cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici

European Institute on Economics and the Environment

EIEE

Climate Sciences in the **21st century**

CMCC is an international institution producing advanced research on climate modeling **whilst at the same time developing transversal and multidisciplinary competencies that combine first-class climate modeling with climate change impact modeling and environmental economics**.

Three multidisciplinary research institutes

Four strategic programs on frontier topics

A computing infrastructure dedicated exclusively to the study of climate change

Two specialized centers on digital innovation, and high-level education and training

Over 200 international research projects
A management structure that supports research

Guaranteeing **globally relevant** results for:

- **the scientific community**
- **decision-makers**
- **stakeholders**
- **civil society**

Supporting decisions and actions that promote sustainable development.

Antonio Navarra
President

Giulio Boccaletti
Scientific Director

Laura Panzera
Operations Director

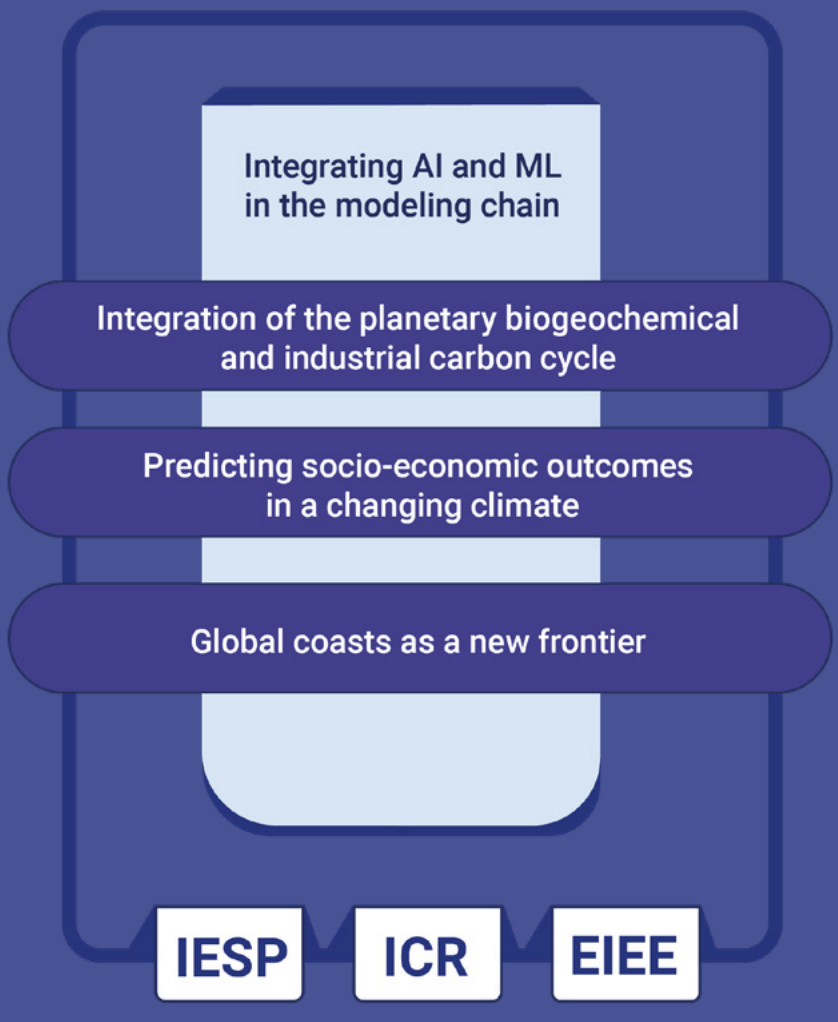
From models to solutions: our research

Our research is organized into three institutes that are home to Earth's sciences and social sciences researchers worldwide:

- **Institute for Earth System Predictions - IESP**
- **Institute for Climate Resilience - ICR**
- **European Institute on Economics and the Environment - EIEE**

A set of strategic programs addresses frontier issues crucial to understanding the challenges facing socio-economic systems in an environmental and social context characterized by a changing climate.

This setup ensures cross-disciplinary research that, leveraging the advanced technology of CMCC's High Performance Computing Center, making CMCC a standout in climate studies covering the entire chain of climate research (from drivers to impacts), as well as the social, economic and technological dimensions.



