



Science
Advisory
Council

Defra Science Advisory Council

Activity Report: 1 April 2019 to 1 July 2021

November 2022

We are the Department for Environment, Food and Rural Affairs. We're responsible for improving and protecting the environment, growing the green economy, sustaining thriving rural communities and supporting our world-class food, farming and fishing industries.

We work closely with our 33 agencies and arm's length bodies on our ambition to make our air purer, our water cleaner, our land greener and our food more sustainable. Our mission is to restore and enhance the environment for the next generation, and to leave the environment in a better state than we found it.



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Introduction

This report provides an overview of Defra's Science Advisory Council (SAC) during the period April 2019 to July 2021. It is produced under SAC's openness policy and accounts for its activities during the reporting period. This is a longer reporting period than usual and reflects activities under the then Chair of Professor Sir Charles Godfray.

The SAC is a Non-Departmental Public Body (NDPB) which provides independent expert advice and scientific challenge to Defra at a strategic level. The SAC helps guide Defra's scientific priorities and planning, including long-range planning, as well as dealing with immediate risks and opportunities. Full details of the responsibility of the SAC can be found on its [website](#).

Membership and ways of working

The SAC strives to be visible and available to Defra and, without compromising its position as an NDPB, has made clear its role as a resource that can help to improve the quality of the evidence upon which Defra policy is built. This ambition continues and has been particularly important at a time when the Defra group was focussing on delivering Brexit, managing impacts of Covid-19 as well as working to join up activities across evidence and policy and taking a systems-thinking approach to understanding the key policy questions across the Defra Group.

As well as working with the Defra Chief Scientific Adviser (CSA) and officials, the SAC engages at a ministerial level, this is reflected by an annual meeting between the Defra Minister responsible for science and the SAC Chair.

The SAC's membership changed during the reporting period. It currently comprises of eleven members, including the July 2021 appointed Chair, Professor Louise Heathwaite. During 2020 two members departed from the SAC: Professors Tim Jickells and Paul Monks. To address these vacancies and manage the imminent end of terms of the Chair, Professor Charles Godfray, and two members Professors Sarah Whatmore and Wayne Powell a recruitment campaign was initiated during 2021.

An overview of SAC membership, governance and working practices is at **Annex A**.

Discussion topics

The range of topics discussed by the SAC reflects the issues confronting Defra. Its agenda is structured to integrate it within the Department's workings, whilst retaining its capacity to provide critical advice and challenge. The SAC is both reactive to Defra's needs and raises issues itself that it believes would be helpful for the Department to consider. The SAC

provides immediate feedback on evidence-related issues through discussion or written correspondence. It also considers whether some topics need more detailed discussion at a subsequent meeting or through convening a time-limited subgroup.

To ensure the SAC maintains an up-to-date overview of evidence priorities, both ongoing and emerging, the Chief Scientific Adviser (CSA) provides regular updates. This approach provides an opportunity to identify where the SAC might provide future advice or respond immediately to issues. The SAC also receives regular updates from the Chairs of the standing Social Science Expert Group (SSEG) and SAC-Exotic Diseases subgroups (SAC-ED).

SAC achievements and activities

Throughout the reporting period the SAC has provided advice and challenge on a wide range of issues aligned to Defra's objectives and priorities. Issues discussed by the SAC during the reporting period are described in **Annex B**. An overview is below.

[Agri-Innovation R&D.](#)

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[Areas of Research Interest \(ARI\)](#)

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[Chemicals Science Policy Interface for the Sound Management of Chemicals and Waste](#)

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[Land use to meet CB6 and net zero goals](#)

[Marine Ecosystem](#)

[Natural Capital and Ecosystem Assessment Programme: Soil Health Monitoring Scheme](#)

[Net Zero - Carbon Budgets](#)

[Net zero](#)

[Resources and waste](#)

[Systems Research Project](#)

[TB Programme - social science perspective](#)

[25 Year Environment Plan](#)

[Transforming natural capital asset and ecosystem assessment](#)

[Water Quality](#)

Subgroups

There are two standing subgroups: Exotic Diseases and Social Science. The SAC also constituted a time-limited subgroup to conduct an in-depth study on Biodiversity Targets.

Exotic Diseases (SAC-ED)

From January 2015 until January 2022 the subgroup was Chaired by Professor James Wood, thereafter Professor Rowland Kao was appointed as the Chair. The subgroup works in partnership with the Defra Chief Veterinary Officer (CVO) and has two separate functions in relation to animal diseases: in an emergency situation and during the absence of a disease outbreak. During the reporting period, the SAC-ED held two annual meetings (January 2020 and February 2021) which provided an opportunity to discuss Avian Influenza Monitoring, African Swine Fever, generic modelling, the European Food Safety Authority and Covid-19 animal health risk work. The CVO also updated SAC-ED on ongoing priorities and issues. The subgroup collectively reviews its membership and function to ensure it remains relevant to Defra.

