Support to the coordination of national research and innovation programmes in areas of activity of the European Energy Research Alliance

SUPEERA

Policy Brief

THE EU ADAPTATION STRATEGY

CHALLENGES AND OPPORTUNITIES AHEAD

Setting the scene

The European Green Deal testifies the renovated push from the European institutions to focus the attention of policymaking on the threats posed by climate change. To reach climate neutrality by 2050, the EU will need to incorporate several initiatives in energy and climate to develop a stable and coherent framework for concerted action. Within this framework, the recently published “Fit-for-55” package, a set of 13 legislative proposals aiming at making the EU’s climate, energy, land use, transport, and taxation policies fit for reducing greenhouse gas emissions by at least 55% by 2030, represents a key milestone for the EU’s ambitions and provides the roadmap to translate EU climate goals into concrete actions. The 13 proposals put forward within the package are strictly interconnected between each other, as well as with the targets agreed in the European Climate Law, the centrepiece of the EU Green Deal.

The approved EU budget and the creation of Next Generation EU, a plan to boost the post-pandemic recovery of Europe, ensure substantial backing to many projects and initiatives supporting the reduction of emissions and promoting the EU's digital ecosystem and its competitiveness. Green investments and collaboration on transnational projects are now crucial to ensure that the efforts of the Member States, industry, and research organisations will not fall short of the set objectives.

To complement the efforts made by policymakers, it is vital to ensure that R&I challenges are addressed in parallel, increasing the collaboration between research and industry to achieve the goals towards a climate-neutral energy system in the EU. The research community has undoubtedly a pivotal role in this process, supporting identified political priorities with empirical findings and developments. It can also advise policymakers on the way forward through fundamental research, particularly focused on low TRLs, for the advancement of breakthrough technologies, materials, and systemic approaches.

In the context of the SUPEERA project, a series of policy briefs are currently being developed to identify concrete R&I challenges in EU policies relevant to the energy research community. The final goal is to support the achievement of the Clean Energy Transition (CET). The analysis of the policies identified has the two-fold objective of supporting recommendations towards the EERA membership and the SET-Plan ecosystem at large. This paper analyses the European Commission new Adaption Strategy, published on February 24 of 2021, which sets a pathway to increase Europe’s preparedness to the inevitable consequences of climate change impacts. This updated version of the 2013 Climate Change Adaptation Strategy goes beyond an improved understanding of the problem, by making adaptation measures a central element to be considered across the board.

Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change

In its Communication "Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change"[1], the European Commission outlines a long-term vision for the EU to become a climate-resilient society, fully adapted to the unavoidable impacts of climate change by 2050.

The Communication revolves around four strategic priorities to build a climate-resilient society, by improving knowledge on adaptation, step up adaptation planning, speed-up adaptation actions, and help strengthening climate adaptation globally. The table below provides an overview of these priorities and the related areas for development defined by the European Commission. They are reported as identified R&I challenges as this analysis focuses solely on the areas with the highest potential for further improvement through European R&I actions.

Key priorities	Identified R&I challenges
Improving knowledge of climate impacts and adaptation solutions	1. Translate the wealth of climate information into customised and user-friendly tools. 2. Push the frontiers of adaptation knowledge and acquire more and better climate-related data. 3. Draw on science to improve our understanding of the nexus between climate hazards and socioeconomics vulnerabilities and inequalities 4. Promote the use of the latest technologies and climate services to underpin decision-making (for example remote sensing, smart weather stations, AI, and high-performing computing). New instruments such as Destination Earth and Digital Twins hold great promises to advance our understanding of present and future climate impacts. 5. Need for science-based, robust ecosystem restoration and management that helps minimise risks, improve resilience, and ensures the continued delivery of vital ecosystem services and features: food provision, air and water purification, flood protection, biodiversity, and climate mitigation. 6. Improve the accuracy of data on climate-related risk and losses to better inform decision-making, homeowners, SMEs, businesses, banks, and city planners. 7. Harmonise data collection and extend public access to climate-related disaster loss data by recasting the INSPIRE Directive as part of the "GreenData4All" initiative. 8. Making Climate-ADAPT the authoritative European platform for adaptation; expand the capabilities of online tools and knowledge platforms for the collecting and sharing of data.
Stepping up adaptation planning and climate risk assessments	1. Mainstream climate resilience considerations across all public and private sectors. 2. Ensure adaptation strategies at all National, regional, and local level are effective and based on the latest science. 3. Develop suitable indicators and a resilience assessment framework to improve the monitoring, reporting and evaluation of adaptation progress of Member States. 4. Ensure that regulation and funding take into account disaster risk to avoid creating new expose; reduce existing risk by building resilience, prevention and preparedness; and manage residual risk. 5. Support the local uptake of data, digital and smart solutions related to climate adaptation tailored to local and regional specificities, building upon existing initiatives and instruments such as the Smart Cities Marketplace, Digital Europe Programme, Horizon Europe and the Intelligent Cities Challenge. 6. Support the reskilling and requalification of workers that lead to green jobs, as well as improve our understanding of climate change on workers, working conditions, health and safety. 7. Develop ways to measure the potential impact of climate-related risks on public finances.