Massimo Tavoni

Director European Institute on Economics and the Environment
EIEE

The European Institute on Economics and the Environment

(EIEE)

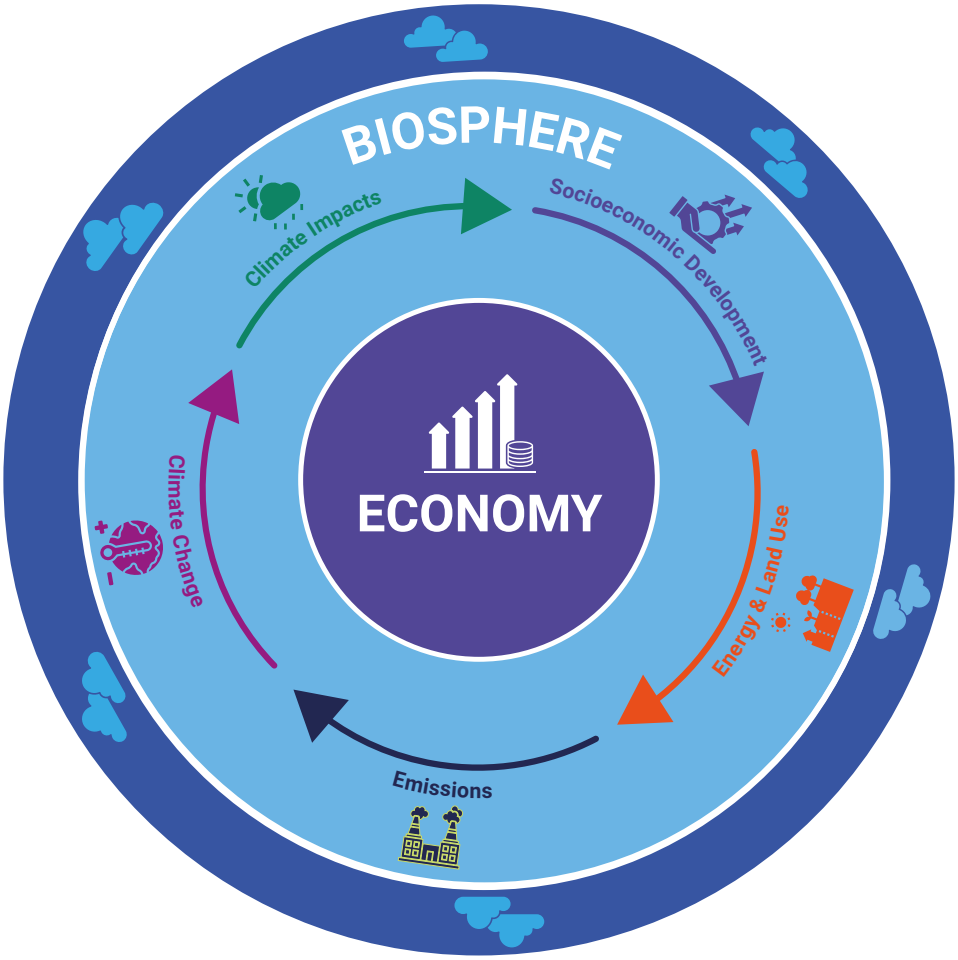
stands at the **intersection between environment, technology and the economy**, evaluating sustainable and socially enhancing strategies that confront climate change and other major environmental challenges.

EIEE is committed to improving environmental, energy, and natural resource decisions through **impartial research and policy engagement**, using a variety of methodological approaches including data science, integrated modeling, and experimental economics.

Founded by CMCC in 2018, as part of a **transatlantic alliance with Resources for the Future (RFF)**, EIEE has provided crucial research and tools that have contributed to **several global assessments**, including IPCC reports.

Economic insights into solving major climate and environmental challenges

EIEE combines environmental and economic sciences, exploring future socio-techno-economic systems and climate scenarios to support climate policy through the provision of robust evidence.



The economy is deeply embedded in the biosphere. Society relies on natural resources for all economic activities, driving energy consumption, land use and contributing to climate change. Figure freely adapted from: Final report - The Economics of Biodiversity: The Dasgupta Review and Primer to Climate Scenarios.

Climate change and environmental hazards impact society in profound ways, causing transformations in socioeconomic and institutional conditions. The disruptive impacts of climatic hazards on economic development and inequality are already apparent. Confronted with these challenges, many countries have committed to and, in some cases, implemented new legislation to mitigate and adapt to climate risks.

Though not collectively sufficient, these policy developments have led to some progress in climate-abating strategies, such as renewable energy development and electrification of end uses. However, policy pressure is often watered down by incumbents who attempt to prolong the *status quo* and resist the ecological transition.

Ecological and environmental economics explore the interactions between the economy and biosphere. EIEE investigates their bidirectional relationship from an empirical and process perspective, focusing on the boundary area between the two spheres. The institute's research provides unique insight into future trends in the economy and society, how they are affected by climate change and their impacts on the Earth system.

Projected consequences of a changing climate can be addressed through significant mitigation and adaptation efforts. However, reshaping our economic systems will inevitably come with costs and risks.