In addition to routine business, the SAC-ED was consulted on risk assessments relevant to companion animals and the SARS-Cov-2 testing in animals. It should be noted that SAC-ED stand ready to help and support Defra and the Animal and Plant Health Agency (APHA) if required.

Social Science Expert Group (SSEG)

From January 2015 until July 2021 the subgroup was Chaired by Professor Sarah Whatmore, thereafter Professor Owens was appointed as the Chair. The SSEG provides advice and support to help improve Defra's policies and their impact through the effective advice on and use of high-quality social science evidence. The social science community within Defra has grown hugely and the SSEG have been on hand to engage across the Defra portfolio.

The SSEG have worked on several projects throughout the reporting period contributing across a broad range of Defra topics. The SSEG report "[landscape quality: A rapid review of the evidence](#)", published in January 2020, informs the monitoring and evaluation of landscape quality as one of the goals of the government's 25 Year Environment Plan. More widely, members contributed, from a social science perspective, to:

- Rural affairs; helping with the definition of prosperity and approaches to measure, track and evaluate attempts to improve prosperity, with a focus on people's wellbeing.
- advice on how to prioritise behaviours to deliver Net Zero
- how to measure social prosperity within the levelling up agenda
- suggested relevant literature & contacts for longer-term work on the impacts of COVID 19 on food supply and demand.

SSEG, in collaboration with Core SAC, constituted a task-group in support of public engagement: a rapid review of key literature combined with a practical “what works” guide to public engagement, citizen science and citizen assembly methodologies. The scoping exercise had input from key Defra social science professionals and considered stakeholder interests across the Defra Directorates. This would support Defra in its consideration of how engagement methods influence outcomes and would enhance knowledge of how to frame questions in different ways. The [Review of Public Engagement](#) report was published in October 2022.

Biodiversity Targets Advisory Group (BTAG)

The subgroup, chaired by Professor Rosie Hails was constituted to provide scientific advice to Defra specialists to inform the development of legally-binding targets for biodiversity. A high-level advisory group to oversee the wider target-setting process was initiated separately and is out of scope of this group. This group covered both terrestrial and marine targets.

Closing remarks

As described above, over the reporting period the SAC has engaged with Defra across a broad range of policy areas. SAC’s working method is to engage collaboratively with the Department to address its science and evidence needs while maintaining its capacity to provide independent challenge. The SAC appreciates the willingness of Defra staff to interact on these terms, as well as their frankness and the openness to new ideas.

A good working relationship with the Chief Scientific Adviser is critical to the effective working of the SAC. Professor Henderson was appointed CSA in October 2019 and the SAC has formed a good working relationship.

The SAC and Defra said farewell to its longstanding Chair, Professor Sir Charles Godfray and four members throughout the reporting period: Professors Jickells, Monks, Powell and Whatmore. We would like to thank the Chair, and each member for their enthusiasm, contributions as well as the time they set aside to support, the CSA and Defra.

Defra faces a period of change as the UK develops policies as an independent sovereign state. The SAC stands ready to work with Defra to ensure that the natural and social sciences contribute as much as they can to the evidence base underpinning the development of Defra policy.

Annex 1: Membership, governance and working practices

The SAC plays a vital role in assisting the Defra Chief Scientific Adviser (CSA) in assuring and challenging the evidence that Defra uses in its policy. In doing so, it provides independent and scientific support, advice and challenge to Defra. The SAC's remit is broad and focuses primarily on the strategic direction of the Departments' evidence. This includes long-range planning, as well as dealing with immediate risks and opportunities. It's terms of reference are here: <https://www.gov.uk/government/organisations/science-advisory-council/about/terms-of-reference>

Structure of SAC's business

To enable the SAC to take its role forward, at an appropriate strategic high level, it organises its business in four ways: principal meetings; monthly teleconferences; subgroups on specific policy/evidence areas and a Defra Official and SAC member pairing scheme. Representatives from each devolved administration are invited to attend SAC meetings, as "observers". This helps to ensure important links with the devolved administrations.

SAC's work plan

A balance of being forward looking and being reactive to issues as they arrive. Both the SAC Chair and Gideon Henderson (CSA) maintain an oversight of the priorities for planned discussion, and meeting agendas are planned accordingly.

