

POLICY BRIEF

EUROPEAN CASE STUD

INTEGRATED SOLUTIONS TO ADDRESS HIGH LEVELS OF CLIMATE CHANGE

Region: Europe Scale: Continent Sectors: Agriculture, Forestry, Water, Health, Biodiversity, Urbanisation

Europe is a highly diverse continent. It ranges from the sub-arctic climate of northern Scandinavia to the Mediterranean climate of southern Europe, and from wide lowland plains to high mountains, with a mix of land-uses including expanding urban areas, intensive arable and horticulture, extensive upland grazing and forestry. Climate and socio-economic change are therefore likely to have different impacts across Europe on social and economic sectors, human health, ecosystems and the goods and services they provide. Policy responses will need to address these regional differences and disparities.

The EUAdaptation Strategy, adopted in 2013, aims to 'climate-proof' Europe through encouraging all Member States to adopt comprehensive adaptation strategies. The IMPRESSIONS European case study has explored the inter-dependent risks and opportunities posed by high levels of climate change (more than 2°C above global mean pre-industrial temperatures) and socio-economic change for people, land-use, water and biodiversity across Europe. It aims to support national and European stakeholders and decision-makers in incorporating these high climate change scenarios into their risk management and climate adaptation strategies.



The consequences of climate change for Europe will depend on complex interactions between climate change, socioeconomic change, land-use sectors and natural resources, as well as society's responses from local to international scales

Key Messages

- **Scenarios:** Socio-economic change can have a larger effect on climate impacts and vulnerability than the direct effects of climate change. Policy action (or inaction) thus has a great potential to positively (or negatively) influence Europe's future.
- Impacts and vulnerability: The impacts of climate change, and vulnerability to those impacts, will vary greatly across Europe. Benefits in some regions and sectors, such as increasing forest productivity in northern Europe, are offset by detrimental effects in others, such as severe water scarcity, heat stress and loss of productivity in southern Europe and parts of central and eastern Europe, and widespread flood damage.
- Vision: A diverse group of IMPRESSIONS stakeholders, representing a mix of European regions, affiliations, sectors, genders and ages, defined a common 'Vision for Europe' in 2100 centred on equality, climate change mitigation, resilience, sustainable lifestyles, good environmental management, and collaborative and participatory governance.
- **Pathways:** Transformative pathways towards sustainable lifestyles, sustainable and integrated agriculture and water management, and a circular and low-carbon economy are able to reduce the impacts and exploit the opportunities arising from climate change under all socio-economic futures. Opportunities can be maximised by seeking co-benefits between sectors and between climate change mitigation and adaptation.
- Actors: Multiple actors across Europe are responsible for delivering these transformative pathways: European and national governments to develop cohesive top-down regulation, incentives and targets; communities to self-organise to deliver local services and change behaviours; knowledge institutions to ensure evidence-based decision-making and monitoring; and businesses to deliver sustainable production.

What could a future above 2°C look like?

Four scenarios were co-created with stakeholders, to reflect contrasting plausible futures for Europe to 2100. These were based on the global Shared Socio-economic Pathways (SSPs), paired with relevant climate scenarios based on the IPCC Representative Concentration Pathways (RCPs). Two fossil-fuel dependent scenarios (SSP3 and SSP5) were paired with the highest warming scenario (RCP8.5), which is expected without additional climate change mitigation, and two low carbon scenarios (SSP1 and SSP4) were paired with a lower warming scenario (RCP4.5).

Socio-economic scenario	Climate scenario ¹	Narrative for Europe to 2100
We Are The World (SSP1)	RCP4.5 Temperature:	A high commitment to achieving sustainable development, through effective government and global cooperation, results in less inequality and less resource-intensive lifestyles. There is a shift to low meat diets and reduced food imports.
Riders on the Storm (SSP4)	+2.0 to 3.0°C; Precipitation: -4 to +3%	Power becomes concentrated in a global elite while disparities in economic opportunity increase, leading to a two-tier world where the elite invests in green energy technologies while the rest of the population has a low level of development.
Fossil-fuelled Development (SSP5)	RCP8.5 Temperature:	People place increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital. Lack of environmental concern leads to continuing exploitation of fossil fuels.
lcarus (SSP3)	+3.7 to 5.4°C; Precipitation: +5 to 13%	Sparked by economic woes and regional conflict, antagonism between and within regional blocs increases, resulting in the disintegration of social fabric and a struggle to maintain living standards.

