



Department for
Energy Security
& Net Zero



Economic Benefit Realisation and Evaluation of the Met Office Hadley Centre Climate Programme

Summary Report

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Hadley Centre Climate Programme

The Hadley Centre Climate Programme ('HCCP' or 'MOHCCP'), which is part of the Met Office Hadley Centre ('HC' or 'MOHC'), is a UK government-funded climate research programme that is dedicated to advancing the understanding of climate science and its impacts. The programme, which is renewed every three years, is sponsored by the Department of Science, Innovation, and Technology (DSIT) and the governance sits within the Department of Energy Security and Net Zero (DESNZ).

The HCCP plays a vital role in providing robust, relevant, and current scientific evidence to the UK government. The evidence supports decision-makers formulate policies that address the societal challenges of climate change and help avoid the worst impacts of climate change for future generations. The programme's contributions include producing the UK Climate Projections, supporting Climate Change Risk Assessments, and representing UK climate science globally, including contributions to the Intergovernmental Panel on Climate Change Assessment Reports.

The 2018-21 HCCP aimed to address four main research questions set by the government, focussed on: a) presenting weather and climate risks, b) future weather and climate risks under different emissions scenarios, c) mitigation strategies and the case for early action and impact, and d) opportunities of mitigation and adaptation.

Key findings

Positive value for money:

The value-for-money analysis determined a likely lower bound for the value of the 2018-21 HCCP programme of £1.9 billion. This represents a 33:1 benefit-cost ratio

Positive impact:

The impact evaluation determined that the HCCP has had a significant impact on the understanding of climate change; the UK's global recognition as a leader in climate science; and the UK's research environment.

The HCCP's climate research outputs and modelling capabilities has provided an array of tangible impacts that underpin the MOHC's ability to enable better decision making, improve climate resilience, and advance scientific understanding.

The work of the HCCP has enabled local government, national government, and industries, such as finance and energy, to make informed mitigation decisions, helping to future proof the UK's programmes and economic assets.

The rigorous analysis and cutting-edge research conducted by the HCCP is crucial for informing the UK's adaptation and mitigation policies strategies. The HCCP has driven evidence-based decision-making, fostering resilience, shaping a sustainable future amidst climate change challenges.

Aims and objectives of the evaluation

DESNZ commissioned London Economics and Frazer-Nash through a competitive tender process to undertake an evaluation of the 2018-21 HCCP programme. The primary aim of this evaluation was to conduct a comprehensive analysis of the effectiveness of the 2018-21 Hadley Centre Climate Programme, highlighting its accomplishments and potential areas of improvement. In addition to identifying lessons that are aimed at enhancing the impact of future programmes, the evaluation sought to estimate the value of the benefits created by programme. Information on the value of the 2018-21 HCCP is meant to help the Met Office and the Department for Science, Innovation and Technology (DSIT) prepare for the next Spending Review by feeding into a wider economic evaluation of the Met Office's services.

To answer the research questions that were set by DESNZ and refined as part of the evaluation plan, a Theory of Change (ToC) was developed and a process evaluation, impact evaluation, and Value-for-Money assessment of the 2018-21 Hadley Centre Climate Programme were undertaken.

Insights from the current (2021-24) HCCP workplan were also included in the evaluation, particularly to inform the process evaluation. In addition to practical consideration, insights from the current programme have been included because more recent experiences are more beneficial for the purpose of informing future workplans.

Value-for-Money assessment

The rigorous analysis and cutting-edge research conducted by the HCCP is crucial for informing the UK's adaptation and mitigation policies and strategies. Case studies focussing on the UK rail industry, the agriculture sector, the commercial sector, local adaptation, and carbon budgets illustrate the value that the HCCP provides in driving evidence-based decision-making, fostering resilience, and shaping a sustainable future amidst climate change challenges.

To monetise these benefits arising from the HCCP programme, a literature review was undertaken to establish what methodologies exist to undertake such analysis, based on the available evidence. Six assumption-driven models for three distinct

channels were developed. The modelled channels through which the HCCP creates benefits include a) fundamental climate research used to inform carbon budgets and emission pathways, b) climate research that informs mitigation measures, and c) climate projections from the HCCP that inform adaptation measures aimed at improving the UK's resilience to climate change.