Defra/SAC pairing scheme

To support communication and understanding between the SAC and Defra each SAC member is paired with a relevant senior policy official. It provides Defra officials with the opportunity to update SAC members on emerging policy and evidence issues and to use the SAC member as an independent sounding board for informal advice or challenge. The SAC member has an opportunity to update Defra officials on current and future priorities for SAC and enables the SAC member to develop a detailed understanding of the policy content and associated evidence.

Subgroups

The SAC establishes time-limited subgroups on particular topics when more in-depth studies are considered necessary. These are usually chaired by a member of the SAC and include non-SAC members co-opted to the subgroup, to increase the range of relevant

expertise to contribute to the study. In addition, there are two standing subgroups on exotic diseases and social science.

Representative activities

SAC members are encouraged to use their professional networks and expertise to alert the Department to issues and advances that may affect Defra's evidence gathering and needs. A number of these issues have since been discussed at a meeting or added to the SAC workplan.

Register of interests

The SAC publishes its [register of members'](#) interests each year.

SAC Website: <https://www.gov.uk/government/organisations/science-advisory-council>

Membership

Appointments are made under the Commissioner for Public Appointments Code of Practice. The Chair and members are usually appointed for a three year term, with an option, subject to conditions, to re-appoint for a further three year term. We recognise the importance of staggering appointments to ensure membership is regularly refreshed, introducing a fresh perspective, while retaining a proportion of experienced members. All appointments to the SAC are made by Ministers.

Current membership (as of June 2022)

- Professor Louise Heathwaite, Distinguished Professor and Pro-Vice-Chancellor (Research and Enterprise), University of Lancaster. (SAC Chair). Appointed July 2021.
- Professor Richard Bardgett, Professor of Ecology at the University of Manchester. Appointed July 2021.
- Professor Lisa Collins, Professor of Animal Science, N8 Agrifood Chair in Agricultural Systems, Head of the School of Biology, Academic Director of the National Pig Centre, and Director of the Smart Agri-Systems research initiative at the University of Leeds. Appointed July 2021.
- Professor Peter Cox, Professor of Climate System Dynamics, University of Exeter. Appointed January 2018.
- Professor Felix Eigenbrod, Professor of Applied Spatial Ecology in the School of Geography and Environmental Sciences at the University of Southampton. Appointed February 2022.
- Professor Lin Field, Emeritus Fellow, Protecting Crops and the Environment, Rothamsted Research and Honorary Professor, School of Life Sciences, University of Nottingham. Appointed January 2019.

- Professor Rosie Hails, Director of Nature & Science, The National Trust. Appointed January 2019.
- Professor Nicholas Hanley, Professor of Environmental and One Health Economics, Institute of Biodiversity, Animal Health and Comparative Medicine, University of Glasgow. Appointed July 2021
- Professor Rowland Kao, Sir Timothy O'Shea Professor of Veterinary Epidemiology and Data Science, University of Edinburgh. Appointed January 2018.
- Professor Susan Owens, Emeritus Professor of Environment and Policy and Fellow Emerita of Newnham College, University of Cambridge. Appointed July 2021.
- Professor Marian Scott, Professor of Environmental Statistics at the University of Glasgow. Appointed June 2022.

During 2019 – 2022, the following Chair and members departed from the SAC (presented in alphabetical order):

- Professor Sir Charles Godfray, Director of the Oxford Martin School (OMS) at the University of Oxford. Departed June 2021.
- Professor Tim Jickells, Director of the Future Earth Europe, the European Centre for Future Earth and Director of the Centre for Ocean and Atmospheric Sciences. Departed January 2020
- Professor Paul Monks, Pro Vice Chancellor and Head of the College of Science and Engineering, and Professor in Atmospheric Chemistry and Earth Observation Science at the University of Leicester. Departed September 2020.
- Professor Dame Henrietta Moore, the Founder and Director of the Institute for Global Prosperity at University College, London (UCL). Departed January 2022.
- Professor Wayne Powell, Principal and Chief Executive of Scotland's Rural College. Departed January 2021.
- Professor James Wood, Alborada Professor of Equine and Farm Animal Medicine and Head of University of Cambridge Vet School. Departed January 2022.

Annex 2: Discussion topics (April 2019 – July 2021)

The following high-level areas of scientific work were brought to the SAC during the reporting period. It should be noted that this is a retrospective list and as such comments and policy may have moved on since the discussions took place. Also, some discussion topics continue to be ongoing. The list is presented in alphabetical order.

Agri-Innovation R&D

SAC was consulted, October 2019, during the early stages of considering a collaborative R&D fund focussed on boosting sustainable agricultural productivity. The SAC welcomed Defra's development of the R&D funding package and discussed how success would be measured over a long timescale along with future project evaluation. The SAC suggested that it would be useful for the themes to be prioritised around big challenges and linked to timescales. They also recommended including a strong social science core.

