



→ **CLIMATE CHANGE
MODELLING INFORMATION**

Quarterly report – Q1 2024 report

**Focus on Health, Nationally Determined Contributions,
Mid-century strategies**



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Focus on Health, Nationally Determined Contributions, Mid-century strategies

A report submitted by [ICF S.A.](#)

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> High-level executive summary

This report under the “Climate change modelling information” series presents recent developments reported by key international climate modelling institutions and journals. This issue sets a particular emphasis on climate change and health, in addition to the regular sections on Nationally Determined Contributions, and Mid-century strategies. The topic of health and climate change is of growing importance as climate changes is directly contributing to humanitarian emergencies, such as heatwaves, floods, storms and there are non-negligible costs related to direct damages to health. Moreover, climate change is impacting health in many other ways, including the disruption of food systems, the increase in zoonoses and food-, water- and vector-borne diseases, as well as with mental health issues. Climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged.

The first section of the report features initial results from studies related to **climate change and health**, a topic that saw a growing interest also testified by the attendance to the second CCMI webinar organised on 21 November 2023 titled ‘Climate change and health impacts’. A study in China assessed the additional health expenditure associated to days of extreme heat in the country due to climate change. In Italy, researchers assessed the benefits of European policies related to climate change and air quality, while, similarly, in the United Kingdom researchers assessed the co-benefits of decarbonisation strategies, focusing on air quality and public health. In Switzerland, a research group analysed the influence of climate changes in lakes, affecting the transport of waterborne viruses.

Various developments linked to the implementation of the **Nationally Determined Contributions (NDCs)** are reported in the second section. A research team across international institutions assessed how existing national plans and policies contribute to the global goal of the Paris Agreement. Another consortium of international partners evaluated the progress of implementing the climate goals of the Paris Agreement, analysing the implementation gap towards their achievement. In Mexico, researchers explored the possibility of the power system to comply with the country’s NDC commitments.

In the third section, the report features research linked to **mid-century strategies**. A study led by the United Kingdom analysed tipping points in the Earth system and society. In China researchers assessed the rebound effect in the power sector in the country under the carbon trading scheme. Additionally, the third section features the latest report by the European Commission providing an outlook on climate and energy for the year 2023.

> Introduction

This report is the fourth quarterly report of 2023 under the series “Climate change modelling information” financed by the European Commission. The objective of this series is to inform the European Commission and the wider climate change and energy modelling community about recent and relevant modelling developments. The data presented in this report is the result of desk research and answers provided to the last survey shared via the CCMI newsletter.

The report focuses on developments related to **health**, the implementation of **Nationally Determined Contributions (NDCs)**, and **mid-century strategies**. Although the objective of this report is to present an extensive list of recent developments, it cannot be considered as exhaustive.

The modelling developments discussed in this report are summarised below and further described in the coming chapters.

Modelling developments linked to climate change and health:

- [Behind climate change: Extreme heat and health cost](#) (China)
- [Modelling the air quality benefits of EU climate mitigation policies using two different PM2.5-related health impact methodologies](#) (Italy)
- [Inequalities in Air Pollution Exposure and Attributable Mortality in a Low Carbon Future](#) (United Kingdom)
- [Waterborne Virus Transport and Risk Assessment in Lake Geneva Under Climate Change](#) (Switzerland)

Modelling developments linked to nationally determined contributions (NDCs):

- [Promising climate progress](#) (Austria)
- [Annual Net Zero Report 2023](#) (Netherlands)
- [Paving Paths to 2050: Mapping the Mexican Power Sector’s Potential to Build Sustainable Futures](#) (Mexico)

Modelling developments linked to mid-century strategies:

- [Global Tipping Point Report](#) (United Kingdom)
- [The rebound effect of decarbonization in China’s power sector under the carbon trading scheme](#) (China)
- [Global Energy and Climate Outlook](#) (Europe)

> Modelling developments linked to climate change and health

- Researchers from China conducted a [study](#), published on the journal *Structural Change and Economic Dynamics* and led by [Peking University](#), analysing the effects of extreme heat on health in the country. To perform this study, researchers used data collected through the China Health and Nutrition Survey (CHNS), which has information from ten surveys ran since 1989 with intervals of about three years. An empirical strategy, using the occurrence of heatwave days at city level, was developed to quantify the causal effects of extreme heat on health.