Due to limitations around the underlying literature and some of the modelling assumptions, the study did not attempt to estimate the total value of the 2018-21 HCCP programme. Instead, it aimed to establish a conservative estimate, representing a likely lower bound of its value. Since the above channels provide benefits that are distinctive from each other, the value for each channel would have to be added up to identify the total value of the HCCP. To provide a conservative estimate, the different values were not added up, but the median value from all models was used to identify the likely lower bound. As such, the likely lower bound of the value of the 2018-21 HCCP programme stands at £1.9 billion¹ (after adjusting downwards by 30% to account for optimism bias²). With a total expenditure of £57.6 million, the benefit-cost ratio for this programme amounts to 33:1. This ratio underscores the significant positive value created by the programme and compares favourably to other benefit-cost ratios in the UK. The value generated by the HCCP is relatively high due to the large magnitude of the likely impact of climate change on the UK and the relevance of insights into climate change for a large number of government departments (nationally and internationally).³

It is important to note that the monetised benefits do not capture all benefits of the HCCP. The models developed to estimate the monetary value do not capture all services provided by the HCCP and they also only reflect the value for a sub-set of the HCCP's users. In addition to the monetisable benefits of the 2018-21 HCCP, there are additional benefits, such as the value of the HCCP's global recognition and the value of a strengthened UK-based research environment, that are more difficult to quantify and are not captured in the above estimates.

¹ The estimated benefit attributable to the HCCP in Model 6 is a notable outlier compared to all models. The average including Model 6 is £6.0 billion (representing a benefit-cost ratio of 104:1) and excluding Model 6 is £1.5 billion (representing a benefit-cost ratio of 27:1).

² The UK Greenbook does not provide generic values that should be applied for optimism bias in evaluations. It is advised that adjustments for optimism bias should be based on organisation's own evidence base for historic levels of optimism bias. The Met Office, which undertakes similar internal evaluations of climate benefits, normally applies a benefit optimism profile of 30%-40% within formal investment cases.

³ For comparison, the benefit-cost ratio for the 'Zero Emission Vehicle Mandate and CO2 regulations' is 1.3:1 ([Zero emission vehicle \(ZEV\) mandate consultation: final cost benefit analysis \(publishing.service.gov.uk\)](#)), the benefit-cost ratio for 'The Future of UK Carbon Pricing Impact Assessment' is 2.5:1 ([De minimis assessment \(legislation.gov.uk\)](#)), and an academic study (Haskel et al., 2014) finds a social return on investment from public sector research of around 20%.

Impact evaluation

The HCCP's climate research outputs and modelling capabilities provide an array of tangible impacts that underpin the MOHC's ability to enable better decision making, improve climate resilience, and advance scientific understanding. The 2018-21 programme contributed to a diverse range of research communities and provided partnership opportunities that have strengthened ties between academia, government, and industry. Its work has enabled local government, national government, and industries, such as finance and energy, to make informed mitigation decisions, helping to future proof the UK's programmes and economic assets. The HCCP has also had a distinguishable impact on wider stakeholders by informing the public about the impacts of climate change and by enhancing the UK's global climate science reputation. The following paragraphs explore the HCCP's impacts in more detail by summarising the findings for each impact evaluation question.

To what extent have the outputs from HCCP improved the understanding of climate change?

There is strong evidence that HCCP outputs have improved the understanding of climate change, through the development of world class climate and Earth system models and the production of high-quality datasets of recent climate observation and future climate projections. The MOHC's historically influential climate research continues to have global reach, with the cutting-edge development of, for example, convection-permitting models. The UKCP18 dataset is the most widely used HCCP output. It enables significant onward multi-disciplinary research into the UK impacts of climate change, acting as a bridge between climate science and climate impacts. This enhances understanding of climate change both within UK industry and at all levels of government within the UK.

To what extent have the outputs enabled further climate research and provided better information to decision makers?

Outputs from the HCCP feed into and leverage significant further academic research across multiple disciplines within the UK, which is evident through the HCCP's long list of peer-reviewed publications and extensive onward web of third-party citations. The influence in climate research extends globally, with the MOHC able to exploit its world class reputation to instigate international collaboration and advance understanding in key areas, for example, climate sensitivity. Beyond the academic world, the impact of the HCCP on UK decision makers, both within government and industry, is strongly driven through undocumented mechanisms, without an openly accessible paper trail. For example, many government HCCP users receive tailored scientific evidence and briefings on the state of the UK climate, but these documents are often not open-access and are uncited in government documentation. Within industry, UKCP18 is widely trusted, with industry either prescribing or encouraging the use of the HCCP's UKCP18 data to inform climate resilience decisions. Much of the value from UKCP18 is only fully realised due to the activity of a growing number of engineering and environmental consultancies who interpret the data and tailor it to

the precise requirements of specific users; although this harbours the risk of data misinterpretation and misrepresentation.