Agri food innovation

In January 2021, the SAC was consulted on a futures study to inform Agri-Food innovation development and realisation. The SAC considered early plans for a futures study in support of the Food Strategy development, and to help prepare the agri-food system for longer term change to meet the UK's carbon emissions and sustainability goals. The SAC raised points about investment landscape mapping and private investment, whether a food systems approach would be embedded within the thinking and the importance to consider the regional dimension and partnerships that could be created. SAC confirmed the importance of collaboration, social inclusion, and bringing people together in new ways to create innovation and to think about where knowledge sits; perhaps embedded in a landscape approach. The SAC also recommended ensuring a balance between short term risks and benefits, how monitoring might be conducted and how tools could be used. SAC members have since been updated and invited to participate in a stakeholder workshop.

Areas of research interest (ARI)

Government department ARIs prioritise research needs and allow UK Research and Innovation (UKRI) to respond to policy needs. In support of a Defra ARI refresh the SAC was asked (March 2020) to help identify gaps or areas for development. The SAC stressed the importance of annual updates and suggested that linkages between the ARIs and 25 Year Environment Plan could be developed. They also suggested incorporating a figure to capture key interactions across topics which would help to demonstrate the systems approach as well as support the cross-cutting themes. The SAC offered to

communicate ARIs with external audiences and suggested using Defra's Centres of Excellence as a conduit to link ARIs, policy teams and the wider world where applicable.

Centres of excellence

The Defra Group has established Centres of Excellence (CoE): Earth Observation CoE, and more lately DNA Methods CoE and the Data Science CoE. The SAC had previously been consulted on the design but further advice in relation to next steps, potential new centres and potential different vehicles using futures and horizon scanning was requested in May 2020. The SAC recognised the clear rationale and development of the two new centres of excellence (DNA and Data). In relation to the Data CoE the SAC suggested that the Defra Group further seize opportunities to support the 25 Year Environment Plan metrics work. The potential analytical value of the vast quantities of data Defra Group collectively owns and could access, to deliver priority objectives, was recognised and the SAC recommended that Defra should consider how these might be brought; thinking around the information architecture, and how data should be organised. The SAC was supportive of the development of shared work-streams and objectives across the three extant Centres of Excellence recognising data as a unifying theme and the potential additional power of combining all these innovative technologies. In relation to the DNA CoE the SAC recognised the value to Defra in this first year, recommending careful consideration of priorities given the wealth of future opportunities and opportunities for future proofing, for example long term retention of samples now that could be used in the future.

Chemicals science policy interface for the sound management of chemicals and wastes

During December 2019 Defra highlighted the cross-cutting position of chemicals and waste which impacts on almost every aspect of Defra's remit and sought advice on how a new science policy interface could be structured. The SAC agreed that developing a full intergovernmental panel approach would be extremely resource intensive and not agile enough to deal with the issues. They discussed setting up groups to deal with evidence needs using a case by case approach rather than trying to set firm boundaries. The SAC acknowledged that there was no easy answer but suggested a network of networks might work to pull together intelligence globally and bring in horizon scanning.

Climate change overview

In June 2020 Defra provided an update on how the department is addressing climate change issues, it is important that science guides the policies and decision making. The SAC discussed several areas which Defra should consider, including reforestation and peatland restoration. The discussion also focussed on the complexity of the issue and the models needed to represent the different farming conditions across the country. The SAC

recommended that a case-based approach to the problem would be the most appropriate means at a social level. This would help to understand how to balance the complex ecological system with non-agricultural livelihoods, population etc.

Climate adaptation

This was an opportunity (June 2021) to seek the SAC's views on how to better embed climate risk and adaptation into decision making. The SAC stressed the importance of allowing a degree of flexibility in the design to allow adaptations to respond to change and the need to incorporate information on the effectiveness of measures and their cost to ensure uptake by society. There was also discussion around using adaptations from other countries to enable parallels to be drawn, especially those with modified environments, compared to natural environments.