The results show that extreme heat increases morbidity, disease severity, hospitalization, and treatment costs. Specifically, each additional day of extreme high temperature leads to an increase of approximately CNY 38.97 million in health expenditure (approximately EUR 5 million).

Policy implications: public health systems should consider the effects of extreme heat to create a resilient public health system and avoid the incurrence of unexpected non-negligible health cost.

- A research group from the European Commission, [Joint Research Centre](#) (JRC) in Ispra (Italy) published an [article](#) to assess the benefits of the foreseen European policies related to climate change and air quality. Specifically, the study focused on assessing the impacts of 1) the policy package 'fit for 55' (FF55) dealing with the ambitious climate target of reducing greenhouse gases (GHG) emissions by 55 % in 2030 in comparison to 1990, and 2) the National Emission Ceiling (NEC) Directive for the remaining pollutants not covered in the FF55 package emission reductions. The team used a modelling chain based on Emissions Database for Global Atmospheric Research (EDGAR) emissions, the chemical transport model from the co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe, known as the 'European Monitoring and Evaluation Programme' (EMEP) air quality model, and on two health-impact modules: CaRBonH (based on the Health Risks of Air Pollution, HRAPIE) and the Global Burden of Disease (GBD), as implemented in FASST-GBD model. Benefits of these policies were analysed via the health benefits resulting from the reductions in yearly average PM2.5 concentrations.

Results show that the air pollutant PM2.5 will be strongly reduced, as a co-benefit of climate policies, but also thanks to the NEC directive foreseen reductions. Looking at the monetized health impacts, reduced morbidity could result in economic benefit in average of 0.3 % of the GDP, with maximum of 0.9 % of the GDP considering GDP 2015 values, with values for mortality-related economic benefits around 3 to 5 higher than for morbidity.

Policy implications: integrated approaches to tackle both the climate and health challenge can increase synergies and avoid side effects. European policies can bring health and economic benefit in the country, with several billions of euros of benefits both in terms of morbidity and mortality indicators.

- A [study](#) published on the *Earth's Future Journal*, led by the [Institute for Climate and Atmospheric Science](#) (ICAS) of the School of Earth and Environment at the University of Leeds, examined the co-benefits of decarbonization for air quality and public health globally, under scenarios transitioning to a low carbon future. Future global projections

of the air pollutant, PM_{2.5}, were used under three different pathways: a baseline scenario and two decarbonisation scenarios with strong air pollution control. The study used existing model data from experiments conducted as part of the Coupled Model Intercomparison Project Phase 6 (CMIP6). The global surface distributions of PM_{2.5} concentrations was calculated using data from five CMIP6 models from the Earth System Grid Federation (ESGF) database. Health impact assessments were performed to estimate the future premature mortality burden attributable to long-term exposure to the identified air pollutant, using the Global Exposure Mortality Model (GEMM), taking into account four different socioeconomic groups.

The study finds that decarbonisation can generate substantial health co-benefits by averting millions of premature deaths associated with PM_{2.5} exposure across all income groups, however the low-income population will experience the lowest benefits. In fact, with a decarbonised future pathway, the global socioeconomic disparity in exposure to PM_{2.5} reduces but persists at around 30% by 2100.

Policy implications: when implementing decarbonisation strategies, it is important to consider the additional benefits or “co-benefits” through improved air quality and public health. Also, additional and targeted air quality measures are needed to ensure that lower and middle-income populations (especially in Africa and Asia) can receive the same benefits.