To what extent has the HCCP strengthened the UK-based research environment?

Both observational and climate projection datasets are widely employed by researchers within the UK. In particular, the high resolution of UKCP18 acts as a key facilitator of climate research, with multiple researchers stating that their work was only possible because of this dataset and the fact that it enables region-specific analysis to be performed. Beyond this, observational datasets that permit analysis of extreme events or include the outputs from convection-permitted models were singled out as particularly useful. There is evidence that, by providing better opportunities for collaboration between universities and the UK's research institutions and improved access to data, the HCCP has fostered a thriving UK climate research environment.

To what extent have the outputs contributed to the UK's global recognition in climate science?

The MOHC enjoys an outstanding global reputation in climate science, contributing to world class publications, driving and influencing international research and adopting key roles within international climate forums such as the IPCC and CMIP projects. Multiple interviewees expressed the opinion that the UK 'punches above its weight' in the field of climate science, and that the MOHC's long track record of climate modelling, and the production of high-quality climate data and trusted future projections is largely responsible for this. The MOHC played a major part in preparations for the 2021 COP26 meeting in Glasgow, and stakeholders reported that it is held in high esteem by foreign governments as a provider of robust and credible scientific advice.

To what extent have the outputs enhanced public understanding and trust in science?

Using media profile as a proxy for the impact of HCCP on public perceptions of climate science, the traditional news media is identified as the primary mechanism by which HCCP outputs reach the public. However, direct naming of the Hadley Centre in news reports is rare. Rather, its findings are disseminated via the Met Office, which acts as a conduit and enjoys a much more prominent media profile as a provider of context for climate news and the source of new climate research. While the MOHC itself is largely invisible to the UK public, there is some evidence of an uptick in media coverage of climate following publication of significant MOHC reports. The nature of news coverage suggests the media plays a role through drawing out the parts of HCCP outputs that the public may care about (for example, impacts on lifestyle, or individual adaptation measures) and, through this mechanism, the HCCP indirectly informs the public about the latest climate science.

Process evaluation

The process evaluation assessed the effectiveness of the 2018-21 Hadley Centre Climate Programme (HCCP) in terms of:

- designing the workplan
- producing deliverables
- collaborating
- disseminating outputs
- governance structure
- efficiency of the operation

The HCCP was found to be successful in producing highly relevant climate research and in maintaining its reputation as a world-leading climate research centre. The outputs and advice from the HCCP are regarded highly by both government and industry stakeholders, as they provide relevant and reliable information for decision-makers. The HCCP provides a unique opportunity and value for UK policy stakeholders, as they are able to direct the focus of the research and to align it with the needs of the UK government. Despite the already high value and effective generation of information of the HCCP, some improvements can be made to ensure that the research is aligned and disseminated more effectively to generate even more value for UK stakeholders. Below, a summary of the strengths and potential improvements is presented for each area of the process evaluation.

Producing deliverables: The HCCP successfully addressed and met the formal goals of the 2018-21 programme (incl. addressing research questions and deliverables) and was effective in producing outputs and maintaining high-quality standards. Despite some challenges arising from the UK's departure from the EU, the HCCP's research excellence and contribution to global climate research continues to contribute to the HCCP's and the UK's global reputation in climate science. Stakeholder feedback confirmed the significance of these deliverables, particularly through initiatives like the UK Climate Projections (UKCP18), in supporting both government and industry stakeholders in climate adaptation and decision-making. Nonetheless, many government and industry stakeholders, who feel overwhelmed by the volume of information and perceive some outputs as too complex and difficult to understand, would appreciate more guidance to make the outputs more accessible for stakeholders with less technical background and more limited resources. While the HCCP is very proactive in collecting stakeholder feedback, some stakeholders highlighted the need for a more structured approach to feedback collection, prioritisation, and implementation.