Data

A strategy for the exploitation of data for Defra's policy making and delivery. The discussion (March 2021) was designed to help Defra take its internal Data Strategy forward focussing on what Defra needs from its data and SAC views on the Data Strategy Paper. In light of the SACs past advice (via the Data Subgroup) Defra is looking to adopt some of the [report recommendations](#); the Strategy would be part of that journey and includes issues such as the creation of a hub and improvements to the data infrastructure. In summary, the SAC recommended that the value of warehousing data should not be overlooked and that curation and longevity of data should be included. In relation to different data sources, it would be beneficial to consider having a sophisticated catalogue of data which might include organisations with cognate interest. The SAC recommended that Defra could initiate an agreed process for managing data flows from local sources which should, in turn, draw into a national framework. The SAC also recommended scenario testing (likely challenges on the horizon) which would help determine what Defra needs of its data, as an example it might be appropriate to focus on some of the 25 Year Plan goals. It was noted that a lot of data handling work is being conducted by Universities and Defra should consider how best to connect with this work. The importance of data in relation to net zero was also noted.

Environmental impact of burning on blanket bog

The SAC provided advice during March 2021 in support of Defra's consideration of options for introducing legislation to end rotational burning without licence on protected blanket bog sites to help conserve these vulnerable habitats. The SAC was asked to provide an independent assessment of two reviews which reached opposing conclusions. On analysing both reviews, the SAC consensus was that, on balance, in the UK, burning on blanket bog is detrimental as it moves away from the original wet state of the bog and therefore raises the risk of reducing this globally scarce habitat further by peat bogs becoming converted to drier, heathland habitat.

The then Secretary of State had agreed with going ahead with laying the statutory instrument for the banning of burning practices on protected blanket bogs. One of the sections of the Parliamentary Handling Plan was on the scientific discourse around the impact of burning on blanket bogs and to support Defra's position the independent advice sought from SAC was utilised.

The statutory instrument was subsequently debated in both the House of Commons and the House of Lords before coming into force in May 2021. During both debates the scientific evidence was examined and challenged; the advice of the SAC was instrumental in ministers having the confidence to defend the regulatory intervention. At the time of writing no licenses to burn on protected deep peat have been granted and there is much anecdotal evidence that landowners have switched to more sustainable alternatives.

Earth observation

The discussion (September 2019) provided an opportunity for the SAC to advise on the use, by the UK academic community, of the Copernicus Earth observation programme. After Brexit, without a transition period, the UK would still be able to access most of the Copernicus EO data as a third party. However, this may not be in real time but at a lower latency and bandwidth. The team is investigating contingency plans using commercial data access (paying for the access mechanism, not the data, which remains free). The SAC suggested it might be beneficial to provide examples of potential lost capability. The SAC offered to further assist either acting as a sounding board, providing specific examples of the impact, or if required, providing an independent view on the risks attached to not being able to access Copernicus. The CSA suggested that this should be explored further, with the SAC, as events unfold.

Environment Act targets

In January 2021, the SAC was asked to provide a steer on the common framework approach. The SAC raised concerns that the parameters for setting effective targets referenced financial constraints which were moveable and noted that further consideration needed to be given to internal constraints: financial budgets and delivery. The SAC recommended that measurability and the number of targets to set is important for designing the approach. Targets should be ambitious but viable.

Environment Bill (now Act): biodiversity targets

Throughout 2021 Defra and the SAC held discussions to support the Biodiversity Target Setting.

Biodiversity indicators:

Defra officials informed the SAC on the process being taken to develop legally binding targets for biodiversity. The SAC acknowledged the complexity involved in setting targets within this arena, including the multiple drivers of loss and not being able to develop new indicators due to reliance on volunteer-based monitoring schemes. The SAC encouraged Defra to manage expectations around the potential need to amend indicators during their 15 year life-span, and have a clear process on how this would happen if it became necessary. The SAC advised that Defra think back from the desired outcome to help set the direction of policy and produce smart targets. Care should be taken when building in relevant milestones to allow for the inevitable shifts that will happen within the 15 year lifespan of the policy; genomics and e-DNA will become important within this time and should be built into how indicators are monitored.

Biodiversity targets (March 2021):

The SAC provided a steer on the biodiversity target framework building on previous SAC discussions. While a lot of work has focused on the creation of specific targets the SAC recommended that the detail needs additional development to indicate a timescale relevant to reversing biodiversity decline. The extent to which climate change was considered was discussed along with the relation of biodiversity targets with other interventions and the importance of creating pathways to help assess the co-benefits. The systems approach to target development was also discussed, with consideration to the evidence base supporting the delivery of these targets. The SAC suggested that Defra should work towards defining a standard that is outcome-based and works towards the refining of a 'global standard' for mitigating species extinction.

