



Scotland's centre of expertise connecting climate change research and policy

ClimateXChange
Centre of Expertise on Climate Change

Annual Report 2016-17

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1. EXECUTIVE SUMMARY

ClimateXChange (CXC) continues to work closely with Scottish Government across a wide range of issues as it develops and implements policies on adapting to the changing climate and the transition to a low carbon society.

Work in 2016/17 focused in large parts on preparing and responding to three major documents:

- **The draft Climate Change Plan** (the third Report on Proposals and Policies required by the Climate Change (Scotland) Act 2009), with a particular focus on:
 - o expertise on mitigation in the agriculture sector; and
 - o research and advice on climate change behaviours and the social aspects of the low carbon transition.
- **The draft Scottish Energy Strategy**, in particular advice on
 - o understanding future energy systems; and
 - o considering the evidence base on heat decarbonisation
- The Committee on Climate Change's **Climate Change Risk Assessment Evidence Report** and the final **Risk Assessment** (Scottish summary), working on
 - o Scottish data and analysis for the assessments; and
 - o interpreting the findings and their importance.

All of this will be carried forward into our support on developing the forthcoming Climate Change Bill.

A key priority for CXC is to align research programmes and make the best use of available resources. For example, following the establishment of the National Centre for Resilience (NCR), CXC has helped develop and support its research and training agenda. We are also working closely with the Centre for Knowledge Exchange and Impact (now SEFARI-GATEWAY) and the other centres of expertise (CREW and EPIC) to coordinate management and communication approaches.

Going forward we will continue to provide research to, and work closely with, the Committee on Climate Change, engage on the UKCP18 Non-Government Users' Group, and work with research partners across the UK and internationally, particularly in relation to monitoring and evaluating the effectiveness of policy.

This wider context has, of course, been deeply affected by the UK vote to leave the European Union. We are including the need to respond to emerging policy questions in our forward planning.

We are working on a five-year plan agreed with RESAS in early 2016, based on recurrent one year funding awards. The programme is to be fulfilled in the context of both CXC's resource and Scottish Government policy and analytical teams having been slimmed down. Reduced capacity in some policy teams for analytical interpretation / review of academic work means we are actively using outcomes and impacts to learn from the best examples of our work and we will continue to deliver plain English reports that are timely, and respond to the policy agenda.

2. EXTERNAL CONTEXT

CXC's work in 2016/17 was heavily influenced by the preparation and publication of two major policy documents: the draft Climate Change Plan (the third Report on Proposals and Policies required by the Climate Change (Scotland) Act 2009), and the draft Scottish Energy Strategy. Both were published in January 2017. Both also had a long lead-time of analysis and drafting, where CXC expertise and discrete research projects were important.

For the draft Climate Change Plan, CXC expertise was sought in particular around mitigation in the agriculture sector, with several research projects specifically commissioned in support of development of the policies and proposals that contributed to the draft Climate Change Plan. CXC was also the go-to place for policy makers in preparation of the draft Plan for bringing together research and advice on climate change behaviours and the social aspects of the low carbon transition.

CXC was also called upon to provide advice, both formal and informal, around the shape and content of the draft Energy Strategy. This was focused in particular on understanding future energy systems from a number of angles, such as considering heat decarbonisation and the strength of the evidence base for various heat decarbonisation solutions.

At the UK level, there were policy developments on understanding and responding to the impacts of climate change, with the publication of the Climate Change Risk Assessment Evidence Report in summer 2016 and the final Risk Assessment in January 2017. CXC was instrumental in contributing a Scottish dimension to the development of these documents and then in interpreting their importance for Scotland and Scottish policy makers.

Whilst CXC's own resource was reduced in 2016/17 (see Internal Context), there was a parallel reduction in capacity within Scottish Government policy and analytical teams to commission and respond to academic work. Reducing capacity in some policy teams that provide analytical interpretation / review of academic work means an increased demand for CXC's preparation of crisp, plain English reports that answer the policy question.

The wider external context has, of course, been deeply affected by the UK vote to leave the European Union. Questions about areas of climate-relevant policy that currently fall under EU Directives and/or may be devolved under a post-Brexit settlement have begun to emerge, and CXC is working with partners to ensure we are equipped and ready to support policy development as these issues crystalise.

3. INTERNAL CONTEXT

CXC's proposal for a five-year programme was agreed by RESAS in early 2016. However, in line with all publicly-funded programmes, CXC must now operate on the basis of one-year awards. This applied to 2016/17 and will do so for the foreseeable future, meaning that CXC must operate 12-month budgets and workplans must fit within that timeframe.

