-free vehicles in public transport (Ministerstvo pro místní rozvoj ČR, n.d.) provides €128 million for the

purchase of new public transport vehicles. The call is open until December 2027. To the date (22 Feb 2025) 72,8% of the resources have been allocated. The Low-emission public transport call has been divided into two chapters based on the regional development level.

In previous calls, tax reliefs and subsidies were in place to support mainly CNG vehicles (IEA 2021). A key focus of the CNG programme was to replace old, diesel-powered city and inter-city buses with CNG fuelled buses.

Increasing attention has been paid to electric vehicles; recent grants focus mainly on the relevant infrastructure such as building new charging points. The NAPCM targets that by the end of 2025, all cities with a population more than 10 000 should have charging stations installed (IEA 2021). Electric vehicle owners also benefit from other support measures, such as an exemption from the road tax, reduced or free parking and an exemption from highway tolls (Šitner 2024).

Economic, Equity and Distributional Considerations

The current subsidy programmes are intended mainly to businesses, municipalities, regional and other public entities, but not for individual citizens and private vehicles (Šitner 2024). Buying a new vehicle (regardless of the type of fuel) has been still an expensive affair for many private users. The average age of the passenger car fleet in the Czech Republic was the third oldest in Europe in 2019, which is in a strong contrast with the below average age of the Czech fleet of buses and light, medium and heavy commercial vehicles (ACEA, 2021).

The Czech Republic is a significant market for the second-hand vehicles, and the government does not offer specific incentives to scrap old cars and to replace them with newer ones (Fraňková, 2016). Nor are there any legal or regulatory measures in place to remove old inefficient vehicles from the road. Additionally, it is worth noting that the right to own a fossil fuel vehicle has been a key political issue in the Czech Republic, significantly influencing local elections (Zachová 2024).

Alternative approaches and Recommendations

The IEA review report (IEA 2021) recommends introducing measures to make the vehicle fleet younger and more energy efficient, speed up the introduction of electric vehicles, implement the measures identified in the updated NAPCM in a timely fashion, effectively with a sufficient budget.

United Kingdom

3.3.3 Green Home Finance Accelerator programme in the UK

Importance and alignment with national policy

It is widely recognised that high temperatures can pose numerous health risks, including increases in morbidity and mortality, including in the UK (Jenkins et al., 2022), with periods of extreme heat and heatwaves projected to increase in frequency and intensity under climate change (IPCC, 2023). In the UK the summer of 2018, which was up to 3°C warmer than the baseline climate, is projected to occur every other year by 2050 (Met Office, 2022). These temperatures have large repercussions for public health in the UK, with effects often exacerbated by localised socio-economic factors such as deprivation, underlying health conditions and quality of accommodation (Ellena et al., 2020; Lindley et al., 2011; Paavola, 2017; Sera et al., 2019).

The Green Home Finance Accelerator (GHFA) programme is a government led initiative to support the design and testing of pilot studies providing finance mechanisms to encourage low carbon and efficient energy and heating, and to support retrofit measures in existing residential housing (DESNZ, 2024). The programme aims to support homeowners to decarbonise and invest in energy efficient measures. Importantly it is focused on fostering partnerships between lenders, investors and property value chains to incentivise the creation of products and services for homeowners, acknowledging current limited demand and financial barriers at the household level. Furthermore, it aims to explore current barriers and motivators for energy efficiency at the household level, way to reduce such barriers, and ways to finance measures (DESNZ, 2024). The GHFA aligns with national policy as a component of the UK Government's Net Zero Innovation Portfolio (NZIP) which focuses on support to mitigate climate change. Whilst the focus overall is on mitigation, in relation to energy efficient housing and retrofit options, synergies with adaptation are clearly highlighted. In this regard it aligns with the UKs National Adaptation Programme (NAP), setting out a 5-year plan for action to address priority risks. In response to the UK's Climate Change Committee 2023 report, mandated under the UK's 2008 Climate Change Act, the UK government was required to reflect on this technical evidence and published its third NAP (Defra, 2024). In response to high priority risks to overheating in residential and commercial properties and risks to human health, wellbeing and productivity (Climate Change Committee, 2021) the NAP has highlighted in its policy recommendations the need to make finance available to install adaptation measures for overheating. It is recognised that under the GHFA, if energy efficiency retrofits are installed correctly then they should not exacerbate heat risk in buildings and can in fact reduce heat risk for many building types.

How it works?

The programme is being delivered by PwC on behalf of the Department for Energy Security and Net Zero. While PwC is responsible for market engagement, the competition process, monitoring project performance and capturing learning from the projects, the UK government via DESNZ has ultimate decision making on grant awards and provides funding.

Interested organisations were invited to apply for funding, beginning with a first 'discovery' phase that selected and supports ~25 projects with low value grants to develop new products and test these through strategic pilot studies. Phase two then supported a sub-set of projects successfully piloted in phase one, with more significant grants to test their products on the market over ~15 months. To date, £16 million has been awarded to thirteen projects through phase two to upscale and test different green finance mechanisms, products and consumer platforms.

Figure 2 Timeline of the UKs Green Home Finance Accelerator (GHFA) programme. Source: (Carbon Trust, 2025)

Economic, Equity and Distributional Considerations

The GHFA could benefit families in terms of spiralling energy costs across the UK as well as improving the efficiency of housing to both retain heat in the winter and avoid overheating in the summer. Providing more attractive green finance options is required to get to a critical mass of demand. The GHFA provides an initial initiative on which to build in the future to provide more options for the who wish to invest in energy efficient home improvements (Phillips et al., 2022). However, whilst it may stimulate more diverse options beyond green mortgage products these are still aimed at those households that wish to invest and are financially able to pay.

The UK NAP has highlighted the need to go beyond grants or green finance schemes to provide public funding targeted at low-income or vulnerable households, alongside energy efficiency retrofit (Defra, 2024). Potentially, less affluent households would have greater access to funds. This will be important given a national survey of homeowners in England with gas boilers reported low willingness to spend money on heat pumps unless supported by government funding (Lamb & Elmes, 2024).

Important for this case study, there are potential co-benefits of enhanced energy efficiency, beyond meeting mitigation targets and reduced energy bills. Increasing the energy efficiency of buildings can also improve thermal properties and reduce overheating risk and improve indoor air conditions, leading to additional public health benefits including improvements to indoor air quality (Lucon et al., 2014). This is important given identified relationships between heat exposure, vulnerability, adaptive capacity and inequality, including when considering heat and health outcomes in cities such as London (Cole et al., 2024).

Alternative approaches and Recommendations

Whilst the GHFA focuses on retrofit to existing properties alternative approaches could consider new buildings. In England and Wales Building regulations have been expanded to consider the health and welfare of occupants to heat, including for the design and construction of new buildings. Additions were made to buildings regulations in December 2021 and took effect in June 2022 (Approved Part O). The new requirement seeks to reduce the occurrence of high temperatures in new residential buildings including flats, houses and residential care homes. Working on retrofitting existing homes and enhancing the design of new homes can help to rectify issues around energy efficiency, thermal gains, and carbon emissions if well designed. This complements the Future Homes and Buildings standard due in 2025, which will ensure new homes produce 75-80% less carbon emissions than those under the old regulations and links with the UKs cross government working group on overheating to ensure overheating risk is identified and actively managed when installing measures to increase energy efficiency of buildings (Defra, 2024).

There are also further recommendations via the NAP to enhance evidence and availability of data of the health-related impacts of issues such as overheating in homes, using empirical studies and smart data to monitor internal temperatures (Defra, 2024). This will help contribute knowledge on the vulnerability to overheating, and potential benefits of mitigation and adaptation strategies, and could be used to prioritise investment related to energy efficient retrofit for those less able to pay.