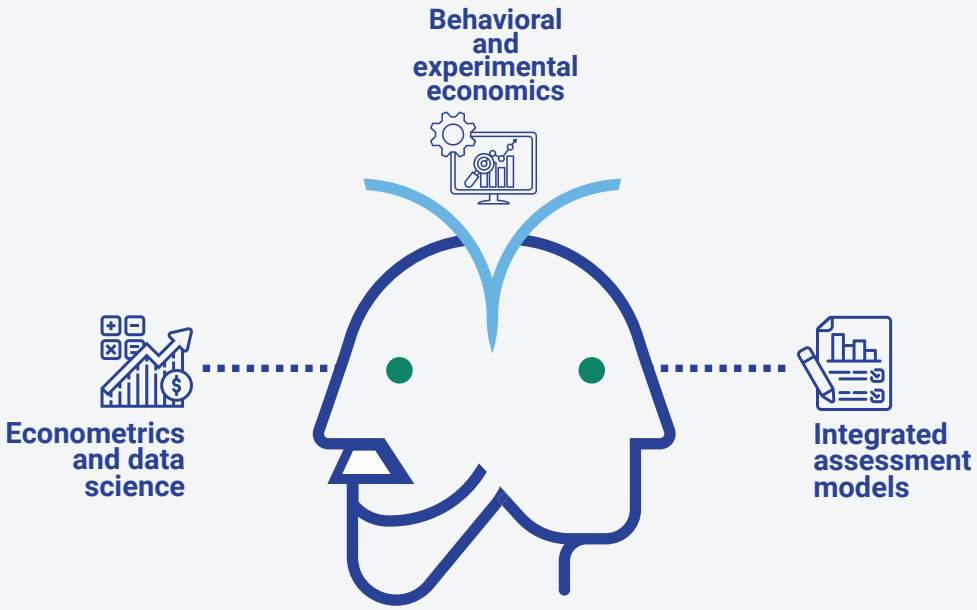
> EIEE's work supports policymakers in envisioning and implementing the transition toward a carbon-free economy whilst managing the impacts of emerging scenarios on society and accounting for potential inequalities.

Through technological innovation and advanced analysis of past and future climate, economic, and social data, EIEE provides an integrated outlook on the various pathways towards a carbon-neutral and resilient future.

What does EIEE do?

EIEE links a variety of disciplines to understand social, economic, and technological processes driving key environmental and climate challenges and foster a sustainable transition to a prosperous society within a healthy environment.

Climate change and other major environmental challenges are primarily societal issues. EIEE serves as the CMCC's reference institute for placing society, economics, and technology at the core of decision-making processes. The closed loop that links socio-technical-economic systems and the environment can only be managed with well-designed climate strategies. This requires an understanding of the best solutions for mobilizing scarce economic and political resources and placing ecological transformation as a core societal goal. EIEE combines backward and forward-looking methodologies in the provision of critical information and knowledge for key decisions.



Research at EIEE engages with a plurality of disciplines including economics, behavioral and political sciences, engineering, and environmental sciences. This multidisciplinary approach integrates socio-economic and technical perspectives, aligning closely with the themes of other CMCC research institutes.

Advanced research and expertise

Grounded in quantitative methodologies, EIEE also embraces qualitative and behavioral sciences in shaping its research landscape.

EIEE's analytical toolkit features a range of computational models offering diverse numerical strategies with which to explore the intricate connections between environment, economy, and society. EIEE takes a pluralistic modeling approach, with a model suite that includes and integrates Integrated Assessment Models (IAMs), Computable General Equilibrium Models, Agent-Based Models, Energy System Models, Resource Use Models, and Environmental Models.

EIEE employs empirical methods to leverage data-driven insights, evaluating the effectiveness of policies in driving green transformations and enhancing societal resilience. Furthermore, econometric and data science methods are used to analyze observational data and interpret it through modern statistical approaches. There is also a strong theoretical component to EIEE's work, such as insight from experimental political economy, which can inform our understanding of human behavior and organizational dynamics.

EIEE's research output distinguishes itself through a strong focus on publications and success in competitive bids, most notably 8 European Research Council projects, making EIEE an established and recognized member of the global community of scholars that work at the intersection between economics and the environment.

Research pillars

EIEE's work focuses on the transition to a green and prosperous society.