Working to one-year budgets has meant a change in emphasis towards projects that can be completed within the financial year, or that can be split into phases such that they can be completed in stages, each of which has value on its own. This change to the commissioning and management of projects carries with it some challenges, but also some benefits in terms of the even tighter specification of deliverables and milestones for our research.

At the start of this five-year programme phase, CXC changed the membership of the CXC Directorate to better align with the programme set out in our five-year proposal. The Directorate membership now reflects the range of CXC research projects and institutions very well, and the Directorate is able to provide strategic advice about the direction that CXC research needs to take.

In addition to a changed Directorate, CXC has established a new Advisory Group of Scottish Government Officials. The Group met for the first time in the new financial year (early April 2017) with the membership and remit agreed. The Group will support the Directors and Secretariat in strategic direction-setting and in particular in prioritising work, and ensuring value for money. In tandem with ongoing engagement with policy teams through the Secretariat, the Group will strengthen CXC's ability to be fully responsive to emerging policy needs and to tailor our resource allocation accordingly. This is already proving invaluable in supporting RESAS to plan for future resource allocation to CXC.

At the start of 2016/17, CXC appointed three new post-doctoral fellowships, using funding released from research projects that concluded at the end of CXC's first programme (2011-16). The new fellowships provide CXC with outstanding academic support in critical areas of energy policy: local / decentralised energy, energy efficiency and policy appraisal. In addition to these fellowships, CXC secured additional funding from the Energy & Climate Change Directorate for a social science fellow working on evaluation of energy efficiency interventions through Scotland's Energy Efficiency Programme pilots. Together, this cohort of four fellows positions CXC effectively in continuing to provide highly relevant, high quality research on key Scottish policy questions.

4. OUTPUTS AND OUTCOMES

4.1 Impact on policy

Cross-Cutting

1. Contributing to calls for evidence

The statutory UK Committee on Climate Change (CCC) hosted their Scotland meeting in January 2017 at CXC's offices in the Edinburgh Centre for Carbon Innovation (ECCI). The Committee gathered the views of Scottish stakeholders as part of their call for evidence on the Scottish Government's planned new climate change bill. The Committee heard evidence on carbon targets from CXC Policy Director Andy Kerr, and on agriculture and land use from CXC researcher Prof Bob Rees (SRUC). The CCC released its report, [Advice on the new Scottish Climate Change Bill](#) following this call for evidence on 22 March 2017.

Andy Kerr, CXC Science Director Pete Smith, Directorate Members Mark Winskel and Robin Matthews, and CXC researcher Keith Bell presented evidence to the Fair Work and Economy, the Rural Economy and Connectivity, and the Environment, Climate Change and Land Reform Committees of the Scottish Parliament on the draft Climate Change Plan and Energy Strategy.

Building on his previous role on the TAGECCA group, Andy Kerr has become an informal and trusted expert advisor to the Scottish Government on issues relating to the draft Climate Change Plan, the draft Energy Strategy and the new Climate Change Bill.

ECCI also hosted the UK's National Infrastructure Commission for its Scottish evidence session, with Andy Kerr part of the Scottish roundtable providing evidence. Contact: Gemma Holmes, UK Committee on Climate Change; Lynn Tullis, ECCLR Committee.

2. Climate conversations toolkit

A CXC [desk review](#) conducted by Climate Outreach and the Surefoot Effect, looked at the existing research base used to inform the design of workshops with the public, and where materials and scripts were trialled with members of the Scottish public. This research fed in to the development of the [Climate Conversations toolkit](#) which was produced by the Scottish Government for holding conversations with the public on how Scotland can become a low carbon country. The toolkit has been used in two further projects, and outputs were used in the drafting of the Climate Change Plan. Contact: Helen Mansbridge.

3. EU Climate Change and Energy Policy Case Studies

CXC conducted a review of relevant national Climate Change and Energy strategies, plans and policies from elsewhere in Europe. Researchers from the University of Edinburgh and SRUC produced case studies focused on heat, transport and agricultural policies in a range of countries, resulting in a suite of seven case studies: heat in Germany, the Netherlands and Sweden; transport in the Netherlands and Norway; and, agriculture in Denmark and France. The case studies have directly

influenced Government thinking on the new Climate Change Bill. CXC is now engaged in producing follow-on research to these case studies for Scottish Government re: the new Climate Change Bill to review international climate change targets. The case studies will be published in June 2017. Contact: Debbie Sagar.

4. TIMES modelling and the draft Climate Change Plan

A CXC project delivered by researchers at Imperial College produced a set of evidence-based assumptions on potential the role of Hydrogen in the energy system as an input to the modelling in Scottish TIMES. Scottish TIMES modelling underpinned the development of the draft Climate Change Plan. The report was directly used by officials developing the draft Plan and in briefing Cabinet about the potential future roles of various technologies. Contact: Colin McBean.