- A [study](#) led by the [École Polytechnique Fédérale de Lausanne](#) explored the influence of climate changes in lakes, affecting the transport of waterborne viruses. For this study, researchers used a water quality-microbial risk assessment model to estimate virus concentrations and associated risks to recreational water users for each month in 2019 and 2060.

The study suggests that during warmer seasons, the increase of virus inactivation due to higher water temperature and stronger solar radiation at the earth's surface will compensate for the additional virus discharge brought about by population growth over the time period considered. In contrast, during winter the virus concentration near the lake shore and the associated infection probabilities risks are likely to increase due to population growth. The study finds that the risks posed by enteric viruses with recreational water users near popular beaches around Lake Geneva in 2060 will likely remain similar to current risks.

Policy implications: estimation of the environmental inactivation of viruses is crucial for predicting the fate of enteric viruses in aquatic systems in the future.

> Modelling developments linked to Nationally Determined Contributions (NDCs)

- As part of a collaboration of international groups coordinated by the International Institute for Applied System Analysis (IIASA), the Exploring National and Global Actions to Reduce Greenhouse Gas Emissions ([ENGAGE](#)) Project funded by the European Union's Horizon 2020, assessed how existing national plans and policies contribute to the global goal of the Paris Agreement. To conduct the assessment different integrated assessment models were used and compared, each of them analysing seven different broad scenarios, including the use of a new feature in the integrated assessment model

MESSAGEix-GLOBIOM, which allowed for the representation of national near-term policies as well as NDCs. The latest policy brief of the project, highlighting the results of the assessment is available [online](#).

Main findings show that neither current policies nor existing NDCs come close to the Paris Agreement goals. At best, current policies stabilize GHG emissions, whereas a deep cut is needed. The brief also shows that net-zero pledges would bring global emissions down to a much lower level than current policies or NDCs. Although net-zero targets are a big step forward, countries would not meet the long-term climate goals.

Policy implications: net zero pledges are a big step forward as long as governments deliver the promised GHG cuts. To meet the climate goals, global ambition on fossils and renewables must be increased further and efforts to implement climate targets should increase.

- The [ELEVATE project](#), consisting of a consortium of 19 international partner institutions, recently published the [Annual Net Zero Report 2023](#), led by PBL Netherlands Environmental Assessment Agency. The report evaluates the progress of implementing the climate goals of the Paris Agreement via the long-term goals and assessed the implementation gap for five major emitters: European Union, the United States, China, India and Brazil, using the results of the IMAGE model. The next edition of the ELEVATE Annual Net-Zero Report (foreseen in October 2024) will dive further into the questions of fairness, discussing how justice and equity dimensions can be incorporated into modelling tools and scenarios, and will analyse how effort-sharing principles can be applied to close the emissions gap.

Results show that the implementation of current climate policies is not enough to achieve net zero on a global level. The ambition gap to a 1.5°C compatible pathway shows that on a global level, announced net-zero emission projections are not fully aligned with the collective Paris Agreement goals. Two of the five major emitters (EU-27 and USA) have an NDC that is aligned with their net-zero target, meaning that if they manage to achieve their NDC goals and maintain their level of effort, they could also achieve their long-term strategy.

Policy implications: countries should increase their ambition level if they are to achieve the self-imposed targets. The ambition gap reflects the need for a collective discussion on how the burden of closing this gap could be shared.

- An [article](#) led by the [Instituto de Energías Renovables](#) (IER) in Mexico analyses the possibility of Mexican power system to comply with the NDC commitments adopted in the Paris Agreement in the National Climate Change Strategy of the General Law for Climate Change. The analysis was carried out using the Low Emissions Analysis Platform (LEAP) scenario modelling software, with an economic optimization that accounts for the lowest emissions possible as a second optimization criterion. Four different scenarios were developed, taking into account GDP and population, the policy potential for renewable resources under different policies.

The research shows that the country has the capacity to meet the Mexican commitments adopted in the Paris Agreement if, on one side, techno-economic renewable technologies and electricity storage systems are used, and on the other, if the country's strategic areas evolve into a more holistically sustainable future.