[1] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52021DC0082

	8. Quantify the benefits of blue-green (as opposed to grey) infrastructure to be communicated to decision-makers and practitioners at all levels. 9. Develop certification mechanism for carbon removals, which will enable robust monitoring and quantification of the climate benefits of nature-based solutions.
Speed-up adaptation action across the board	1. Close the financing gap for climate resilient investments. 2. Accelerate the rollout of adaptation solutions and step-up innovation. 3. Enhance climate-proofing guidance to increase investments in resilient, climate-proof infrastructures. 4. Promote synergies across projects to promote best practices, standards, guidance, targets, resources and knowledge at National, EU and International levels. 5. Include climate resilience considerations in critical infrastructures. 6. Explore the wide use of financial instruments and innovative solutions to deal with climate-induced risks (Renewed Sustainable Finance Strategy). 7. Improve water management across sectors; reduce water use and guarantee a stable and secure supply of drinking water.
Helping strengthen climate resilience globally	1. Cooperate closely with third countries on adaptation strategies and sharing of best practices to strengthen global adaptation strategies. 2. Scale-up international finances to build climate resilience.

Adaptation might prove to be one of research's most difficult challenges in the years to come

As shown in studies published by the likes of the Intergovernmental Panel on Climate Change[2], the International Energy Agency[3], the European Union[4] and the European Environmental Agency[5] and other relevant organisations, climate change cannot be halted anymore. While it is indeed true that it can be contained, with countries aiming at limiting global temperature rise to around 1.5C degrees in comparison to pre-industrial levels, its effects are already visible nowadays and will continue to provoke disruptions to the environment and human life on earth. The quest for adaptation to climate change is already a crucial part of international efforts, as it is central to the United Nations Sustainable Development Goals (SDG) 7 and 13.

Adaptation to climate change

Adaptation is the process of adjustment to actual or expected climate and its effects (IPCC AR5). It is not a one-time emergency response, but a series of proactive measures to deal with the nexus of hazard (e.g., drought, sea level rise), exposure (e.g., less water in the South), and vulnerability (e.g., poverty or lack of education).

The impacts of climate change on the energy system are various and cross-cutting, potentially reaching many different areas and affecting, for example, renewable energy availability. In this sense, research challenges may be specifically posed to the energy community, as many of the renewable sources we know today depend highly on factors directly touched by climate

[2] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change: https://www.ipcc.ch/report/ar6/wg1/

[3] "Net Zero by 2050 - A Roadmap for the Global Energy Sector": https://www.iea.org/reports/net-zero-by-2050

[4] Communication from the Commission on The European Green Deal: https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f1aa75ed71a1.0002.02/DOC_1&format=PDF

[5] Adaptation challenges and opportunities for the European energy system - Building a climate-resilient low-carbon energy system: https://www.eea.europa.eu/publications/adaptation-in-energy-system

change. To name a few, modifications in water supply, soil quality, and temperatures will alter supply patterns for a diverse range of renewable energy sources.

The importance of the energy-water nexus

Different energy sources pose various challenges. Water is a primary element in producing energy from hydropower, nuclear energy, Concentrated Solar Power (CSP), biofuels, and ocean energy, while it is less fundamental in wind energy and solar photovoltaic (PV). Water-using energy sources will face increasing challenges in the coming years, although in different ways depending on geographical positioning. Climate change adaptation will therefore spur various conditions across Europe, with alteration in water availability in both the North and the South of the continent.