3.4 STL DROUGHT

3.4.1 Romania´s State aid grant schemes for farmers

Importance and alignment with national policy

Drought is one of the most important risks identified for Romania (National Disaster Risk Management Plan, 2020) and acknowledged in the strategic and legal framework. Significant damage and financial losses due to droughts were experienced in Romania in recent years. In response, the government has developed support mechanisms to assist producers and mitigate economic risks.

As part of national policies regarding the risks and disaster management, the Romanian legislation authorizes transitory payments under as the European Union (EU) state aid regulation for farmers whose crops have been significantly affected by drought. The aim of this aid is to ensure the food security, to reduce the major risk of distortion of agricultural markets regarding the supply-demand ratio as well as to reduce the social and economic vulnerability (e.g., impossibility to continue the agricultural activity, significantly degraded income). National grant regulations are

established annually based on identified needs, with the government issuing dedicated decisions accordingly.

This annual grant scheme aligns with national policies on food security and rural development while strengthening Romania's framework for managing agricultural crises. It mitigates the financial risks associated with climate-induced agricultural loses and complies with EU state aid regulation. Additionally, it supports the objectives of Romania's two key programmatic documents: the National Strategy on Adaptation to Climate Change and the Medium- and Long- Term Strategy for the Development of the Agri-Food Sector.

This measure complements the state aid scheme "Farmer's Credit," established by the government in February 2024. While this scheme primarily addresses the financial constraints faced by farmers due to geopolitical instability and economic pressures caused by the conflict in Ukraine, it also acknowledges drought as a critical threat to agriculture and the food market. Together, these measures create a cohesive framework that tackles both short-term and structural challenges posed by drought. The immediate grants help mitigate the economic losses of climate, while Farmer's Credit provides long-term financial stability, enabling farmers to recover and reinvest in agricultural labour.

How it works?

The grant provides direct financial support to Romanian agricultural producers whose crops were severely affected by drought. For the identification of crops affected by drought two conditions need to be fulfilled simultaneously: a) pedological drought to be confirmed; b) at least 30% of the cultivated area of a certain crop to be affected. The reports from MeteoRo and from the Academy of Agricultural and Forestry Sciences 'Gheorghe Ionescu-Șișești' regarding the precipitation amount, the evolution of climatic conditions, of the soil water reserve, of evolution temperatures on the ground and in the air, the state of vegetation constitute the basis for the identification of the pedological drought. The crop type and area affected by drought are assessed through in-situ observations and reports from the regional Directions for Agriculture - coordinated by the Ministry of Agriculture and Rural Development (MARD). Based on this information, the state of natural calamity/ disaster may be established, and a governmental document will be issued, defining the conditions, amounts and procedures for granting the state aid. These should also be in line with the Guidelines for State aid in the agricultural and forestry sectors and in rural areas (2022) and Article 107(3) of the Treaty on the Functioning of the European Union. Eligible beneficiaries include individual farmers, authorized agricultural businesses, cooperatives, and other legal entities engaged in crop production. The potential beneficiaries have to submit a number of documents to request the state aid. Finally, upon further verification, the

Agency for Payments in Agriculture, an institution also under the coordination of MARD, makes the payments toward the eligible farmers. To prevent overcompensation, the grant is structured so that if beneficiaries receive insurance payouts or other state aid for drought damage, total compensation cannot exceed 80% of eligible expenses. By offering direct financial relief, the grant aims to stabilise farm incomes, prevent land abandonment, and sustain agricultural production in response to climate-induced losses.

Example of implementation: The drought in 2023-2024 affected about 2mil. ha of crops and state aid of 400 mil EUR has been paid to 236 000 farmers. In 2020 the government allocated 850 million RON (≈177 million EUR) to compensate farmers for drought-induced crop damages.

Economic, Equity and Distributional Considerations

Risk Sharing: The EU-regulated state aid (available in all member states) has a transitory character being granted only in the case of a natural calamity/disaster (i.e., large, cultivated areas affected by pedological drought). In such cases, the socio-economic impact may be very large, with repercussions not only on farmers with crops affected by drought, but also for society at large, through difficulties of farmers on continuing the agricultural works in the near future (i.e., the rest of the year affected by drought) and thus affecting the food security. Therefore, the role of this state aid is to take over a part of these risks and to increase the short-term response capacity of farmers to the drought risk.

Financial protection: The state aid does not represent a financial protection, as the amount of the state aid may cover at most 80% of the costs related to the establishing the culture affected by drought, including payments received by farmers from other insurance options. Also, it may be granted only when the pedological drought is manifested over large areas, associated with a significant negative socio-economic impact. Nevertheless, by providing direct grants to affected farmers, this measure helps prevent large-scale financial distress, reducing the risk of farm bankruptcies, supply chain disruptions, and food price volatility. It also sustains rural employment by enabling farmers to continue their activities, preventing labour displacement and broader economic downturns in the agriculture sector. Additionally, by ensuring continued production, the measure supports market stability for essential crops, minimising wide fluctuations in agricultural products prices.

Distributional effects: Through this state aid, the negative impact of pedological drought is partially distributed from farmers to the national government. The legislation is applied at national level and affected farmers may require the grant, independently of the crop type and area cultivated.

The regulatory framework is designed to ensure fair access to compensation, prioritising those most affected by drought. Eligibility criteria based on the percentage of crop loss focus support on farmers whose livelihoods are at the greatest risk. Furthermore, it considers structural inequalities in financial resilience mechanisms, such as insurance. As many small-scale farmers cannot afford private drought insurance, the mechanism addresses this gap by providing direct financial relief. However, insurance holders are subject to limits on total compensation capped at 80% of eligible costs, preventing overcompensation and ensuring the fair distribution of financial support.

Alternative approaches and Recommendations

The state aid for reducing the impact of pedological drought is an extraordinary measure, put in place when extraordinary conditions require it. Other measures for managing the drought risk are also considered at national level, for instance the extension of the irrigation infrastructure and/or improved water management. Furthermore, the use of drought-resistant hybrids and species and replacing traditional crops with more resilient ones in the new climate conditions are among the practical approaches investigated and recently implemented in some agricultural areas often affected by drought. For instance, sorghum is a highly resistant crop to drought and high temperatures, which makes it ideal for regions with low rainfall. This adaptability allows farmers to achieve good yields even in difficult climatic conditions and it is thought as an alternative to corn. Sorghum has multiple uses, from human and animal food to bioenergy and alcohol production. This means that there are more potential markets for selling these yields. However, present discussions with Romanian farmers at various levels, as reported by MARD, research projects, and media, show that they see the extension of the irrigation infrastructure as one of the most important adaptation option, substantially contributing to reducing the drought-related risk and its impact and potentially diminishing the need for state aid. Shifting from reactive compensation to proactive adaptation would reduce future reliance on direct financial aid and create a more resilient agricultural system.

Relying on damage assessment reports and farm data carries the risk of inaccuracies or fraudulent claims. To address this, the reporting procedure should be based on more precise data, eliminating inconsistencies and subjectivity. The current process follows a broader administrative route, which can be inefficient. Implementing a digital platform would streamline the procedure, reduce bureaucracy, and enhance transparency, ensuring a more accurate and efficient distribution of financial aid.

Additionally, establishing a multi-annual support mechanism instead of issuing emergency regulations on an annual basis would increase the effectiveness of these financial measures (Huang, 2022). A structured, long-term policy framework would reduce the uncertainty and allow farmers to

plan investments in resilience strategies while ensuring financial stability in the face of recurring drought risks. This mechanism could integrate predictable funding allocations, and performance-based incentives for sustainable farming to provide more comprehensive and stable support for the agricultural sector.

In the general context of increasing resilience to climate change (including in the case of drought) there are also interventions in the form of direct payments in accordance with the National Strategic Plan (NSP) 2023-2027, financed from the European Agricultural Guarantee Fund (EAGF), the European Agricultural Fund for Rural Development (EAFRD) and from the national budget (NB) (https://apia.org.ro/wp-content/uploads/2024/09/ANEXA_INTERVENTII-APIA-2023-2027.pdf). For example, eco-schemes dedicated to environmentally friendly agriculture in small farms (the traditional households covering most of the landowners) (covered by EAGF) could significantly contribute to limiting the impact of droughts. Other relevant interventions focus on rural development such as those dedicated to areas affected by significant natural constraints and areas affected by specific natural constraints (DR 11) (covered by both EAFRD and NB).