Collaborations: To steer the research, develop outputs and make use of the findings, the HCCP engages in a variety of collaborations and partnerships, for example, with policy makers, external research collaborations with universities and research centres, internal collaborations with other Met Office teams, and industry/technological collaborations. The wide range of collaborations indicates the HCCP's relevance and interdependence with other stakeholders. *For collaborations with policy makers*, the Knowledge Integration (KI) team, HCCP secondees and the User Group serve as vital channels, allowing stakeholders to provide input on the workplan and outputs. Recent changes to the User Group in the 2021-24 programme have enhanced engagement, but the current format is not considered suitable for co-development given the varying stakeholder requirements. To ensure that the research meets user needs, the co-development process would likely benefit from closer working relationships between the scientists and the end users and from smaller groups of stakeholders with similar needs. *External research collaborations*, particularly with universities and Natural Environment Research Council (NERC) centres, are effective and provide valuable opportunities to leverage existing research infrastructure and knowledge. Due to their success, this type of academic collaboration could be expanded further whilst taking into account the strategic alignment of partnerships with the programme's objectives. *Collaborations across Met Office teams* that facilitate resource sharing and knowledge exchange are also used effectively in enhancing efficiency and generating synergies by sharing resources. Some stakeholders suggested that more synergies could be realised from increased interlinkages of different Met Office programmes. *Technological collaborations*, of which the HCCP already has established some, are likely to become more important going forward to ensure that information produced by the HCCP remains world leading.

Dissemination of outputs: The Knowledge Integration (KI) team and HCCP secondees in government departments are highly valuable and are crucial in making information accessible to policy stakeholders. However, not all government departments have access to secondees and the KI team. More structure and clarity around the timing and frequency of outputs, such as seminars and briefings, would be appreciated. Stakeholders have suggested that information that is not directly received from the KI team or secondees is often complex and difficult to interpret. Industry stakeholders, who mostly access HCCP data via the HCCP website, have indicated similar challenges regarding the access and understandability of the data. Simplifying access, providing clearer guidance, and offering tailored trainings could enhance stakeholders' ability to utilise HCCP outputs effectively. Similarly, improvements in the user-friendliness of data platforms, such as the Climate Hub and SharePoint, would also be beneficial to facilitate easier access and interpretation of information. The HCCP has recently developed an overview of stakeholders they consider relevant and identified stakeholder-specific channels and needs. Reflecting on the relevant stakeholders and developing stakeholder-specific interactions is very

useful to ensure that the relevant stakeholders are targeted effectively. However, the government should consider if and to what degree it wants the HCCP to address and tailor outputs to industry stakeholders.

Operational efficiency: While a comprehensive analysis of the HCCP's efficiency of research activities was outside of the scope of this evaluation, the level of funding and the balance between different activities was generally considered to be appropriate for the agreed activities and deliverables. While the HCCP suggested that the balance between research activities and dissemination activities improved to a healthy level throughout the 2018-21 programme, the need to sufficiently fund existing and potentially new dissemination channels was identified to ensure an effective use of HCCP outputs. Long-term fundamental research, despite potentially lacking immediate policy implications, is also crucial for generating value. The funding for fundamental research was considered to be adequate and should be maintained to sustain the strength of UK climate science. The HCCP was also undertaking appropriate measures to ensure and continuously improve its operational efficiency, for example, through external research collaborations, technological partnerships, and the development of standardised data analysis tools. While the Met Office is facilitating collaborations across Met Office programmes, some stakeholders thought that more synergies could be realised from more interlinkages.

Wider Met Office weather and climate evaluation

In parallel to this evaluation of the HCCP commissioned by DESNZ, the Met Office commissioned London Economics to conduct a separate, wider economic evaluation of the UK Met Office ('wider evaluation'). The main objective of the wider evaluation was to update the 2015 Met Office General Review (London Economics, 2015) and to evaluate economic impacts associated with the Met Office's activities on the UK economy, society and government over the period 2024 to 2033.

Since the HCCP is part of the Met Office and makes up most of the Met Office's climate services, the value of the benefits estimated for the HCCP in this evaluation were used to inform the value of the Met Office's climate services in the wider evaluation. To ensure the transferability of the estimates from the HCCP evaluation, the counterfactual and overall modelling approach were aligned between the HCCP evaluation (this study) and the wider Met Office evaluation.

In particular, the likely lower bound of the HCCP benefits was used as the lower bound of the Met Office climate benefits (after accounting for the different time horizon in both studies). Individual estimates from the six assumption-driven models in the HCCP evaluation were used as the central assumption and the upper bound. It should be noted that the wider Met Office evaluation did not add up the value of the benefits from the three distinct channels that were identified in the HCCP evaluation to provide conservative estimates.