EIEE's research focuses on:

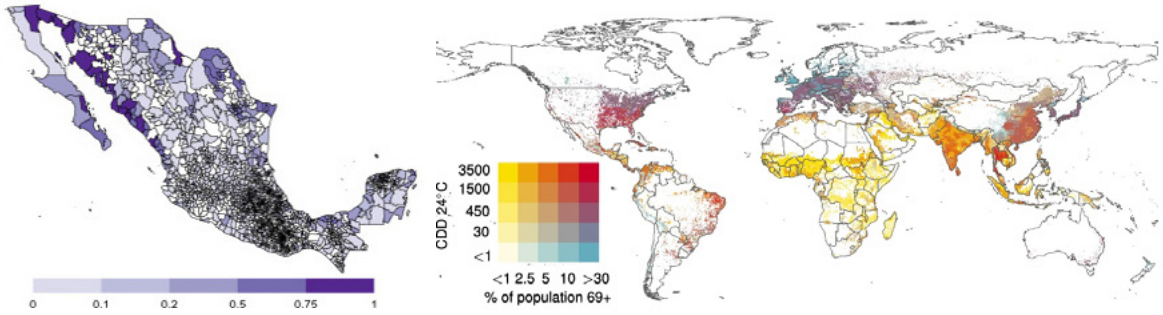
- Climate stabilizing strategies
- Socio-economic impacts of environmental and climatic hazards
- Policy evaluation

This involves not only mitigating greenhouse gasses and reducing environmental pollution – such as air and water pollution – but also addressing the best strategies for managing the impacts of environmental issues on society and the economy, and designing effective policies and interventions that help integrate society and the environment.

> The European Institute on Economics and the Environment focuses on quantifying the socio-economic implications of environmental and climatic hazards and assessing their impacts on the economy and society.

EIEE is widely recognized for its work on the climate transition, particularly in modeling pathways and scenarios to achieve net-zero emissions. Various reports from the IPCC have highlighted the need to bring emissions down to zero in the coming decades. EIEE's research has contributed to this knowledge through model-generated decarbonization pathways, identifying key signposts for an effective climate transition and its repercussions for the economy, technology, and society.
EIEE's work also includes quantifying the impacts of climate change on energy usage, macro-economic development, economic inequality, financial stability, as well as loss and damage.

To effectively understand climate change impacts, EIEE analyzes historical records in the evolution of environmental and socio-economic variables to pin down critical drivers and develop scenarios of environmental hazards depending on the future evolution of socioeconomic, technological, and environmental trends. EIEE has also championed work on the effectiveness and limitations of adaptation in reducing the socio-economic impacts of climate change.



Left: Share of Mexican households with air conditioning in 2018 according to calculations using data from a nationally representative repeated cross-section survey carried out biannually by the Mexican statistical institute INEGI. Figure from: Randazzo et al. (2023), https://doi.org/10.1016/j.jeem.2023.102818.

Right: Current global exposure to days above the 24° C threshold—called Cooling Degree Days (CDDs)—for older population aged 69+. Figure from: Falchetta et al. (2024), https://doi.org/10.1038/s41467-024-47197-5.

Sustainable transition, adaptation and innovation are our primary areas of activity, as well as technological change, digitalization and circularity.

EIEE has leverged natural experiments, such as COVID restrictions, geopolitical tensions, and weather shocks to better understand how society and the environment respond to changes in external conditions.

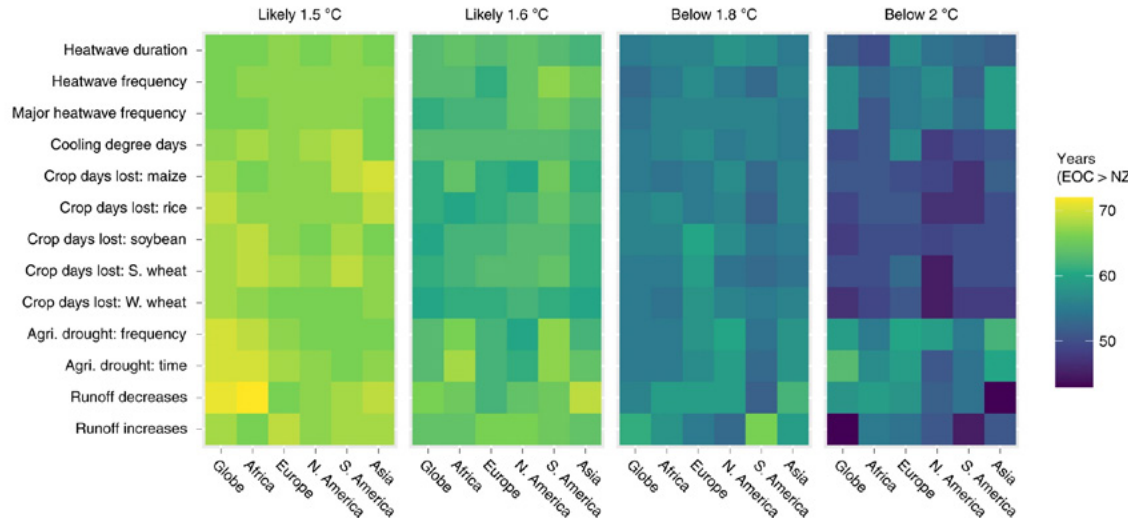
EIEE has evaluated climate and energy policies on a broad set of socio-economic variables, carrying out randomized experiments on millions of households that test the effectiveness of pro-environmental behavioral interventions.