Policy implications: complying with Mexican’s NDC is possible, however policies should be designed to foster the society, government and financial ecosystem that aligns with the SDGs in a holistic comprehensive manner.

> Modelling developments linked to Mid-century strategies

- The [University of Exeter’s Global Systems Institute](#) with the support of more than 200 researchers from over 90 organisations in 26 countries published a [report](#), which assessed the risks and opportunities of both negative and positive tipping points in the Earth system and society. More than 25 Earth system tipping points were identified from evidence of past changes, observational records and computer models, showing that early warning signals have been detected that are consistent with the Greenland Ice Sheet, AMOC, and Amazon rainforest heading towards tipping points. The report also present priorities areas to advance knowledge on the topic.

The report highlights that harmful tipping points in the natural world pose some of the gravest threats faced by humanity. Their triggering will severely damage our planet’s life-support systems and threaten the stability of our societies. For example, coal reefs and some ice sheets could tip at current warming levels. In this context the risks of crossing Earth system tipping points can be minimised through rapidly reducing anthropogenic drivers of global change.

Policy implications: the study provides some recommendations, including preventing destabilisation of the Earth’s tipping systems through urgent and ambitious elimination of GHG emissions and reduction of other pressures such as deforestation, black carbon emissions and nutrient pollution. The report also underlines the importance to invest in improving early warning of Earth system tipping points, refining methods, use of models to guide monitoring efforts, palaeo-data¹ gathering and improving remotely sensed datasets.

- A research group in China led by the Management School, [Zhengzhou University](#) carried out a [study](#), published on the *Energy Policy Journal*, assessing the rebound effect in the power sector in China under the carbon trading scheme (ETS). With the aim to verify the actual decarbonisation effect of ETS in the sector, researchers used an almost ideal demand system (AIDS) model and simulation analysis method to systematically assess the rebound effect. To perform the study, researchers considered the seven primary power generation technologies available in China, which are hydropower, coal, natural gas, nuclear, wind, photovoltaic, and biomass power. Geothermal and ocean energy power generation were not considered in this study because the proportion is too low and the technology is not yet mature.

The study finds that there is a strong correlation between the rebound effect and carbon prices, specifically the lower the carbon price, the higher the rebound effect.

Policy implications: the study suggests considering the rebound effect when formulating or improving policies related to the decarbonization of China’s power sector, also assessing the effectiveness of the current ETS. The study also highlights the need to increase carbon prices to help mitigate this rebound effect.

¹ “Palaeo” means old, ancient or prehistoric.

- The European Commission's [Joint Research Center](#), has just published its annual [report](#), the Global Energy and Climate Outlook (GECO) 2023. This report presents an updated view on the implications of energy and climate policies worldwide on energy trends and emissions, and what they imply about reaching the goals of the Paris Agreement. The report was produced based on results from the partial equilibrium global energy model POLES-JRC and the general equilibrium model JRC-GEM-E3 that covers the interactions between the global economy, the energy system and the environment. The study provides insights into investments and related new jobs required by the transition to a low-carbon economy.

Results show that global emissions are projected to peak during the current decade, but a failure to implement additional policies puts the world on a trajectory towards a long-term temperature increase of 3°C, so gaps remain both in implementation and in ambition.

Policy implications: Accelerated decarbonisation efforts are needed across all sectors of the economy. These must happen in this decade if we are to keep the 1.5°C target within reach.

> Insights from the 2023 IAMC Annual Meeting

The 16th annual meeting of the Integrated Assessment Modelling Consortium was held in person in Venice, Italy, and online between 14 and 16 November 2023. The event was attended by 433 people, whose 324 in person and 109 online, from 34 different countries from four continents. The Annual Meeting programme included four plenary sessions, 176 papers presented in the oral sessions and 131 poster presentations (82 online and 49 in person). The first plenary session discussed role of scenarios in the IPCC AR7. The second plenary session focused on climate policies comparison at international level. The third plenary session provided an update on climate resilient development and just energy transition in African countries. While the fourth plenary session focused on the relevance of climate science and scenarios for the finance and private sectors.