Other complementary insurance: Private insurance options are available for farmers and some financial schemes implemented by MARD (e.g., 'Crop, livestock and plant insurance premiums' (https://www.afir.ro/domenii-de-interventie/detalii-si-anexe-sm-171/) which have started in 2022) encourage farmers to use them as part of risk management related to their crops, including the drought-related risk.

3.5 STL STORM

3.5.1 The Danish Storm Flood Damage Levy

Importance and alignment with national policy

Denmark faces substantial risks from storm surges and flooding events (Halsnæs et al., 2024). To address these risks and ensure financial sustainability, Denmark has implemented the Storm Flood Damage Levy (Danish Natural Hazards Council, 2024), a mandatory insurance scheme designed to provide financial protection against the economic consequences of storm surges. It is a crucial component of Denmark's comprehensive flood risk management strategy, complementing other measures such as flood protection infrastructure, spatial planning, and early warning systems. The levy aligns with national policies such as the 2008 National Adaptation Strategy (NAS) and the 2012 National Action Plan (NAP), which emphasise the importance of climate change adaptation and flood risk management.

How it works?

The Storm Flood Damage Levy is a mandatory insurance scheme. All property owners in Denmark are required to contribute to the fund through an annual levy, which is calculated based on the property's value and flood risk exposure. *"All homeowners with fire insurance pay DKK 40 annually via their insurance to the government scheme. In 2023, the total levy was DKK 193 million. The insurance companies collect the fee on behalf of the state, and the companies also handle the damages on behalf of the Danish Natural Hazards Council when a storm surge is announced."* (Forsikring & Pension, 2023)

In the event of a storm surge, the fund provides financial compensation to property owners for damages caused by flooding. The compensation covers the cost of repairs, replacement of damaged property, and other related expenses. The scheme ensures that property owners have a financial safety net to recover from the economic impacts of storm surges. A web portal is available to understand how to receive compensation (Danish Natural Hazards Council, 2024). Effective from July 2021, the contribution to the Danish Storm Flood Damage Levy will be reduced from DKK 60 to DKK 40. The scheme has reached its target balance of DKK 500m therefore the temporary increase of DKK 20 which was introduced in 2014 has been removed. The scheme compensates policyholders who have an insurance policy that covers fire, against damage caused by floods or storm surges (Shulver, 2021).

Example from a real-life event: More than 1,000 insurance claims have been filed in Denmark due to Storm Babet that happened on 20th-21st October 2023. The claims are related to sewage rising in houses due to overflowing sewers, damage to cars from standing water, damage to boats, including those that have become detached, flooded, or damaged by wind and water. "*We see examples of sewage rising in houses as a result of overflowing sewers, as well as damage to cars standing in water and boats that have become detached, flooded or otherwise been damaged by the violent gusts of wind and water," said Charlotte Dietzer, a claims manager with insurance company Tryg.*

Economic, Equity and Distributional Considerations

Risk Sharing: The Storm Flood Damage Levy is mandatory for all property owners in Denmark. This means everyone contributes to a shared pool of funds, regardless of their individual risk level. This broadens the base of contributors and helps to keep the levy amount lower for everyone. If only those in high-risk areas participated, the cost per person would be much higher. This mandatory system ensures that when a storm surge occurs, the costs of damage are distributed across a large group of people, making the financial burden more manageable for individual property owners.

Financial Protection: The levy acts as a safety net for property owners. By the mandatory paying into the fund by all property owners, they are essentially purchasing insurance against storm surge damage for the owners, which are in the risk of damages. This protects risky properties from potentially catastrophic financial losses if their property is flooded. Instead of facing huge repair or replacement costs on their own, they can rely on the fund to cover a significant portion of the expenses. This will help individuals, businesses, and communities recover more quickly after a storm surge. It provides peace of mind and prevents financial ruin in the face of extreme weather events, enhancing their health and financial capabilities.

Distributional effects: Instead of a flat rate, the Storm Flood Damage Levy can be designed to ensure equitable distribution of costs and benefits, by considering affordability for low-income households or those in high-risk areas. This can be done by a tiered system where the levy amount varies based on income levels or property values.

Alternative approaches and Recommendations

Alternative approaches to managing storm surge risk in Denmark could include incorporating this risk into existing schemes, but it is difficult accurately to determine the risk of individual properties, and risks like that is not really a good area for insurance companies. Studies from financial institutions (Forsikring & Pension, 2023) have proposed to expand the existing "demolition pool" to include vulnerable homes or businesses where financing cannot be obtained on market terms. The existing demolition pool (Viborg Municipality, 2025) is targeted at the demolition of poor buildings in smaller cities with very cheap houses and is jointly financed by the state and municipalities. In 2023, the pool totalled 98 million DKK. Demolition of climate-affected houses or businesses is likely to be significantly more expensive, as these buildings are often very expensive due to their proximity to water, and there are potentially many properties at risk. To help Danes with destroyed homes due to climate change, Forsikring & Pension (2023) proposes a tax deduction for climate-proofing homes. This would allow homeowners to receive a tax deduction for solutions such as flood gates, drainage systems, and perimeter drains.

To encourage homeowners and businesses to build climate-resilient structures, the concept of Blue Loans is being introduced by Forsikring & Pension (2023). These loans are specifically designed for those in high-risk areas of Denmark, where factors like high groundwater, cloudbursts, or storm surges pose significant threats. These loans aim to address the challenges faced by homeowners and businesses in these areas, such as difficulty selling their properties due to the perceived risks. Studies have shown that property prices drop significantly when an area is affected by flooding. Furthermore, it is proposed that Blue Loans can be combined with compensation from Naturskadeordningen. Currently, compensation received from the Storm Surge Programme can only be used to repair the damage on the affected property. The proposal suggests allowing

homeowners to transfer this compensation to a new property located in a safer area, further incentivizing relocation and climate-proof building (Forsikring & Pension, 2023).

The Storm Flood Damage Levy is an important part of Denmark's flood risk management strategy, providing financial protection against the increasing risks of storm surges in a changing climate. To ensure the scheme's long-term sustainability and effectiveness, ongoing monitoring and evaluation are essential. This includes:

- Regularly assessing the fund's financial solvency in relation to the projected increase in storm surge risks.
- Evaluating the scheme's impact on risk reduction behaviour by property owners.
- Considering adjustments to the levy structure to ensure equity and affordability.

Other complementary insurance

In addition to the mandatory Storm Flood Damage Levy, homeowners in Denmark can purchase private building insurance for added financial protection against storm and water damage related to flooding from cloudburst events. One such provider is IDA Forsikring, which offers building insurance that includes coverage for flood events as an add-on to their standard fire insurance. This add-on safeguards homes from a variety of weather-related damages including those caused by storms, burst pipes due to freezing, snow pressure on roofs, avalanches, hail, and flooding resulting from extreme thaws or rainfalls. (IDA Forsikring. (n.d.)). While "*Cloudbursts are now covered by most insurance companies. House insurance covers cloudburst damage when at least 15 mm of rain has fallen in a maximum of 30 minutes. In practice, this means that cloudburst damage occurs in situations where water is pushed back through the sewers and into the home through toilets and floor grates or enters the home through doors and windows as the water cannot be drained away via the sewers.*" (Forsikring & Pension, 2023). Figure 3 shows the claims statistics for cloudbursts events in 2023.