EIEE has also engaged in numerous other critical areas, such as climate finance, which is essential for global change, and environmental social justice, a key element in any transition. Other significant topics include sustainable behavior, political economy, biodiversity, city science, and migration.

Managing the physical and economic risks of climate overshoot

We are entering a world of climate overshoot, which we are likely to remain in for decades. Improved science is needed to understand the dangers of temperature exceedance whilst assessing ways to reduce atmospheric CO_2 concentrations and stabilize the climate.

EIEE's research focuses on the double challenge of managing the risks of climate overshoot and ensuring society restores the climate to safer levels. EIEE's research has helped quantify the additional climate risks, as well as the physical and macroeconomic impacts, of exceeding mitigation thresholds, providing insight for long-term planning and risk management. At the same time, it has also examined the potential of negative emissions for many years, publishing the first collection of interdisciplinary papers on the subject. EIEE's work has not just assessed CO_2 removal from a techno-economic and climatic viewpoint but also in terms of financing needs and their repercussions for economic inequality depending on support schemes for negative emission technologies.



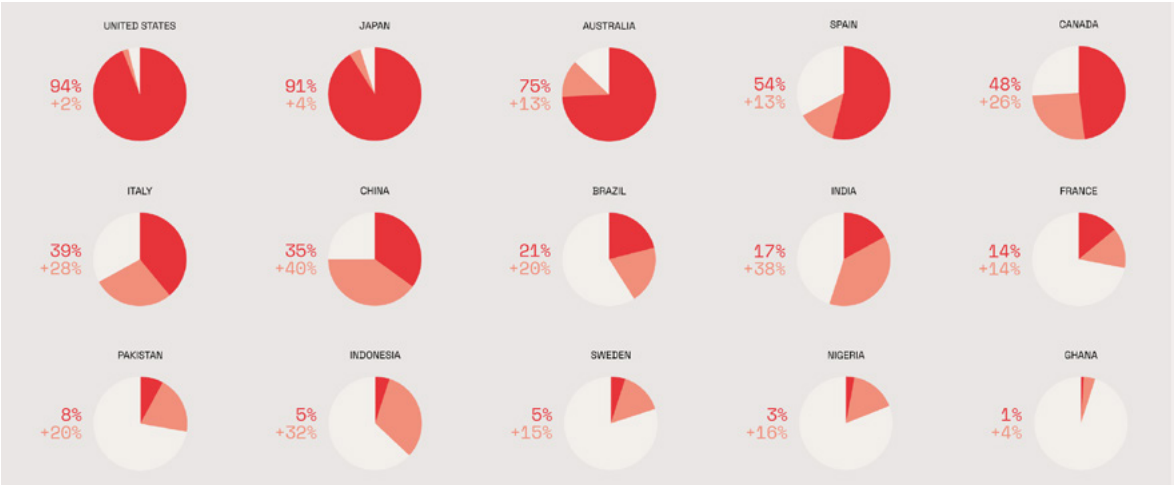
The figure shows how many additional years we will experience the tail impacts of an 'End of Century' (EOC) scenario design—a scenario where all the remaining carbon budget is used without restrictions— compared to 'Net Zero' (NZ) scenario— a scenario where the remaining carbon budget is used until we achieve consistent net zero CO2 emissions. The impact comparison is made across different regions and different temperature targets. As the temperature target increases, the number of years we will experience tail climate change impacts due to missing the net zero targets decreases. However, there are some differences based on the impact type (e.g. extreme heat and crop duration are more at risk of experiencing impacts of overshooting for a longer period) and between regions. Figure from: Drouet et al. (2021), https://doi.org/10.1038/s41558-021-01218-z.

Cooling poverty

As temperatures increase and urban heatwaves intensify, research addressing inequalities in the lack of access to cooling solutions provides vital information on adaptation.

Heatwaves, worsened by climate change, pose serious health risks, particularly for those most vulnerable. In particular, poverty is a defining factor for climate vulnerability, as the poorest communities often lack the financial means to prevent and adapt to the most severe consequences of a warming world. In this context, lower-income residents and marginalized groups face significant barriers to accessing affordable cooling solutions, underscoring climate adaptation inequalities. Moreover, as the wealthier adopt energy-intensive technologies such as air conditioning, emissions from air conditioning are expected to spike.