¹Annual average change in Europe in 2071-2100 relative to 1961-1990

What are the impacts and risks in a future above 2°C?

Modelling projects lower rainfall and higher temperatures in southern Europe, leading to severe water scarcity, reduced agricultural and forest productivity and tens of thousands more deaths per year from heat stress, all worse in RCP8.5. In northern Europe, in contrast, agricultural and forest productivity could increase, boosted by higher temperatures and possibly by a CO_2 fertilisation effect (although the possible spread of pests and diseases is not modelled). However, flood damage will increase across Europe, especially in coastal areas, with damage from a 1 in 100 year flood event growing from \in 50 billion today to \in 1800 billion in the 2080s and affecting an extra 17 million people under SSP5. Impacts on biodiversity will be severe, especially if species cannot migrate northwards.

Impacts and vulnerability depend strongly on socio-economic factors. Efficient water-use technologies and water-saving behaviour, coupled with high human, social and natural capital (which increase coping capacity), reduce vulnerability to water stress under SSP1. Under the resource-intensive SSP5 and the chaotic SSP3, however, severe vulnerability to water, flooding and heat stress extends across much of Europe. Integrated modelling that accounts for interactions between urban areas, agriculture, forestry, water resources and biodiversity shows that land-use policies are also critical. Under SSP1, a shift to less intensive agriculture is assumed to reduce yields, and low-meat diets are offset by an increase in dairy consumption. To meet demand from a growing population while minimising food imports, agricultural land

expands at the expense of forest. In SSP5, in contrast, productivity is high due to inputs such as fertilisers, and arable and intensive livestock farming concentrate in northern and western Europe, with forestry expanding in the east and south (unless limited by climate). However, SSP5 involves high levels of urban sprawl. Sealed surfaces cover 9% of Europe, compared to 4% in the other scenarios, with negative impacts on biodiversity and ecosystem services.



Vulnerability to water scarcity in European river basins for SSP1, SSP3 and SSP5 (left to right) in the 2080s (CC = coping capacity)

What do we want our future to look like?

The IMPRESSIONS stakeholders developed a shared 'Vision for Europe', centred around equality, climate mitigation, resilience, sustainable lifestyles and environmental management, and collaborative and participatory governance.



How can a sustainable future be achieved?

IMPRESSIONS stakeholders and researchers co-created adaptation, mitigation and societal transformation pathways which define strategies and actions that could support society in moving towards the 'Vision for Europe' under the socio-economic constraints within each scenario. For example, actions in SSP3 are predominantly 'bottom-up', driven by local communities that self-organise to build self-sufficiency, whereas in SSP4 the centralised authority of a strong elite enables a strategic top-down approach to planning, and in SSP5 the actions are market-based.

Pathways to move Europe towards a common desirable future in 2100

These pathways were generated during stakeholder workshops to match the main priorities and constraints under each scenario. Omission of a pathway for a certain scenario does not necessarily imply that it would not be needed.