The papers presented in the oral and poster sessions were divided into 20 research topics, including:

- the assessment of national mitigation strategies;
- the analysis of deep mitigation strategies;
- demand-side mitigation, including lifestyle change and degrowth;
- energy supply-sector analysis;
- carbon dioxide removal and nature-based solution;
- sectoral transition pathways;
- circular economy;
- analysis of the contribution of non-state action;
- climate justice (including equity and distributional impacts);
- economic assessment analysis of climate policy;
- adaptation and mitigation (synergies and trade-offs);
- climate finance; and
- impacts of climate change (including representation of the climate system); transition scenarios and sustainable development.

All posters presented at the meeting are available online on the Conference platform for all registered participants. Information about the speakers and edited recordings of the plenary sessions can be found on the [website](#).

> Events

Event	Date and location	Objectives	Topics covered	Deadlines
EGU General Assembly 2024	April, 14-19, 2024, Vienna, Austria and online	The European Geoscience Union (EGU) General Assembly 2024 brings together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary, and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.	The Assembly covers all disciplines of the Earth, planetary, and space sciences.	Call for abstracts is closed. Registration is open.
12th International Congress on Environmental Modelling and Software	June 23–27, 2024, Michigan, USA	Every two years, the International Environmental Modelling & Software Society (iEMSS) holds an international congress. The purpose of this conference is to foster discussion and encourage the interchange of challenges, solutions, ideas, and new methods and techniques in environmental modelling and software. Each conference is organized around a different theme	Conference streams are: 1) Decision making and public participation in environmental modelling; 2) Modeling environmental fate of contaminants, human well-being and ecological public health, 3) Computational methods, workflows, informatics and integrated systems in environmental modelling; 3) System design, identification and uncertainty in modelling complex environmental & agricultural systems; 4) Socio-environmental systems modelling for planetary health and environmental sustainability; 5) (Big) data solutions	Registration is open.

			for environmental systems planning, management, and operation.	
International Energy Workshop (IEW) 2024	June, 26-28, 2024, Bonn, Germany	The IEW is a leading conference for the international energy modelling community. The IEW provides a venue for scholars and researchers to compare modelling tools, to discuss modelling advances for emerging energy sector issues, and to observe new trends in the global energy sector.	A (non-exclusive) list of potential conference topics is available on the conference website. Topics include: net-zero emissions and climate neutrality, role of renewable energy in the energy transition, climate resilience of energy systems, etc.	Paper submission is closed.
9th GEWEX Open Science Conference	July, 7-12, 2024, Sapporo, Japan	The conference will celebrate 30+ years of GEWEX research, the strong role of the Japanese research community and set the stage for the next phase of research addressing the World Climate Research Programme (WCRP) main challenges on water resources, extremes and climate sensitivity through observations and data sets, their analyses, process studies, model development and exploitation, applications, technology transfer to operational use, and research capacity development and training for the next generation of scientists worldwide.	The conference is organized around three themes: <ul style="list-style-type: none"> • Water, Climate, Anthropocene • Extremes and Risks • Water, Energy and Carbon Processes 	Registration is open.
EMS Annual Meeting 2024	September 2-6, 2024, Barcelona, Spain	The Annual Meetings of the EMS aim at fostering exchange and cross-fertilization of ideas in the meteorological, climatological and related communities, focusing particularly on strategic issues relevant	A particular focus of the EMS Annual Meeting 2023 will be on <i>The role of weather and climate research in the achievement of a climate-neutral Europe.</i>	-

		to the future of meteorology in Europe.		
AGU Annual Meeting 2024	December, 9-13, 2024, Washington, D.C., USA	AGU Advancing Earth and space science meeting fosters learning and collaboration, and promotes topics that enhance perspectives across Earth and space science.	-	-