The Cooling Solution is a project involving CMCC scientists that tells the story of thermal discomfort experiences and solutions to extreme heat around the world using a combination of scientific evidence, visual approaches, and storytelling. The project highlights the need for a systemic approach to heat adaptation and to address cooling poverty.

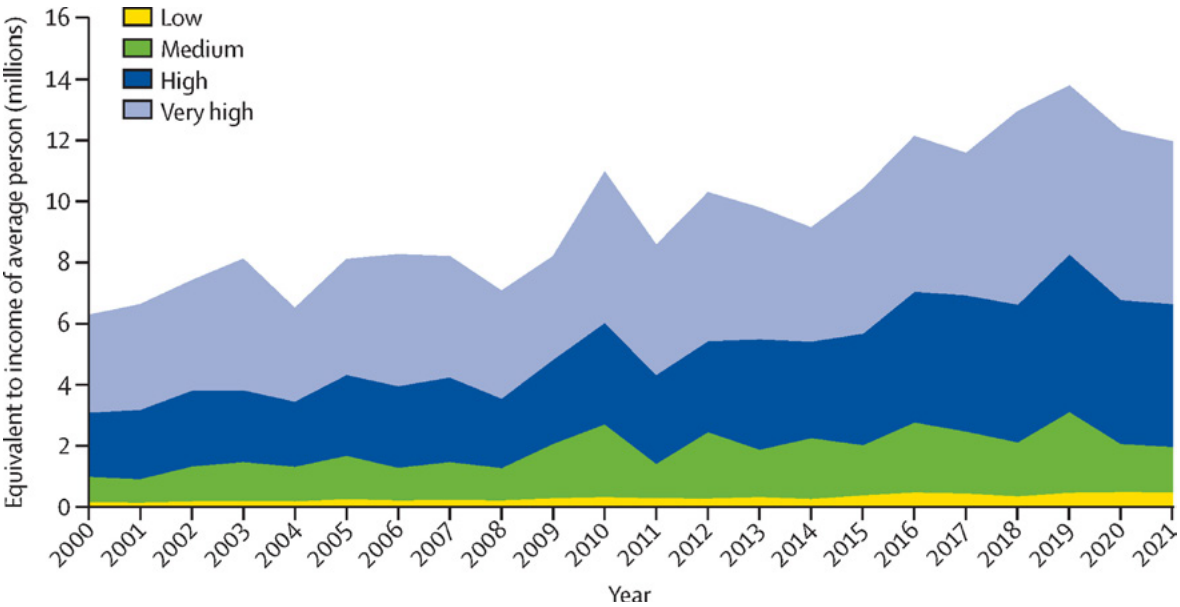


Present and projected air conditioner adoption in different countries. Air conditioning adoption in households today (in red) and in 2050 (in orange) for different countries.
Source: The Cooling Solution.

Human behaviour

Human response to rising environmental hazards is key for adaptation and mitigation. Research at EIEE uses behavioral and economic sciences to quantify human responses and their socio-environmental consequences.

EIEE uses methods from behavioral and applied economics to quantify people's responses to climate risks and policies. This includes the use of randomized controlled experiments (RCTs) on millions of households across the globe to evaluate behavioral interventions for a green transition; the assessment of historical climatic data and surveys to quantify climate-induced migration and its economic and institutional consequences; and the analysis of the human health implications of climate change and air pollution, both in developed and developing countries and on the most vulnerable.