Energy

5. CXC secondment to the Scottish Government

Ragne Low, CXC Programme Manager undertook a six-month part-time secondment into the Scottish Government's Energy Division to work on a range of projects relating to onshore wind policy and the drafting of the Energy Strategy. On secondment, Ragne produced a policy statement on peatland and energy, which now forms part of the suite of consultation documents issued by the Scottish Government under the draft Energy Strategy. She was also instrumental in establishing the principles for public engagement on energy enshrined in the draft Energy Strategy. Contact: Sue Kearns.

6. Onshore wind projects

Following on from the CXC [Wind Farm Impacts Study](#) published in July 2015, CXC worked with policy stakeholders to develop an Action Plan to take forward recommendations from the Study. The Action Plan was agreed by a range of policy teams and created momentum for two further CXC projects. CXC commissioned these projects to look further at the noise impacts from renewable technologies in Scotland and to review evidence of the light and shadow effects from wind turbines in Scotland. The Action Plan and follow-on projects represent a direct input to onshore wind policy development during a critical phase for both the Government and the onshore wind industry. Contact: Sue Kearns.

7. Electrification of Heat Demand

CXC delivered a model to represent the electrification of heat and electricity network capacity in Scotland. The model allows Scottish policy makers explore the potential impact of electrifying a proportion of heat demand. The model was designed to 'soft-link' to the Scottish TIMES model and, together with the [accompanying report](#), has directly informed development of policies contained in the draft Climate Change Plan and Energy Strategy. Contact: Mike King.

Natural Environment

8. CXC outputs used in draft Climate Change Plan

The draft Climate Change Plan relies on several of CXC's science outputs – JHI researchers explored the effectiveness of the Peatland Action Programme to support assessment of the feasibility of increased levels of peatland restoration. This work has directly informed the policy outcomes set out in the draft Plan. Contact: Gordon Struth.

Agriculture

9. Nutritional strategies to reduce emissions from livestock

CXC researchers from SRUC carried out a rapid evidence assessment for the effectiveness of probiotics, nitrates and high fat diets in addressing enteric fermentation as a source of GHG emissions. The [report](#) was well received by Scottish Government officials working on preparing the draft Climate Change Plan, who described it as 'crucial and readable'. It has directly informed the draft Plan at chapter 14, policy outcome 3. Contact: Gordon Struth.

Transport

10. Clean air zones

CXC researcher Craig Morton, University of Leeds sits on the National Low Emission Framework Advisory Group and is contributing insights based on his work on assessing the impact of the introduction of a Clean Air Zone (CAZ). A key early deliverable from this work is a [report](#) for Transport Scotland on the structure of Scotland's car fleet. This work has been influential in the early stages of designing a CAZ. The report explored the configuration of Scotland's car fleet, which was shown to be quite distinct from the rest of the UK in terms of European Emission Standards. The report also shows that car fleets registered across Scotland's four main cities are also distinct and it examined the possibility of using car registration data to estimate the cost of introducing a CAZ policy. Contact: Drew Hill, Transport Scotland.

4.2 Policy relevant outputs

Cross-Cutting

1. Low Carbon Scotland: Behaviours Framework.

A CXC project delivered by researchers from the University of Edinburgh provided an assessment of new evidence on the Scottish Government's original 10 Key Behaviour Areas (KBAs) where individuals and households could contribute most to reducing Scotland's consumption-based GHG emissions. CXC provided updated carbon saving estimates for the 10 KBAs. The report is already being used by Scottish Government officials and will be published in June 2017. Contact: Debbie Sagar.

Energy

2. Public engagement with energy system change in Scotland

A CXC [report](#) delivered by researchers from Cardiff University and UKERC gave Scottish Government officials working on the draft Energy Strategy a summary of insights on Scottish public values towards energy system change. The project provided evidence into the consultation phase on the draft Energy Strategy and is informing current development of public engagement processes. The research findings were discussed at the CXC-hosted stakeholder workshop looking at options for public engagement on energy policy in March 2017. Contact: Kat White.

3. Meeting Scotland's peak demand for electricity

CXC researchers at the University of Strathclyde have [reported](#) on the analyses they've conducted on the current level of transmission import capability and investigated the transmission capability required going forward. This research will inform the debate about Scotland's ability to meet its peak demand for electricity since the closure of Longannet power station in 2016, and with further major changes expected to the Scottish electricity system in the period until 2030. Contact: Mike King.