Biodiversity marine protected areas (March 2021):

A series of six work packages cover the different facets of developing the target and assessment in the longer term. The SAC discussed whether an action or outcomes approach was most suited to the MPA target encouraging the focus to be on outcome based with links to natural capital assessment. The SAC agreed that the targets need to be ambitious to reach the environmental goals set, however, the policy levers also need to be clear when considering meeting the targets set. Other factors discussed were impact of areas outside of UK control, interconnectedness with land run off and the actions relying on inactivity to promote regeneration. The extrapolation of the results will form a key part of the monitoring strategy. The SAC encouraged the use of novel techniques such as environmental DNA and non-vessel oceanography and to take advantage of other technological developments. The refresh rate for the marine environment would be slower than the terrestrial environment.

Biodiversity terrestrial (March 2021):

The targets for Species Extinction and Protected Sites will be outcome based. The habitats creation/restoration target is action based at the moment with a transition to an

outcome based target in due course. More work is needed on how to measure the targets. There is significant pressure to have ambitious targets, particularly around species abundance and this needs to be representative of the habitats we are trying to improve. There are a number of interdependencies with other targets and science policy areas. Recognising the complicated concept of metrics and connectivity from an ecological viewpoint the SAC stressed the social science element should not be underestimated. Although the species abundance metric is a lead indicator, currently species abundance doesn't include microbiology or genetic diversity. The SAC encouraged Defra to consider if the targets should be national or in defined regions only. SAC stressed that great care is needed when determining the weight of importance of different areas and those smaller sites that might be overlooked but of equal importance. An index which incorporates recreation and local health is also worth considering.

Environmental land management (ELM)

A new agri-environment measure which will contribute to delivery of environmental outcomes set out in the 25 Year Environment Plan based on 'public money for public goods.' It was agreed that given the range, width and the depth of work it would be useful to return to SAC frequently. As such, Defra would bring a series of papers to SAC adopting a specific lens in each to set out the evidence base.

The contribution of environmental land management schemes to carbon goals (March 2021):

The SAC advised on aspects of the Environmental Land Management Schemes (ELM) in particular the scientific basis for determining how much the new ELM schemes would contribute towards meeting the UK commitments on carbon. A substantial lever would be around stocking densities but it remains uncertain given the scheme has only started the pilot phase, whether ELM would bring the required system change. There was recognition of the benefits of adopting a whole landscape approach. Clarification was made of a perceived disparity between Defra figures and those of the Committee on Climate Change (CCC) it was recognised that ELM delivery is relatively small compared to what the CCC would deliver. Defra is showing a similar trajectory and the same baseline is being used but there are decisions to be made about the extent to which ELM delivers alongside other policy levers. The figures help to identify gaps and demonstrate challenging areas around forestry, crops and peatlands. The SAC agreed that issues should be weighted, for example in understanding the contribution of the range of policy instruments to UK soil loss. Defra should develop its understanding on how the framework of packages and their associated levers would work in practice; taking the policy beyond theory. Social science has an important role to play and would help to inform how the scheme could motivate people to deliver in the desired areas. Defra will consider the consequences of what might have happened if ELMs was not introduced (counter-factual). It will be important to drive integration rather than separating issues such as the theoretical target for change around the carbon budget, through farmers and stakeholders who are essential to achievements.

ELM learning strategy:

In April 2021 the SAC discussed the learning strategy for the schemes' design and delivery activity. The SAC considered it important to set out how the outputs would be analysed including plans for the broader community to help with learning. There was discussion on how the environmental outcomes would feed into the learning process and link into the measurement and the Natural Capital & Ecosystem Assessment.

ELM approaches to monitoring:

In June 2021 the SAC discussed the proposed approaches to monitoring during the sustainable farming incentive piloting and how this will inform monitoring for the full scheme roll out. Seeking advice on three key areas: does it help reporting environmental change; is Defra sufficiently alert to areas of scientific contention; and, are there additional measures, social or technical innovations Defra could engage with. The SAC emphasised consideration of how everything integrates for example, what is the relationship between large scale trends as opposed to place based. They also emphasised the need to highlight what success will look like, how success will lead to success and how failure will lead to changes in design. Natural capital forms a good framework and the proposed ecosystems approach is based on assets which will allow monitoring of the environment and link through to the 25 Year Environment Plan (YEP) goals.

General licences

In July 2019, the SAC considered the science used in the determinations of General Licences to use lethal control for some bird species. At the request of Defra, a small SAC working group was constituted to help with the analysis of the results from the second public call for evidence; the SAC reviewed documents relating to the science. It was recognised that SAC's input had improved the process and provided independent assurance.

Gene editing

In June 2020, the CSA raised gene-editing and the possibility of a change in how we legislate post EU Exit. In response, the SAC highlighted a less appreciated issue relating to public perception; the constraints or limitations that consumers potentially face by not being able to differentiate production methods at the point of purchase: the issue of consumer choice. Other issues relate to arguments in relation to the association between modified crops and the environmental impacts, for example industrial/intensive methods of production.