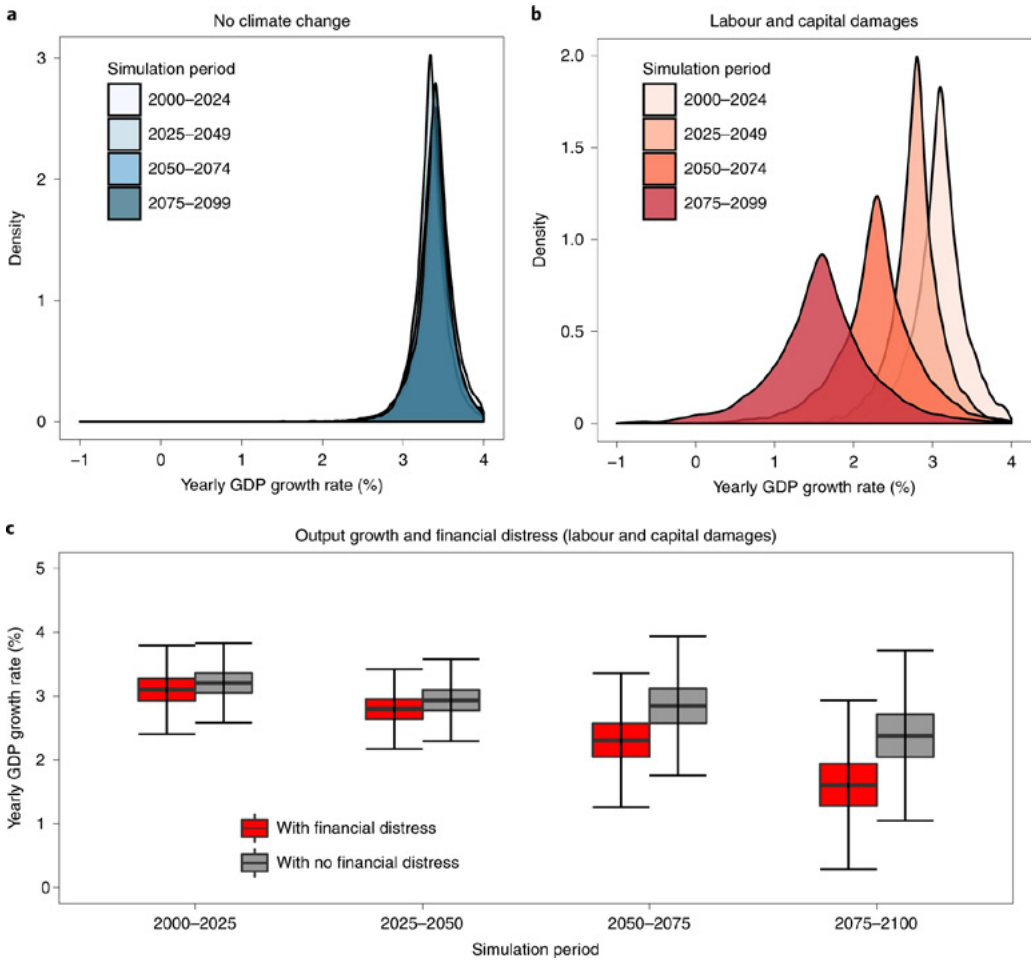


Heat-related mortality has already imposed significant costs on society. In 2021, the cost of deaths caused by heat reached $144 billion, which corresponds to the summed average annual income of 12.4 million people. The figure shows trends in the monetized costs of deaths related to heat over time. The colored areas represent the costs attributed to countries grouped by different Human Development Index, from low to very high. Figure from: Romanello et al. (2022), http://dx.doi.org/10.1016/s0140-6736(22)01540-9.

Climate finance

Adequate and fair finance is essential to address the double challenge of investing in the transition and adapting to climate induced economic risks.

The macro-financial implications of climate change are profound as societies both green their economies and spend on adaptation. EIEE's work has addressed both these aspects, quantifying the investments needed for climate stabilization and informing the IPCC chapters on climate finance. EIEE has analyzed the macro-financial risks of climate change, including for the stability of the financial system and for international policy issues such as the funding of loss and damage.



Expected yearly GDP growth, depicted as Kernel densities – statistical curves that represent the estimated probability density of projected data – in a scenario without climate change (a) and with labor and capital damages (b) across different 25-year periods. The box plots (c) show the yearly GDP growth rate in percentage, along with their confidence ranges, for each 25-year period, comparing scenarios with and without financial distress. Figure from: Lamperti et al. (2019), https://doi.org/10.1038/s41558-019-0607-5.

Future goals. Paving the way for climate and economic resilience

The CMCC European Institute on Economics and the Environment is dedicated to improving environmental, energy, and natural resource decisions by fostering informed policy solutions.

A transatlantic collaboration for climate economics and the environment

RFF CMCC European Institute on Economics and the Environment

CMCC and RFF joined forces in 2018, establishing a transatlantic partnership that explores the relationship between climate and the economy. This has allowed EIEE to leverage the capacity and skills of RFF, the first think tank devoted exclusively to natural resources and environmental issues and still the leading one in environmental economics. At the same time, RFF has benefited from its European connection through access to a variety of methods and models developed by EIEE and a proximity to the world of European climate legislation, which is taking on an increasingly central role.

The RFF-CMCC European Institute on Economics and the Environment has carried out significant joint initiatives. These include establishing a global network of research institutions powering global net-zero decision-making, co-organizing international research and policy events, sharing research personnel, and co-promoting the institutes.

Looking ahead, EIEE aims to:

- Advance the state of community research, to which we proudly belong, for aggressive climate and environmental action that benefits ecosystems and pays off in economic terms.