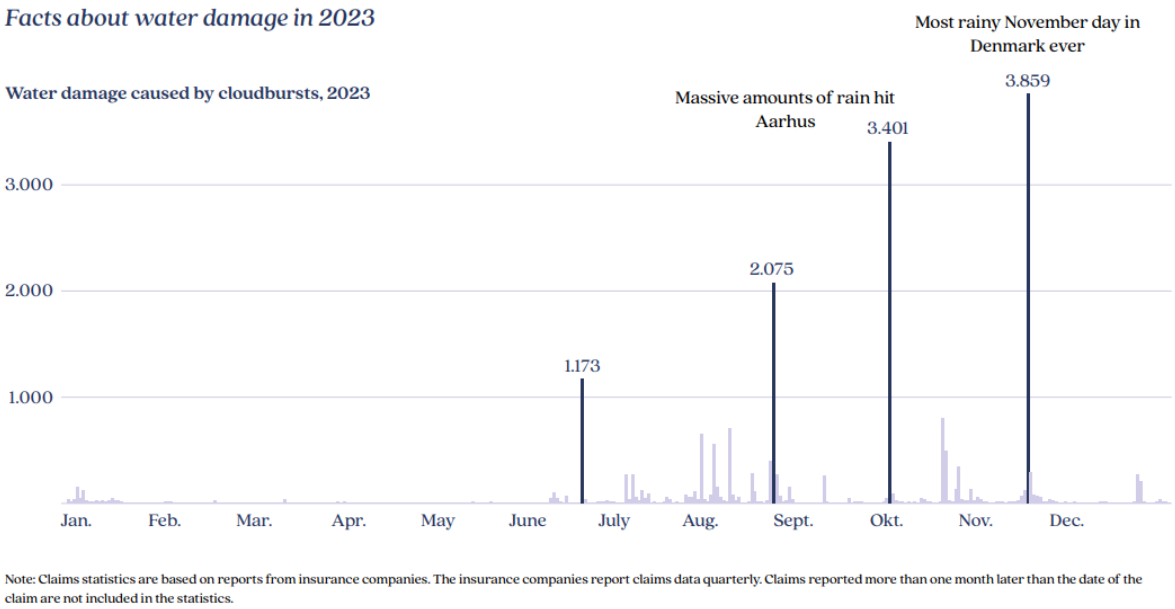

Figure 3 Claim statistics for water damages by cloudbursts in 2023.

Source: Taken from (Forsikring & Pension, 2023)

3.6 STL FLOOD

3.6.1 The Emergency Interventions in Case of Natural Disasters and the Disaster Relief Grants for Agricultural and Forest Properties in Italy

Importance and alignment with national policy

Floods are among the most severe natural hazards in Italy (Zabini et al., 2021), with projections indicating a general increase in flood risk across the country in the coming years (Ojeda et al., 2022). As in the broader Mediterranean region, floods in Italy predominantly manifest as flash floods triggered by intense and localised rainfall, presenting significant challenges for forecasting and risk management (Francipane et al., 2021). The increasing frequency and intensity of extreme weather events, exacerbated by climate change, underscore the necessity for effective policy interventions to mitigate their socio-economic impacts and support affected communities.

To this end, the Provincial Administration of Bolzano (Trentino Alto Adige region) has introduced two financial schemes: Emergency interventions in case of natural disasters fund and the Disaster Relief Grants for Agricultural and Forest Properties. These two measures are aligned with the National Flood Risk Management Plan (PGRA), which serves as the operational tool at the national level to identify and implement targeted actions aimed at reducing the adverse consequences of floods on human health, land, assets, the environment, cultural heritage, and economic and social activities.

How it works? *(official websites of the Province of Bolzano and Alto Adige portal)*

The first scheme, the Emergency interventions in the event of natural disasters fund, provides financial support for the repair or reconstruction of primary residences and the replacement of household goods damaged by floods, landslides, and other extreme weather events. This scheme is designed to assist individuals whose primary home has suffered substantial damage and who do not own another residence. Eligibility is determined based on income criteria, with access restricted to those within the fourth income bracket as defined by provincial regulations. The financial support covers up to 70% of eligible costs for rebuilding or repairing homes and up to 50% for replacing household furniture. In addition to these forms of support, the scheme also provides grants for geotechnical safety and stability interventions necessary for residential buildings affected by natural disasters. This scheme aims to ensure structural stability and prevent further damage caused by ground instability following extreme weather events.

The second instrument, the Disaster Relief Grants for Agricultural and Forest Properties, provides financial support for the repair of predominantly agricultural or forestry-related infrastructure affected by natural disasters. This support is available to property owners, tenants, municipalities, cooperatives, and other entities managing agricultural or forestry infrastructure. The financial assistance covers up to 70% of the recognised costs, with a maximum of €25,000 per beneficiary.

Economic, Equity and Distributional Considerations

The Emergency interventions in the event of natural disasters fund is designed to ensure that financial assistance is directed towards those most vulnerable to the economic consequences of natural catastrophic events. The scheme prioritises low-income households, recognising that these groups often face greater financial barriers to recovery after natural disasters. Additionally, by restricting aid to primary residences, the mechanism ensures that public resources are allocated where they are most needed, preventing support from being directed towards secondary homes. This progressive allocation of resources upholds the principles of social equity, ensuring that financial relief in the face of extreme weather events reaches those who would otherwise struggle to rebuild without public assistance.

The Disaster Relief Grants for Agricultural and Forest Properties extends these equity considerations and distributional concerns to the agricultural and forestry sectors. In Italy, these sectors play a strategic role in rural land management and the rural economy, yet they are particularly exposed to climate-related disasters (Ortiz-Bobea et al., 2021) and face increasing risks

of abandonment due to financial vulnerability (Pawlewicz & Pawlewicz, 2023). Supporting the recovery of agricultural and forestry facilities and infrastructures in case of natural disasters is essential not only for safeguarding livelihoods and economic stability in rural areas but also for preventing land abandonment, which could further deepen the marginalisation of these territories and intensify socio-economic disparities.

Alternative approaches and Recommendations

One potential improvement involves increasing the maximum financial aid available for farmers and forestry operators in the case of the Disaster Relief Grants for Agricultural and Forest Properties scheme. The current cap of €25,000 may be insufficient to support the restoration of buildings and infrastructures, particularly when managing extensive damages. A complementary funding stream, possibly through the integration of national or European funds, could help address this limitation and enhance the scheme's capacity to sustain long-term recovery efforts.

Another recommendation concerns the implementation of financial mechanisms aimed at promoting the adoption of preventive measures. At present, financial aid is predominantly reactive, covering damages only after they have occurred. However, regional initiatives, such as the regional grant for home safety in case of floods introduced by the Emilia-Romagna region, demonstrate the potential of proactive measures. This programme provides financial contributions for the purchase and installation of protective systems and devices designed to prevent or mitigate the impact of flood events. Introducing similar subsidies on a broader scale could significantly mitigate the economic and social impacts of future flood events.

Additionally, the creation of a dedicated microcredit programme for farmers and small businesses in flood-prone areas could facilitate investments in climate adaptation strategies.

Other complementary tools

Homeowners can choose to purchase private building insurance to strengthen their financial protection against floods and other weather-related damages. All major italian private insurance providers, such as Unipol, Generali, and Reale Mutua, offer building insurance policies that may include coverage for catastrophic risks, including flood events, upon request. Furthermore, by 31 December 2024, Italian businesses must comply with a significant regulatory requirement. All companies operating in Italy are required to obtain mandatory private insurance against damages caused by natural disasters. This obligation, introduced under the 2024 Budget Law (L. 213/2023), aims to enhance financial resilience by safeguarding businesses from the economic risks associated with catastrophic events such as earthquakes, floods, and landslides. This mandatory catastrophic risk

insurance policy covers direct damage to business assets, including land and buildings, plants and machinery and industrial and commercial equipment. Businesses are free to select their insurance provider and tailor their coverage, with the possibility of adding supplementary protections, such as coverage for indirect damages or loss of profits.