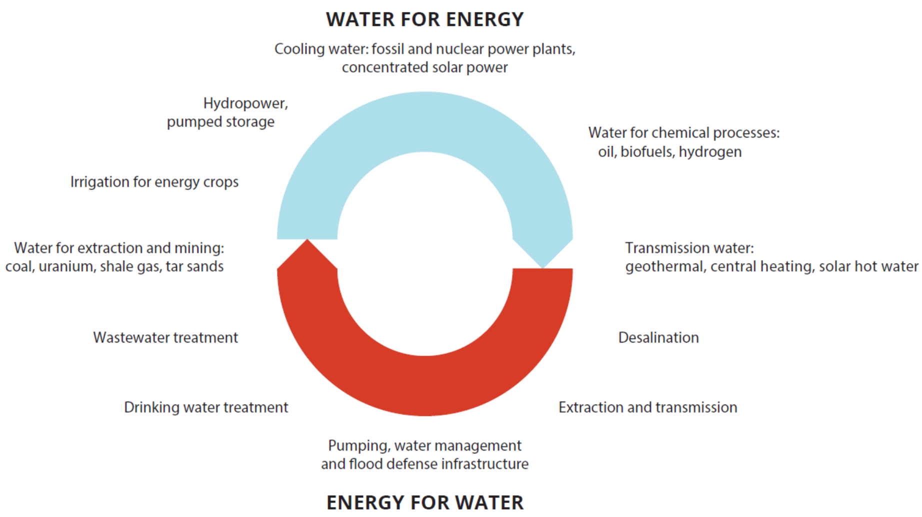

Fig. 1: The energy-water nexus. Source: EEA, based on EP (2012)

Hydropower technology is susceptible to a changing climate, as it can benefit or suffer from very different developments. Northern Europe is projected to experience increased rainfalls and higher temperatures, melting glaciers. On the contrary, ; Southern Europe is expected to be confronted with fewer rainfalls and suffer from a lack of water. This will pose an immediate threat to hydropower plants and infrastructures in both locations: in the South, draughts could decrease hydropower potential, while in the North, floods could increase risks of damages to structures and the ecosystem around the plants. **Research challenges include new assessments of plants stability and waterflow modelling, together with new environmental studies tackling the main impact of increased streamflow on river and dam ecosystems.**

Not only energy production, but also the choice of cooling technology for power generation will need to undergo new adaptation assessments. Once-through cooling systems are cheap and efficient, but they also demand high water withdrawals. The dry cooling option uses very little water, but it is also costly and not yet as efficient as other options. **Research can go a long way in making dry cooling more easily deployable and efficient, but efforts should also be directed towards decreasing water input in other technologies.**

Developments in this sector will be crucial for CSP and nuclear power plants. Both plants make intensive use of water in their processes, and forecasting scarcity of water in countries where the technologies are used will create serious difficulties to operation management. **Cooling technologies will need to become more efficient and less water-intensive. Nuclear**

power plants might also risk being the victim of floods, which means additional research in the waterproofing of plants should be developed.

Higher temperatures, more extreme climate events

In a warmer climate, energy systems will have to be carefully designed to adapt to the new conditions. Once again, Europe is expected to experience different situations depending on geographical locations. Northern Europe is set to see a reduction in total energy demand due to higher average temperatures, while Southern Europe's energy demand is predicted to increase. The difference will be in the need for cooling systems in environments subject to higher temperatures, especially in the summer. As a result, peak electricity demand for cooling will rise in Europe, increasing the need for electricity and creating an additional burden on the system.

Collapsing power cables causes temporary loss of power to users, and brings about additional reparation costs for power providers. Storms can damage power lines, and cause power outages and black-outs, through direct impact or indirect impact (e.g., falling trees). Furthermore, storms can increase the rate of lightning flashes, a further cause of power outages through damage to power lines.

In this context, **the adaptation's main challenge will become the design of integrated and stable energy networks throughout the continent.** There are different measures that can be adopted to reduce unstable or overloaded networks' risk, **including new efficiency standards to reduce the load on the transmission lines, augmented network capacity, increased energy storage technology and the introduction of more water-saving technologies in the energy mix, such as solar PV.** Moreover, it will be crucial to collaborate with Transmission System Operators (TSOs) and distribution system operators (DSOs) to address correct and updated planning and management of energy production and distribution. Particularly in the context of the EU Renovation Wave Strategy[6] and the New European Bauhaus[7], **developments in energy-efficient buildings should also be encouraged to design structures that require less cooling or deploy advanced cooling technologies to reduce the need for electricity use.**

The issues with increased temperatures do not end at cooling. Various research studies have shown how a warmer climate impacts the efficiency of thermal power plants, with an estimated loss in power output of around 0.5% per additional degree[8], and the transmission capacity of power lines by reducing it approximately 1.5% per degree in the summer[9]. **Developments in transmission lines technology and new output production processes will be needed if global temperature will not be halted at 1.5C degrees.**

[6] A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1603122220757&uri=CELEX:52020DC0662

[7] The New European Bauhaus: Beautiful, Sustainable, Together: https://europa.eu/new-european-bauhaus/system/files/2021-09/COM%282021%29_573_EN_ACT.pdf

[8] European Environmental Agency, 2019, "Adaptation challenges and opportunities for the European energy system - Building a climate-resilient low-carbon energy system", p. 37, Publications Office of the European Union, ISSN 1977-8449, doi:10.2800/227321

[9] Ib.