- Address the political economy of the climate and environmental transitions, identifying outstanding barriers that prevent businesses and households from committing to change.

- Analyze the inevitable risks of climate and environmental overshoot, focusing on evaluating climate strategies and interventions to deal with it.

- Leverage the development of deep learning to develop foundational models for the interplay between the economy and the climate, while also retaining tractable approaches for general insights.

EIEE is committed to addressing the complexities of climate and environmental transitions by examining the political economy and identifying barriers to change, and by evaluating strategies and interventions.

The institute aims to expand its focus on sustainable transition, adaptation, innovation, climate and energy policies, and technological change, while also prioritizing areas like climate finance, environmental social justice, biodiversity, city science, and migration to better understand societal and environmental responses to global challenges.

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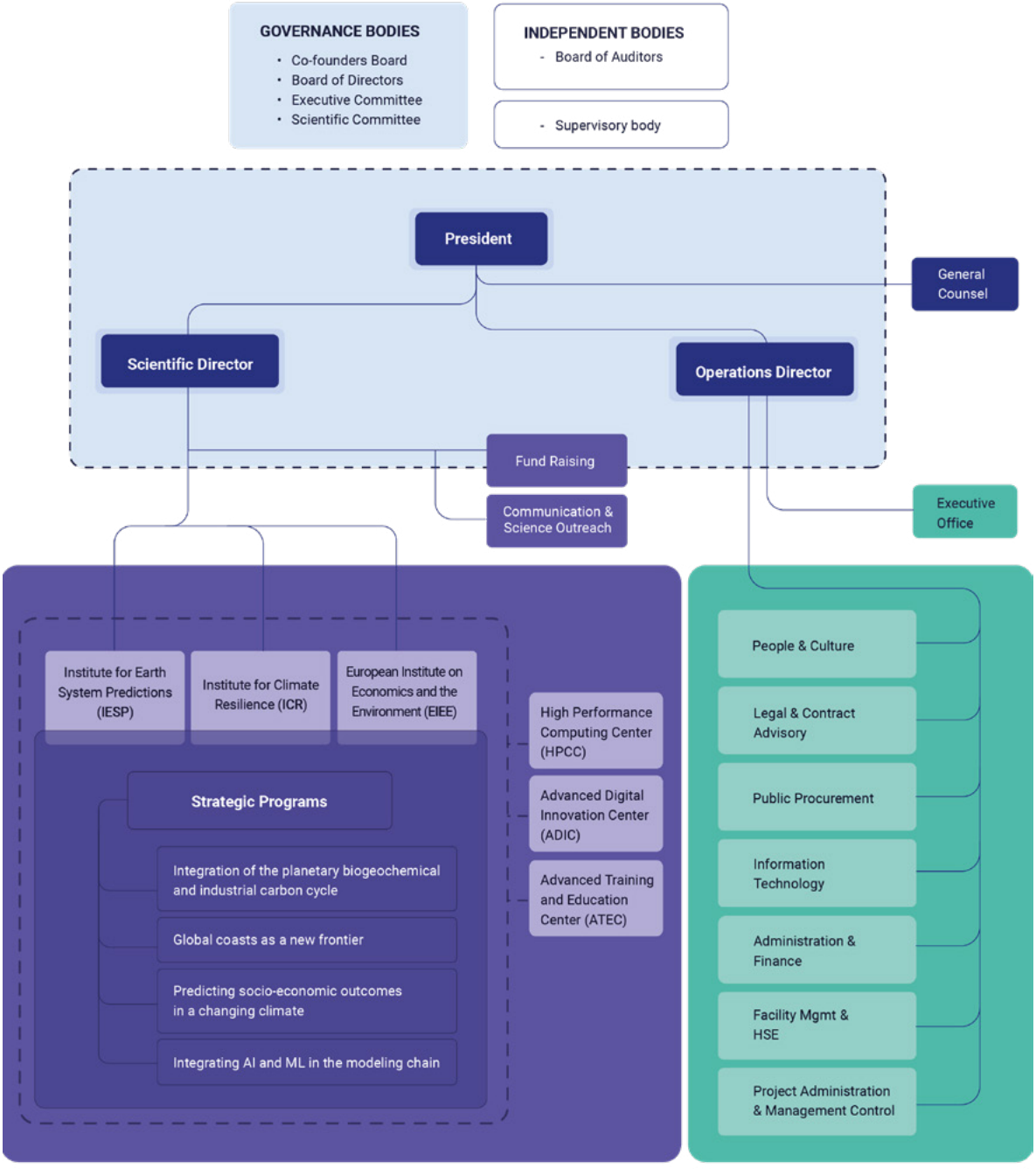

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