3.7 STL SNOW

3.7.1 Insurance systems in relation to avalanches in Romania and Italy

Importance and alignment with national policy

Given that snow avalanches represent a relatively minor risk at the national level compared to others (e.g., earthquakes, floods, droughts, and landslides), both in Italy (Alps) and in Romania (Carpathians) there are no specific references to financing instruments in the main risk management policy documents in these two countries.

In Romania, the National Strategy for Disaster Risk Reduction does mention snow avalanches just through a specific action related to monitoring and risk evaluation, which led to the implementation of the National Programme for Snow Avalanche Risk Monitoring within Meteo-Romania (action AI.5). Additionally, a State Aid Scheme (Forestry-Environment-Climate, under PS PAC 2023-2027) refers to snow avalanches as part of intervention actions in forestry. However, the policy document itself does not provide specific or relevant details on snow avalanche risk management. In fact, no specific policy instruments are directly tied to avalanche risk management at the moment of this report

In Italy, avalanches are almost ignored by the main national climate policies, while they are obviously taken into strong consideration at the regional level, especially in some regions of the Alpine arc such as Valle d'Aosta and Trentino Alto-Adige (but also Veneto, Piedmont and Friuli-Venezia Giulia). These regions have established AINEVA (Interregional Association for Coordination and Documentation for Problems Relating to Snow and Avalanches), to allow the coordination of initiatives that the member bodies carry out in the field of prevention and information in the snow and avalanche sector ("Avalanche Bulletin Home," n.d.). The primary objectives are the exchange and dissemination of information, the adoption of common methodologies for data collection, the testing of tools and equipment, the dissemination of publications regarding the subjects being studied, the training and updating of technicians in the sector, with attention aimed, above all, at monitoring the phenomenon and prevention (e.g. dissemination of information so that people do not go to areas subject to avalanches when such risk exists (e.g. "avalanche danger bulletins"). In

some municipalities, precise indications have been installed on the territory to prevent lethal effects deriving from avalanches.

In Austria, in provinces with mountainous terrain like Tyrol and Vorarlberg, the adaptation policies emphasize the protection of landscapes from the impacts of landslides, avalanches, and glacial retreat due to rising temperatures. These regions have invested in infrastructure improvements such as stabilizing slopes, enhancing early warning systems, and restoring natural barriers.

Summarizing the above, at the moment of this reporting, it is challenging to identify about the existence of economic instruments connected to snow avalanches that are aligned with the national policies.

Insurance systems in relation to avalanches: how it works?

The Romania's national mandatory insurance system does not cover snow avalanches, whether for skiers, tourist operators, or buildings. However, the private insurance sector offers such coverage, but these policy instruments are usually individual and difficult to track. An example in this respect is the *home insurance with extra coverage* that includes the option to cover damages caused by several additional natural (i.e., storms, hail, snow/ice load, rockfalls, snow avalanches) and anthropic (i.e., impact on buildings by road vehicles, accidental damage to water and sewer installations, accidental glass breakage, political risks) risks, ensuring financial protection in case of destruction resulting from these risks.

In the Italian part of the case study (Alps), it appears that the insurance system explicitly targets this risk. More specifically, in Italy, the following issues can be highlighted.

- It has become mandatory for every skier to take out insurance in relation to the damage they may cause to third parties. Sometimes, insurance policies are included in daily/periodic ski passes. However, it would seem to concern only those who ski on the slopes and not those who do cross-country skiing, who, when not on the slopes, are involved in (or may also cause) avalanches.
- Furthermore, ski lift operators (who may be hit by avalanches with consequent damage and even casualties) must also take out insurance policies.
- Motorists (and any other person who travels on roads in means of transport - trucks, etc.) can take out an "Atmospheric events" insurance policy. This is an additional (or optional) guarantee that can be combined with compulsory insurance to be able to drive on the road. Among the atmospheric events considered are also avalanches ("Assicurazione eventi atmosferici," n.d.).
- Similarly, there are "Home insurance" for atmospheric events (not mandatory for anyone) that also include the risk of avalanches and snow overload. These events, however, must be so strong as to leave visible signs also on other houses or things near your home. It should also be

noted that avalanches and snow are not covered in the "basic policy" (the one that is commonly subscribed to), but only in the "comprehensive policy" (taken into consideration by few people) ("Assicurazione casa con eventi atmosferici," n.d.; "Danni da eventi naturali," 2025). The last reference mentions that a standard homeowners insurance policy does not cover damage resulting from earth movement events such as mudslides, landslides, and avalanches. Given that property damage from this type of peril is often significant, homeowners need to understand the potential exposure for these events in order to determine if they need additional insurance. Insurers need to understand these risks in order to effectively market earth movement insurance in regions of the country most susceptible to this type of loss. There is also the issue that "the owner of a work is required to compensate for damages caused by construction defects or lack of maintenance".

- Where there are Avalanche Commissions (e.g. Trentino Alto-Adige, Valle d'Aosta, Piedmont and Friuli Venezia Giulia), the members of said Commissions are covered by insurance for all damages that may occur in the performance of the Avalanche Commission's activities. Among these activities, there is also the decision whether to close a road, a ski slope, or a specific territorial area to traffic (Autonomous Province of Bolzano - Avalanche Commissions Juridical., n.d.).
- .So, it can include the question of negligence (sometimes serious). For example, it could be the organization or the person responsible who, despite having the opportunity, does not close a road or a ski slope, even though it is obvious that there is a high risk of avalanches (and therefore the question of the resulting economic damages and any insurance in relation to such damages). Or who does not arrange for the evacuation of people from an area that will be hit by an avalanche (Stoffel, 2004)

Economic, Equity and Distributional Considerations

There is no information available on these aspects in relation to snow avalanches. However, it can be noted that in the case of skiing (and similar) it is not mostly a "popular" sport but rather tends to be expensive. Furthermore, insurance policies relating to atmospheric events (even more so those that include the risk of avalanches or snow) are supplementary policies that, one can imagine, are not generally taken out by people in conditions of economic stress.

Alternative approaches and Recommendations

To enhance avalanche risk management and ensure better alignment with national policies, a series of strategic actions are needed. The following recommendations focus on integrating avalanche risk into national disaster management frameworks, fostering monitoring of snow avalanche risk, expanding insurance coverage, strengthening legal regulations, increasing public awareness, and addressing economic and equity considerations.

Recommendation #1: Integrate snow avalanche risk into national disaster risk management policies. Given the increasing unpredictability of extreme weather events due to climate change, avalanche risk should be explicitly included in national disaster risk reduction strategies in both Romania and Italy. Policymakers should expand the scope of existing programs, such as Romania's National Strategy for Disaster Risk Reduction, to include prevention, mitigation, and response measures for snow avalanches, similar to other major natural hazards like floods and landslides. In Italy, where regional policies already address avalanche risks, national-level coordination should be enhanced to ensure consistency and better resource allocation across Alpine regions.

Recomendation#2: Promote the development of tailored insurance products. Private insurers should aim to develop more accessible and comprehensive avalanche insurance policies, covering both property and liability risks for homeowners, businesses, skiers, and tourism operators. Furthermore, it should introduce incentives or subsidies to make avalanche-related insurance more affordable, particularly for businesses located in high-risk regions. Expand mandatory coverage for skiers beyond ski slopes to include off-piste and backcountry skiing, where avalanche risks are higher. Improve public awareness of optional insurance products, ensuring that individuals understand the difference between basic policies and comprehensive coverage for atmospheric events.

Recommendation #3. Strengthen legal and regulatory frameworks. In support of this recommendation, clear liability rules should be established (where they lack) for ski lift operators, road authorities, and local governments responsible for avalanche risk management, ensuring accountability in cases of negligence. Mandatory insurance systems (i.e., in Romania) should extend the requirements for businesses and organizations operating in avalanche-prone areas, including ski resorts, hotels, and transport companies. Encourage public-private partnerships (PPPs) to improve avalanche risk management, particularly in tourism-dependent regions.