Adaptation			1	Adaptation/mitigation		Transformation		
Pathway	Scenario			7.81	Strategies			
	SSP1	SSP3	SSP4	SSP5	Strategies			
Sustainable lifestyles	~	~	1	~	Establish new education sy sustainable lifestyles	stems; Raise awareness for		
					Implement regulation & inc sustainable lifestyles	centives for social protection &		
					Support decentralised local communities			
Sustainability governance	~	~	~	-	Set up transparent, accoun governance systems	table & sustainability-oriented		
					Foster international cooperation; Establish multi-level and polycentric decision-making and planning systems; Make governance inclusive and participatory			
		2		1 mg	Support learning-based governance and experimentation			
					Strengthen physical and so and droughts	cial resilience to protect from floods		
sustainable water		\checkmark	The .	\checkmark	Mainstream nature-based s	solutions for climate adaptation		
management	1.1			-5115	Monitor and control water	quality and water use		
					Invest in efficient water tec	chnologies		
					Support climate-friendly fa	rming		
Sustainable agriculture	~	~		~	Mainstream and scale the G	Common Agriculture Policy (CAP)		
					Invest in new agriculture te	echnology		
					Promote integrated organic	c agricultural systems		
Circular and local economies			~		Strengthen Europe's market position in green technologies for resource efficiency and sustainable energy			
Integrated environmental planning	~		1	1 7 7	Mainstream ecosystem ser market activities	vices into regulation, planning and		
					Strengthen biodiversity pro harmony with nature	otection and land-use planning in		
Sustainability leadership	~)		Position Europe as global leader for sustainability, supporting actions in other countries			

What are the transformative solutions?

There are two key foundational pathways that are robust across all socio-economic scenarios: sustainable lifestyles, and participatory governance for sustainability. These pathways create new societal capacities by setting up new education systems, ensuring social protection, and aligning decision-making processes with long-term sustainability goals. They support the other pathways for sustainable management of agriculture, water resources and energy, and enable synergies between different sectors to be optimised. In all scenarios except SSP3, the pathways to establish strong environmental policy also underpins the resource management pathways. The shift to sustainable lifestyles is the central transformative pathway, underpinning the changes towards sustainable resource consumption and demands for sustainable products. This shift is enabled by two game-changers:

- A transformational accounting framework that fully takes account of the value of natural capital (e.g. soils, water, air, biodiversity), well-being and social equity, which can change the economic paradigm to go 'beyond GDP'. For this, credible indicators are needed to track progress and recognise synergies and trade-offs.
- **Contentment with living-with-less**, which is engendered through integrating sustainability as an explicit learning outcome throughout the educational system. All people become informed citizens, who actively participate in decision-making, support each other, and embrace and foster sustainable lifestyles. Sustainability values, systems thinking and social entrepreneurship are integrated into the school curriculum. This innovative approach to education requires guidance, coordination and funding from the EU, implementation by national authorities and active participation by civil society organisations.

Policy Recommendations

- A long-term sustainability vision should be developed and given political priority, to provide a common European policy goal. Policy development must take a systems-based perspective to exploit synergies and minimise trade-offs between agriculture, forestry, water, energy, biodiversity, urban development and other sectors. Concerted action is needed at all scales and in all sectors to develop and implement pathways for adaptation, mitigation and transformation towards sustainable lifestyles and economies. This will require co-ordination and governance mechanisms that bring together governments, civil society and businesses.
- It will not be possible to adapt to the most severe impacts of climate change, but these impacts can be reduced through mitigation. Continued strong efforts to meet the Paris climate agreement are therefore critical.
- Strengthen 'coping capacity' to build resilience to the potentially severe impacts of climate change by reducing inequality and investing in human, social and natural capital (including nature-based solutions), especially in the most vulnerable areas in southern and central Europe.
- Set up a task force drawn from governments, the education sector, businesses and civil society to investigate the steps needed to integrate sustainability into the education system, as a key foundation for a transition to sustainable lifestyles.
- Encourage the adoption of a 'Beyond GDP' accounting framework by national governments, supported by development of relevant indicators, including for natural capital.
- To counter the potential trade-off between sustainable farming and loss of forests, increase investment in research and development to increase yields from less intensive production methods such as organic farming.
- Building on the species modelling results, invest in creating connected habitat networks to enable species to migrate to suitable new habitats as the climate changes.



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Find out more:

Holman et al. (2017) Modelling Climate Change Impacts, Adaptation and Vulnerability in Europe. IMPRESSIONS Deliverable D3B.2;

Hölscher et al. (2017) Adaptation and mitigation pathways, and synergy mechanisms between them, for the case studies. IMPRESSIONS Deliverable D4.2.

Both available from www.impressions-project.eu.