An additional effect of climate change will be the occurrence of extreme climate events, which are now increasing every year. These include storms, hail, floods, high-speed winds, which impact energy installations. Among the main events, we can list storm damages to the transmission systems, drought (loss of cooling water) and ice build-up. **It will be critical for researchers and industrial partners to collaborate on improving facilities to overcome these challenges.** Wind power will also be highly affected by storms increase, as damages to machinery will grow larger, although not as much as in other energy technologies. The effects are already visible today, with the IEA estimating that weather conditions have prevented a possible 9% increase globally in renewable electricity generation[10].

Changes in soil, growing conditions and the land-energy dilemma

Land use will become an additional issue of increasing concern for different energy outings. Significant impact can be expected in the biofuels domain as climate change will affect the seasons and the areas in which crops for biofuels can be grown. In practical terms, this will mean that certain regions in Southern Europe might become unfavourable for crops growing, while the North of the continent could discover its potential.

Other essential aspects need to be considered, such as increased forest fire hazards (as shown by the fires ravaging Europe throughout the summer of 2021) and a change in soil composition and chemistry due to increased temperature and humidity. **Improvements in technology will be needed to ensure that important crops for biofuels will not be lost due to changing conditions, which may risk driving producers towards imports from outside of Europe.** Such an approach would reduce traceability, increase transport-related emissions and decrease strategic autonomy of the EU in the sector.

A second but no less important issue regards the choices made for land use. In terms of deployment, certain renewable energy sources (RES) can have higher land use requirements than fossil fuels. This large land footprint is an important factor in the land-energy dilemma, defined as the trade-off in building energy infrastructure instead of allocating the land to other possible uses, such as food and nature protection. Conflicts are already arising around the world where local communities protest over solar PV installations in place of agricultural land. **With the purpose of preventing the emergence of such struggles, it will be vital to devise new strategies and technologies that can combine multiple purposes on the same land (for example, agro-photovoltaics).** It is also important to remark that, by default, Renewable Energy Sources do not use more land than fossil fuel plants, and that policy and regulation have a pivotal role to play as far as destination of use is concerned. It will then become key **that researchers, producers and policymakers engage in constant exchanges to identify the best space planning strategy for RES installations to be deployed for the best interest of communities.**

[10] IE1, 2021, “Renewables 2021 - Analysis and forecast to 2026”, International Energy Agency

Conclusions

The new EU Strategy on Adaptation to climate change, "Forging a climate-resilient Europe", sets the scene for more ambitious action on climate adaptation. The strategy's objective is to progress swiftly toward the **2050 resilience vision** by making **adaptation action smarter, more systemic, and faster.**

Strong scientific evidence points towards **sudden and more extreme weather events**. These will challenge our current plans for constructing stable power lines, lasting infrastructures, and the use and cultivation of our land.

> The mission "Adaptation to climate change" focuses on solutions and preparedness to protect lives and assets from the impact of climate change. It includes behavioural changes and social aspects by addressing new communities beyond usual stakeholders, whose help will lead to a societal transformation.

"**Adaptation to climate change**" is a standalone topic chosen for one of the **six EU missions** and interlinks strongly with three others, i.e., "Climate-Neutral and Smart Cities", "Ocean, Seas and Waters" and "Soil Health and Food". The first drafts of the *Adaptation to climate change mission* focus on risk and asset level modelling at a regional level, developing adaption strategies, large scale demonstrators and public involvement in the decision process. The three related Missions have their own focus on developing emission-free cities, clean waters and restoration of ecosystems, and soil health. Climate change will undoubtedly impact city infrastructures, affect energy-water nexus issues, and alter how our soil can continue producing the food we need.

EERA believes that **more research is needed to model the impact of climate change on critical infrastructures, waterways and land use. At the same time,** to **address these issues both at a systems-level and at a more specific, individualised approach,** like hydropower, flood control, drainage in cities, and more powerful storms, to mention just a few.

It is also important to remember one of the main conclusions of the Stern report from 2006*: "the costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly".*[11] The above means that **preventive measures to limit the impact of climate change should be a part of the assessment for adaption**, balancing preventive and impact protection actions at regional and local levels to soptimise measures taken.

As a starting point, EERA suggests the following approach for addressing the adaptation challenge: **focusing on modelling the impact of higher temperatures and more extreme climate events and the effects on critical societal infrastructures**. Research in these fields will be crucial to design more stable, resilient and better performing energy systems in the run to climate neutrality by 2050.

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[11] https://www.lse.ac.uk/granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/

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