Recommendation #4: Increase public awareness and education. Public education campaigns to inform residents, tourists, and businesses about avalanche risks, prevention measures, and available insurance options should be prioritized in all tourists in mountain areas prone to the snow avalanche risk. Avalanche safety training should be integrated into outdoor recreation programs, ski schools, and tourism packages.

Funded by the European Union

3.8 STL INDIRECT

3.8.1 Flood risk insurance - home and agricultural crops

Importance and alignment with national policy

A. Mandatory home insurance against natural disasters (PAD) plays a crucial role in risk management and financial protection for homeowners in Romania (Law No. 260/2008 on mandatory insurance of homes against earthquakes, landslides and floods). For flood events, PAD provides minimal financial support, reducing the economic impact on affected households. Without this insurance, many homeowners would depend exclusively on state aid, which is not guaranteed or may be insufficient.

In the absence of an insurance mechanism, the state would have to bear the costs of restoring homes affected by floods and other disasters. Through PAD, part of these costs is transferred to the private sector (insurance companies), reducing the burden on public finances.

PAD encourages citizens to be more responsible and understand the vulnerabilities of their home to floods. Through the existence of this policy, homeowners are more likely to consider optional insurance, which offers extended protection.

Without PAD, homeowners don't have access to optional home insurance. Banks require this policy to grant mortgage loans, thus guaranteeing a minimum level of protection for the home.

B. Flood Insurance for Agricultural Crops

Agricultural insurance is offered by private companies and can cover a variety of risks, including flooding. Insurance is optional and farmers must take out policies before a flood occurs.

Risks covered by insurance: floods caused by torrential rains or river overflows; hail; drought; frost etc. (depending on the policy).

Crops insured: wheat, corn, sunflower, barley, rapeseed, vegetables, orchards, vineyards etc.

In case of an event, an assessment of the damage is made by the insurer, and compensation is granted depending on the affected area and the estimated value of the harvest.

Problems and Limitations:

- High cost of policies, which discourages farmers from taking out insurance.
- Insurance companies may refuse certain areas with a high risk of flooding.
- Insufficient compensation in some cases, due to policies with limited insured amounts.

Alignment with national policy

PAD is part of a broader disaster risk management framework and is part of national (National Strategy for Disaster Risk Reduction, 2024-2035) and European strategies on population protection and disaster resilience.

a) National Risk Management Strategy

- Romania is frequently exposed to floods, and the Government has adopted strategies to reduce the impact of these disasters.
- PAD supports these measures, providing a mechanism through which homeowners are required to ensure a minimum level of protection.

b) Compliance with EU directives on disaster insurance

- The European Union encourages Member States to develop public-private insurance schemes to protect the population against natural disasters.
- Through PAID (Natural Disaster Insurance Pool), Romania implements such a mixed solution, in which private companies collaborate with the state to manage risks.

c) Complementarity with disaster response programs

- In the event of major floods, the Government can provide additional support to affected families, but the PAD remains the first protection mechanism.
- By increasing the coverage of the PAD, the state can redirect emergency funds to infrastructure and preventive measures, instead of using them exclusively for compensation.

How it works?

Home insurance

The Romanian flood risk insurance system is mainly regulated by Law No. 260/2008 on mandatory home insurance against natural disasters and by optional policies offered by insurance companies.

The mandatory disaster insurance policy (PAD) is managed by the Natural Disaster Insurance Pool (PAID Romania) and covers the following types of risks: earthquakes, floods and landslides. All homeowners must have this policy, and without the PAD they cannot take out optional insurance.

In addition to PAD, homeowners can purchase optional home insurance that provides extended coverage, like compensation higher than the PAD ceiling and other risks covered (such as storms, fire, vandalism, or accidental damage).

Agricultural insurance

In the case of agricultural insurance offered by private companies, an assessment of the damage is made by the insurer, and compensation is granted depending on the affected area and the estimated value of the harvest.

Economic, Equity and Distributional Considerations

Sums insured by PAD:

- 20000 EUR for homes built of resistant materials (concrete, brick etc.).

- 10000 EUR for homes made of less resistant materials (wood etc.).

• Annual premium:

- 20 EUR for type A homes.

- 10 EUR for type B homes.

Although PAD insurance is mandatory, in 2023 only about 20% of homes in Romania were insured. This means that most Romanians remain unprotected in the event of floods. The amounts insured through PAD are relatively small, and in the event of severe flooding, owners must cover the rest of the damage from their own funds.

Many homeowners do not take out insurance policies out of ignorance, financial reasons, or lack of trust in the system.

In the event of disasters, the compensation process can be cumbersome, and people have difficulty obtaining the amounts needed for reconstruction.

The system of protection of farmers against floods is insufficiently developed. Agricultural insurance is expensive and limited (less than 20% of farmers take out policies).

Alternative approaches and Recommendations

The flood insurance system in Romania is underdeveloped and coverage is very low. Although the legal framework exists, better implementation, awareness and possible adjustments to insured amounts are needed to provide real protection to owners.

Recommendations

- More effective information campaigns to increase the level of insurance.
- Increasing the amounts insured through PAD to better reflect the real costs of reconstruction.
- Introducing tax incentives for those who insure their homes.
- Stricter application of sanctions for owners who do not comply with the legal obligation.

3.9 STL INDIRECT

Policy Background and Context

Impacts of climate change are becoming increasingly significant for energy production, consumption, and distribution, with extreme weather events such as droughts, heatwaves, and storms placing heavy economic burdens on society. In this case study, the instruments outlined at both national and European levels are designed not only to secure energy supply and safeguard critical infrastructure but also to support a transition toward a low-carbon energy mix. These instruments are fully integrated within broader national strategies and EU frameworks, ensuring that energy security measures are aligned with sustainable development and climate adaptation goals. This CS utilizes the plan4res electricity-system model on a European level so there is a great level of national, subnational and EU policies that can affect the outcome of the study and makes sector-specific policies signals diffuse across all the interconnected markets. As a result, it is difficult to "isolate" and attribute changes impacts from single interventions for this CS.

3.9.1 National Energy and Climate Plans (NECPs)

The national energy and climate plans (NECPs) were introduced by the Regulation on the governance of the energy union and climate action (EU)2018/1999, agreed as part of the Clean energy for all Europeans package which was adopted in 2019.

The national plans outline how the EU countries intend to address the 5 dimensions of the energy union:

- decarbonisation
- energy efficiency
- energy security
- internal energy market
- research, innovation and competitiveness

The first NECPs for the period 2021-2030 were published in2020. Each country must submit a progress report every 2 years. An update of the NECPs was done in 2024. Member states were requested to publish a first draft in 2023, which was followed by a technical assessment done by the commission. The final versions of the NECPs were then updated in 2024 by (nearly) all member states. The NECPs are built on the national energy policies. (PPE and PNACC for France). Non-EU countries (UK, Norway) do not issue a NECP.
The NECPs of each country are available here: National energy and climate plans

French Multiannual Energy Program (PPE):

The French Multiannual Energy Program (PPE) is a central instrument in France's national energy strategy that aims to secure a resilient and adaptable energy grid Ministère de la Transition Écologique. (n.d.). Its importance lies in its dual approach—combining regulatory oversight with targeted financial investments—to modernize grid infrastructure and expand the share of renewable energy. By channelling funding through mechanisms such as low-interest loans, grants, and guarantees, the PPE supports the upgrading of smart grid technologies and pilot projects, ensuring that energy reliability is maintained even during extreme weather events. Official details on its operational procedures can be found on government portals such as the Ministry of Ecology's website and through national press releases that report on funding allocations and project milestones. In addition, the PPE upholds principles of equitable energy access by targeting investments in regions that are most vulnerable to climate change impacts. Although the current approach is robust, alternative strategies—such as promoting decentralized renewable systems and community microgrids—could further enhance resilience. Future recommendations include increased stakeholder collaboration and adaptive management processes to ensure that funding continues to align with emerging technological advances and local needs.