Genetic technologies

The SAC provided advice on Defra's approach to a public consultation which focussed on the regulation of gene edited organisms. Following the 10-week public consultation, the SAC held a series of discussions to help frame the government response to the public consultation. The SAC provided a crucial safe space for testing how the narratives Defra was preparing would land and hold up to scrutiny both with the scientific community and more broadly with wider stakeholders and the public. The SAC's recommendations were crucial in providing Ministerial confidence on the direction of travel, recommending ways in which the government response could better articulate the benefits of gene editing to sustainability and the food system, and framing the communications handling plan. Defra used SAC's advice to frame the drafting of the response.

Land use to meet CB6 and net zero goals

At the October 2021 principal meeting a discussion was held on the CB6 and Net zero focussing on livestock, biomass and soils as key priority areas. The session also included the systems perspective bringing the livestock, soils and biomass discussions together. The SAC suggested it may be feasible to use a pathways approach to facilitate food CO2 reductions. Many of the systems exhibit hysteresis so tipping points need to be identified. Concerns around biodiversity and competing land use were raised as key issues by the SAC. The SAC noted from a system wide perspective, maximising benefits may be better achieved by driving lots of low impact changes across both systems rather than trying to increase participation in a very different system, and that emission changes need to be measured from each systems starting point.

Marine ecosystem

The discussion provided an opportunity for the SAC and Defra to determine how the SAC might contribute to Defra's evidence work on the threat to UK cold water corals. Defra are keen to build on the SAC's previous contribution on ocean acidification; [the report](#), which was widely disseminated and had received an extremely positive response. Defra consulted the SAC further regarding systems in UK waters. It was agreed that contributions from a non-government academic perspective would be helpful. As a consequence, Defra would develop their thinking on how the SAC could contribute; this might comprise of options for monitoring, the likely implications of the interplay of key stressors in the environment and potential mitigations and on information held on trawling and drilling.

Natural capital and ecosystem assessment programme: soil health monitoring scheme

The SAC provided input and direction (September 2021) on proposals for the National Soil Health Monitoring Programme under the wider Natural Capital and Ecosystem Assessment Programme. Advice was provided in two parts: a deep dive into the development of a soil health monitoring scheme, via e-mail and a subsequent discussion to update the SAC and address their comments. The SACs advice informed early thinking on the sampling design and helped to refine details and costs of the programme in support of discussions with Treasury. In thanking the SAC, Defra acknowledged the need for further science input and to address this an expert group would be constituted to help cross across the different outcomes the programme would straddle. The SACs recommendations would be shared with members of the expert group once it is established. The SAC stressed the importance of ensuring that membership for the expert group is well advertised and agreed to help disseminate the advert when it is released.

25 Year Environment Plan

The SAC provided advice on several related issues throughout the reporting period. It advised on environmental principles and how they should be interpreted and discussed issues around the precautionary principle. The SAC also provided advice on legally-binding targets and recommended that targets could be linked with impact assessments and built into the cost-benefit analysis, which should include long-term benefits as well as the upfront cost of environmental protection. It would also be important to recognised inter-dependencies. The SAC also discussed the role of experts during the development of the targets and confirmed an appetite to be involved where useful; offering a potential session on trade-offs and synergies.

Transforming natural capital asset and ecosystem assessment

The SAC provided advice (June 2020) on a programme of monitoring and research designed to transform our understanding of environmental change on land, water and sea. While strongly supporting the programme, the SAC recommended a strong governance framework, mapping the user landscape (clarity on end users and identifying priority groups), formulating citizen science input and ensuring a joined-up approach across the ecosystems. Also, open source thinking could be developed, and the SAC recommended a deep dive on soil.

Net zero - carbon budgets

Two separate discussions took place (October 2020), both in context of carbon budgets and Net Zero:

Biomass:

Defra is undertaking work to understand the potential for domestic biomass production as a tool to address the challenges of the Net Zero 2050 target. The SAC was updated on Defra's proposed approach and asked to provide advice on a range of specific questions. The SAC cautioned that there was a need for more sophisticated analysis around the type of land that would be utilised to avoid potential biodiversity rich and quality agricultural areas; and that analysis would need qualifying. They made the case for more joined up thinking between government departments to include biofuels from carbon capture storage. The SAC felt bio-energy with carbon capture and storage was not ready to be implemented in short term policies but rather to be included within mid-term policies. The SAC would be interested in seeing how BECCS would affect farming incomes, especially as we exit the Common Agricultural Policy (CAP) for maintaining farming livelihoods; and, the economic analysis around the circular economy.