European Green Deal:

The European Green Deal serves as a comprehensive policy framework designed to guide the EU toward a sustainable and climate-resilient economy (European Commission. (n.d.).). Its importance is underscored by its ambitious goal of achieving long-term climate neutrality while simultaneously ensuring energy security across all member states. The Deal employs a series of strategic regulatory initiatives to drive investments in renewable energy, boost energy efficiency, and construct climate-resilient infrastructure. These measures are implemented through a combination of legislative actions and funding programs that are regularly highlighted in government portals and major news outlets, ensuring transparency in how the initiatives are rolled out. Economically, the Green Deal is structured to distribute costs and benefits in a way that supports vulnerable regions and facilitates workforce adaptation to new green jobs—thus addressing both distributional and equity concerns. To further strengthen its impact, alternative approaches could include more localized energy transition strategies and enhanced public-private partnerships, ensuring that each member state's unique energy challenges are addressed. Such recommendations aim to foster innovation while promoting a just transition for all regions in the EU. It was translated in the European Climate Law in 2021.

France's National Climate Change Adaptation Plan (PNACC):

France's National Climate Change Adaptation Plan (PNACC) lays down a robust adaptation strategy with a complete regulatory framework that targets the resilience of energy systems in the face of extreme climate scenarios (Ministère de la Transition Écologique. (2018)). The PNACC is critical as it provides detailed guidelines and standards to climate-proof essential infrastructure and natural resources, ensuring that energy systems are well-prepared for the increased temperatures and variability caused by heatwaves, droughts, and storms. It aligns closely with national policy objectives by chaining investments specifically to protect and upgrade energy infrastructure, while simultaneously integrating socio-economic vulnerability assessments. This ensures that adaptation measures are distributed equitably, with a strong focus on vulnerable communities. Operational details on the PNACC—such as specific implementation guidelines and case examples—are available on official government portals and through media reports by national newspapers. Looking ahead, alternative approaches might include further decentralization of adaptation initiatives and enhanced community-based planning, which would allow for even more targeted interventions. Recommendations include the continuous monitoring of policy outcomes and a periodic review of investment strategies to better align with rapid climate changes. The PNACC is currently being updated (a draft version is available (Ministère de la Transition Écologique. (2024))

3.10 STL SPILLOVER

Context and Background

The agriculture and food sectors are highly vulnerable to climate change. Over the past 50 years, climate change has already slowed the growth of global agricultural productivity. Moreover, climate change is affecting regions disproportionally, with most of the negative impacts in mid- and low latitude regions and positive impacts in some high latitude regions (IPCC 2022). Extreme weather events such as droughts, heat waves and flooding threaten crop production, deteriorate food security and hinder poverty reduction, especially in rural areas in developing countries, where rainfed agriculture is the main source of livelihood and food (Acevedo et al. 2020).

The pace of climate change in Europe is accelerating at an alarming rate, with the continent warming twice as fast as the global average since 1980s (WMO 2023). This rapid increase in the temperature is impacting energy demand, health, agriculture and natural systems. Climate change has decreased crop yields and increase crop yield variability in various European countries. Moreover, European farmers are already suffering under increased heat, drought and flooding. Adaptation is crucial to overcome the negative effects of climate change. Adaptation measures can be implemented at the national level (e.g. support mechanisms, national

agricultural policies), regional level (e.g. regional early warning weather systems, knowledge transfer) and farm level (e.g. farm management practices, use of different crop varieties) (EEA 2019). Here we explore the development of new, adapted crops as a farm-level option, whose effective implementation can increase the incomes of European farms, rather than seeing a decline without such adaptations (Zhao et al. 2022).

3.10.1 Investment in developing new and adapted crop varieties

Importance

Among all adaptation measures, developing new crop varieties and expanding irrigation are likely to produce the most significant benefits (Lobell et al. 2008). The use of adapted or new crops and varieties resistant to climate-related stresses reduces the impacts of climate change, maintains crop production, and ensures farming income. However, this adaptation requires substantial investments by farmers, governments, scientists, and development organizations (Lobell et al. 2008).

How it works?

Developing new or adapted crop varieties with enhanced environmental tolerances and resource use efficiencies could better resist the increased stress caused by climate change, including biotic factors (e.g. heat, frost, and drought) and abiotic factors (e.g. seeds, pest and diseases) (Zhao et al. 2022). In practice, most farmers who adopt a new crop or crop variety also adopt other climate resilient measures. These include climate-smart agriculture schemes, which aim to increase agricultural productivity and resilience to climate change while reducing greenhouse gas emissions (e.g. crop rotation and agroforestry); and conservation agriculture, which focuses on sustainable farming by minimizing soil disturbance, maintaining permanent soil cover, and diversifying crops (e.g. no-till farming and cover cropping) (Acevedo et al. 2020).

Using adapted or new crop varieties has synergies with mitigation. Higher yields produce larger amounts of residues, which increase soil carbon storage. Cultivating crops with deep root systems, such as maize, wheat and barley, accelerates the sequestration of atmospheric carbon (EEA 2019). Moreover, introducing a range of crop varieties diversifies agricultural production, which can positively impact biodiversity and ecosystem services. This diversification increases the genetic diversity of species, making them more resilient to extreme weather and climate conditions (EEA 2019).

Economic, Equity and Distributional Considerations

Substantial investments are required from both private and public sector to develop new crop varieties. The cost varies widely depending on the specific crop and the technology used (e.g. conventional breeding and genetic

improvements). However, investments in basic and applied research have demonstrated high benefit-cost ratios ranging from 2:1 to 17:1, depending on different scenarios of study selection (Raitzer et al. 2008). Recent advances in artificial intelligence that help studying crop genetics are enabling agri-tech business to create new crop varieties five times faster and at a fraction of the cost compared to traditional breeding methods (www.avalo.ai).

The cost of implementing this measure at the farm level will largely depend on accessibility and price of the seeds of the adapted or new crops and varieties. In addition, farmers are expected to make further investments to adjust their production methods to the new structural changes in crop production (EEA 2019).

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4 Gender and Equity Considerations

Despite the European Union's strong climate leadership, gender and equity considerations remain almost inconsistently integrated into climate change policies across its member states. The European Green Deal and national climate strategies reference the importance of a "just transition" and inclusivity, recognizing the presence of a gender dimension. The European Commission as such plans to implement concrete mechanisms to address gender-specific vulnerabilities, intersectional inequalities, and marginalised voices (European Commission, 2020). For example, few national adaptation plans (NAPs) across Europe include sex-disaggregated data, targeted support for women-led climate initiatives, or participatory governance structures that ensure meaningful inclusion of vulnerable populations (UNFCCC, 2021; UN Women, 2022). This oversight risks neglecting the possible disproportionate effects of climate change on women, and disadvantaged people (elders, children, disabled people, migrants, and socially disadvantaged communities, who often face greater exposure to hazards and have fewer resources to adapt (EEA, 2023; Laukkonen et al., 2009). Addressing these gaps is crucial to ensure that climate resilience efforts in Europe are not only effective but also socially equitable and just.

The United Nations recognises that building socio-economic resilience to climate change and extreme events requires a strong commitment to social justice, equity, and inclusion, in addition to scientific and technical innovation. Across Europe and globally, climate change disproportionately affects vulnerable populations due to pre-existing social and economic inequalities (UN Women, 2022). In response, the UN system—including bodies such as the United Nations Framework Convention on Climate Change (UNFCCC), UN Women, and the World Meteorological Organization (WMO)—has advocated for gender-responsive and inclusive climate policies that prioritise the needs and voices of those most at risk. This includes promoting access to climate finance, ensuring representation in decision-making processes, and integrating equity considerations into national adaptation plans, early warning systems, and climate risk governance (UNFCCC, 2015; WMO, 2023). These efforts are central to achieving the Sustainable Development Goals and ensuring that Europe's transition toward climate resilience is both just and inclusive.

UNFCCC Framework & the Paris Agreement

Article 7.5 of the Paris Agreement explicitly states that: "Parties should acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities, and ecosystems" (UNFCCC, 2015).

Building on this, subsequent guidance from the UNFCCC—particularly through gender action plans, NDC guidance, and related technical reports—has further articulated key equity and inclusion principles to inform the design and implementation of national climate actions. These include:

- Ensuring that climate actions do not exacerbate existing inequalities.

- Encouraging co-benefits for health, employment, and gender equality.
- Supporting loss and damage finance mechanisms that particularly target vulnerable populations.

In line with these principles, Nationally Determined Contributions (NDCs) are encouraged to incorporate social protection measures and assess the distributional impacts of proposed climate actions to ensure they are fair and inclusive (UNFCCC, 2022).

UN Human Rights-Based Approach to Climate Action

The United Nations Human Rights Council (UNHRC) has affirmed through various resolutions that:

- Climate change impacts human rights (e.g., right to health, food, water, housing).
- States have obligations to respect, protect, and fulfil rights in all climate-related actions, including ensuring:
- Free, prior and informed consent of indigenous communities.
- Public participation and access to information.
- Protection of children, the elderly, persons with disabilities, and the poor (OHCHR, 2021).

UN Women and Feminist Climate Justice

UN Women (2023) developed a comprehensive framework for feminist climate justice, which emphasises the need to integrate gender equality, social justice, and environmental sustainability into all aspects of climate policy and action. The framework highlights the intersecting inequalities that leave women—especially those from indigenous, rural, low-income, and displaced communities—disproportionately vulnerable to climate impacts, while also recognising their roles as powerful agents of change in climate adaptation and resilience.

The approach is grounded in principles of intersectionality, equity, and rights-based governance, advocating for the redistribution of power, resources, and decision-making authority in climate processes. Feminist climate justice calls for ensuring that women and girls have equal access to climate finance, technologies, and services, and that they are meaningfully represented in national and international climate negotiations.

At the 2023 Global Climate Talks (COP28), UN Women successfully reinforced this framework within the broader UN system, working with member states to integrate gender considerations into climate financing mechanisms such as the Adaptation Fund, Green Climate Fund, and Loss and Damage Fund (UN Women, 2023a). These funds increasingly recognise the need for targeted support to gender-responsive projects, particularly those designed by and for women in the Global South.

Furthermore, UN Women and partners are advancing gender-responsive climate budgeting, the development of sex-disaggregated climate impact data, and the implementation of national gender and climate change action plans (UN Women, 2022; UNFCCC, 2021). These efforts aim not only to reduce

vulnerability but also to amplify women's leadership in climate governance, recognising that climate justice cannot be achieved without gender justice.

World Meteorological Organization (WMO)

The World Meteorological Organization (WMO) emphasises that effective climate policies must be both scientifically sound and socially equitable. Climate risk is shaped by multiple socio-economic dimensions—such as gender, age, and geographic location—and thus requires tailored approaches that reflect these realities (WMO, 2023). In this regard, WMO aligns with the UNFCCC and the Sustainable Development Goals to integrate equity and gender across climate policy and planning processes.
WMO further supports:

- Gender-responsive early warning systems.
- Pro-poor climate adaptation planning.
- Equitable access to climate services and technologies.

Early Warnings for All is a groundbreaking initiative that was launched in 2022 by the United Nations, with the goal of ensuring that everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027. Early Warnings for All can play a crucial role in accelerating investment to address countries' vulnerability to climate change by improving early warning systems and enhancing resilience in its capacity as a call for scaling up national action. In its role in the UN Early Warnings for All initiative, WMO advocates for ensuring no one is left behind—especially women, youth, the elderly, and Indigenous peoples—when designing and deploying climate risk information and response systems (UN, 2022; WMO, 2023).

Recommended Priorities from WMO

WMO encourages governments and partners to:

- Conduct vulnerability assessments that include gender and intersectional lenses.
- Establish monitoring systems using sex- and age-disaggregated data.
- Provide targeted support to women and underrepresented groups in accessing finance and services.
- Mainstreaming Gender into End-to-End Flood Forecasting and Early Warning Systems and Integrated Flood Management
- Promote participatory governance that amplifies marginalised voices.

Closing the gender and equity gap in climate change mitigation and adaptation across Europe requires moving beyond recognition toward systemic implementation. The way forward involves embedding gender-transformative and equity-based principles across climate finance, planning, monitoring, and implementation. By aligning with the recommendations of the UNFCCC, UN Women, and WMO, European institutions have a critical opportunity to lead by example—ensuring that climate resilience is not only about protecting ecosystems and infrastructure, but also about empowering people, advancing social justice, and leaving no one behind.

5 Conclusion

This deliverable D4.7 has provided an initial analysis of the economic, finance, and investment policies at the EU, national, and local levels across the 8 case studies in Europe. Aligning with the task description for WP4 T4.4, this deliverable has assessed how common European policy instruments and potential interplays with local policies can facilitate or provide barriers for implementing sectoral coping strategies. It has been achieved by examining a variety of policy instruments currently in use, ranging from market-based mechanisms and public-private partnerships to financial and regulatory tools. The diverse range of instruments and governance levels highlighted in the complexities and opportunities in aligning climate action from the EU level down to local contexts. Complementing this analysis, D4.3 provides a broader context by analysing the range of policy responses, including regulatory and other non-economic instruments across case studies. This integrated perspective, considering both specific policy instruments and the wider sectoral landscape, is crucial for developing effective climate strategies.

In this deliverable, the national-level analysis reveals a landscape where EU legislation often provides a foundational framework, but individual countries exhibit distinct approaches based on their specific governance structures and climate priorities. For instance, the Czech Republic demonstrates a strong influence of EU directives alongside a developing national framework. Denmark showcases a long-standing commitment to green transition with a collaborative multi-stakeholder approach. Italy is working towards strengthening its governance through clearer legal and institutional frameworks. Romania's climate governance is still evolving, focusing on enhanced coordination and stakeholder engagement. The United Kingdom stands out with a robust legal framework, including a legally binding net-zero target and an independent advisory body.

The local-level case studies further illustrate the practical application and challenges of these policies in addressing specific climate hazards. In the Czech Republic, the boiler replacement scheme and low-emission mobility program demonstrate efforts to improve air quality and reduce emissions in urban areas. The UK's Green Home Finance Accelerator program explores innovative financial mechanisms to encourage energy efficiency and retrofit measures in residential housing. Romania's state aid grant schemes for farmers provide crucial support in mitigating the economic impacts of drought. Denmark's mandatory Storm Flood Damage Levy offers a financial safety net for property owners against storm surge damages. Italy's emergency interventions and disaster relief grants in the Bolzano province provide financial assistance for recovery from floods and other natural disasters in agricultural and residential sectors. The analysis of insurance systems for snow avalanches in Romania and Italy reveals a less developed landscape at the national level, with more emphasis at the regional level in Italy. Finally, the discussion on flood risk insurance in Romania highlights the

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role of mandatory and optional schemes in providing financial protection against flood events for homes and agricultural crops.
This deliverable also summarises key cross cutting concepts like gender and equity in climate policies. Considerations of gender and equity reveal that while the European Green Deal and national strategies acknowledge the importance of a just transition, the integration of these aspects into climate change policies and therefore instruments remain inconsistent. It emphasises the need for more sex-disaggregated data, targeted support for vulnerable populations, and participatory governance structures to ensure socially equitable and just climate resilience efforts.
Therefore, this deliverable provides a foundational understanding of the diverse policy landscape across Europe aimed at addressing the economic and financial dimensions of climate change. The case studies highlight both the progress made and the areas where further development and integration are needed to enhance policy effectiveness and ensure a just and equitable transition towards a climate-resilient future. Further analysis in subsequent deliverables will build upon these findings to provide more in-depth recommendations for policymakers and practitioners. The next deliverable for T4.4, D4.8 will build on this deliverable D4.7 and will elaborate on how economic instruments and measures be used as a framework for coping with climate challenges.

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