Cattle intensification:

As a thought experiment, the SAC was asked for their expert view on the potential relative impacts of grass fed vs. housed cows with an eye to reducing emissions from the livestock sector, not a policy option that Defra are exploring. The SAC agreed that housed cattle imposed a lighter greenhouse gas (GHG) burden overall, but noted significant misalignment with public perceptions, as well as potential conflict with other Defra policy objectives. The SAC agreed that public opinion leans towards "grass fed is better", including a misplaced assumption that extensive production implies lower GHG impacts, as well as the perception that housed systems compromise welfare, which is not necessarily the case: there could be benefits in housed systems through improved biosecurity for example. The SAC recommended a holistic approach to systems change noting issues on pollution and intense rearing; there are known problems around air and water quality, which are exacerbated by poor slurry management. It was noted that intensive systems offer productivity gains at the expense of local biodiversity, but can play a role in 'sparing' land for other uses including habitat restoration, carbon storage and rewilding, as long as land released was used to help with issues such as carbon and biodiversity; this could potentially tie in with a system approach on land use. SAC also recommended that choices around intensification should be taken in combination with a wider consideration of human health, dietary composition and national herd size, as part of the overall strategy towards net zero.

Net zero

During June 2021, the SAC provided their thoughts on Defra's Contribution to Net Zero specifically focussing on where science can assist Defra in reaching its net zero commitments: High-level interventions Defra might make in its sectors, what the SAC consider might work, and what Defra should be wary about. Issues discussed included: The interlinkages between dietary change (relating to livestock), land use, rural society and international impacts; Delivering biodiversity and climate goals in tandem, noting the possible importance of other habitats such as saltmarsh, as well as woodland and

peatlands; How we account for carbon savings, increasing specificity between greenhouse gasses, and how we work across Government; and the importance of reducing (consumer) food waste.

Resources and waste

In March 2021 Defra sought guidance on the two Environmental Bill targets related to increasing resource productivity and reducing residual waste (per capita). The SAC encouraged thinking in the wider context and the degree to which the target informs moving towards a circular economy. This would drive improvements as tracking primary raw material productivity. The SAC recommended that a dashboard would be helpful to look at multidimensions of waste and thinking about new targets during the first review process. The targets should be assessed against unintended consequences, such as fly tipping, and with consideration of packaging, new technology and new product services. One definition of a zero waste economy could be based on tracking residual waste. This approach has been adopted in some of the indicators tracking the Resources and Waste Strategy.

Systems research project

The Project aims to take a systems-thinking approach, across five key environmental and operation areas, to understanding the key policy questions across the Defra Group. The SAC was asked (October 2019) to provide views on the project. In doing so, and recognising the huge undertaking and complexity of the task the SAC recommended that exemplars might provide advice on how to take the project forward, for example linking up to the Centre for Ecology & Hydrology National Capability Programme which runs along similar lines. The SAC also encouraged Defra to develop a plan for future SAC interaction particularly to review the emerging outputs. They also stressed the importance of embracing social and cultural dynamics and encouraged future engagement with the SAC subgroup on Social Science (SSEG).

TB programme - social science perspective

A strong social science evidence base to support the control and eradication of bovine Tuberculosis (bTB) in England is vital. The SAC provided a view (May 2021) on which areas of social science the bTB programme should focus on in the medium and longer term and identified areas of bTB related social science that might have been overlooked. They discussed negative attitudes to vaccination, belief in the interferon gamma testing having a high false positive rate and the need to understand why these views have become entrenched. The SAC welcomed the fact that Defra was addressing some of the social research suggestions in the strategy review, and recommended that it would be useful to develop analysis in respect of rented land and cattle movements as well as behaviours at auction. Defra is an integral part of the system, and how Defra is perceived and how it communicates can have a massive effect on perceptions around bTB.

Water quality

During February 2021, the SAC discussed the potential indicators or metrics which would be used to measure progress against the water quality targets as well as areas of join-up with other targets and commitments helping Defra to take a systems-thinking approach to assessing interactions. The SAC agreed that targets created through the Environment Bill would need to compliment, or add value, to water regulations and targets already in existence. SAC recommended considering the interactions and whether they influence the outcomes as well as societal benefits and complexities from behaviour and whether this could be built into the work. People need to be able to relate to the targets and feel able to contribute, as well as realise the urgency. There was concern that the targets may result in perverse incentives, such as an increase in abstraction. The SAC considered covariant across the metrics important. Decision tools would need to embrace different farming systems. The SAC suggested adding more weight to water quantum and demand management drivers, stronger legislation and targets to support better management. The SAC recommendation of having “a theory of change” would help navigate the trade-offs.