4. Impact of wind farms on property prices

A CXC project delivered by researchers at the Universities of Bristol, Sheffield and Edinburgh, and drawing on expertise at Duke University (USA), produced the first robust [assessment](#) of the potential impact of wind farm development on house prices across Scotland. The project set out to test whether there is a significant difference in the average house price growth of properties in close proximity to a wind farm compared with properties that are distant from a wind farm. The comprehensive study included data for the whole of mainland Scotland for 1990 – 2014, providing a set of findings highly relevant to Scottish national policy making. Contact: Debbie Kessell.

Adaptation

5. Adaptation indicators and narratives

CXC has published over [100 indicators measuring and monitoring progress](#) in building a Climate Ready Scotland. Their development involved researchers from RBGE, the Crichton Carbon Centre, JHI, SRUC, Forest Research and the Universities of Dundee, Heriot Watt and Strathclyde. The indicators support Scottish Government policy in three key areas: RISK/OPPORTUNITY and IMPACT indicators explore risks and opportunities Scotland faces as a result of current climate change, and quantify the impacts across sectors and the regions of Scotland. ACTION indicators look at the effectiveness of what is being done. The indicators are multidisciplinary and cross-sectoral. As such they are relevant to the work of a wide range of government policy teams, agencies, NGOs, local authorities, planners and others working towards a climate resilient Scotland. Contact: Allen Hughes.

6. Impermeable Land Surfaces in Scotland

CXC researchers at JHI developed an indicator to capture the first quantitative estimate of the extent of impermeable surfaces available for Scotland and explore the rate of geographic distribution of change. The work identified a net increase in the area of impermeable surface for Scotland, and demonstrated that no local authority reduced the area of sealed land between 2008 and 2015. The indicator provides a baseline for monitoring the changes in extent of impermeable surfaces at a local authority level. Contact: Allen Hughes.

Forestry

7. Adaptation measures for the forestry sector

CXC researchers at Forest Research (FR) have continued to interact with Forestry Commission Scotland (FCS) policy and practice teams in exploring adaptation measures for the forestry sector. This has included work on understanding the impact of adaptation measures on emissions mitigation, through modelling the effects of adapting forest management practices on standing forest carbon stocks (report with FCS); and on work analysing and simulating ecosystem service provision on the National Forest Estate under adaptive forest management practices. Ecosystem service indicators included: timber production, biodiversity, recreation value and standing carbon. Forest management practices were developed with forest planners through the Climate Ready Demonstration Forest at Queen Elizabeth Forest Park to ground truth the simulations and support practitioner decision making (report provided to FCS and an article published in Scottish Forestry Dec 2016). Contact: Maida Ballarini.

Natural Environment

8. Information for Species Advice

CXC researchers at JHI worked closely with SNH to provide information on the possible impacts of climate change on species and habitats. This will ensure climate change can be incorporated into the advice provided by their species and habitats experts, and into future planning for species conservation. A report will be published shortly, followed by workshop support. Contact: Mary Christie, SNH.

9. Peatland Action: Lessons Learned

Using social science research, CXC researchers at JHI explored experiences from the first three years of Peatland Action funding, and synthesised the [lessons](#) to inform improved practice as the Scottish Government commits to a new programme of funding. This work is particularly important in supporting Government and agencies in delivering against the ambitious aims for peatland restoration rates set out in the draft Climate Change Plan. Contact: Sandra Marks.

10. Peatland Action: measuring benefits

CXC researchers at JHI worked with analysts at SNH to examine the extensive information and data collected under the Peatland Action programme and the wider potential of programme activities to support delivery of ecosystem benefits. This

[report](#) will directly inform the design of data collection under the future funding scheme, and support monitoring and evaluation of the programme and its wider context. Contact: Sandra Marks.

11. Muirburn, Peatland and Peat soils

Scotland's Moorland Forum is in the process of reviewing the Muirburn Code for the Scottish Government, and CXC were tasked with assessing the current state of knowledge on the impact of muirburn on peatland and peat soils. The [report](#) produced by JHI will directly inform stakeholder discussions and any revisions to the code. Contact: Andrew Coupar, SNH.

12. Supporting the soil policy network with climate change science

CXC applied the rapid evidence assessment (REA) approach in a study on soil carbon and land use. REAs are regarded by many policy makers as a highly effective way of condensing complex areas of science for policy and practice audiences, and this was the first REA project undertaken by CXC. The research conducted by SRUC, JHI and FCS will be published shortly, but has already been welcomed across the Scottish Government and its agencies as a useful support to evolving policy for forestry, soils, land use and ecosystem services. Based on the experience gained from this REA, CXC is developing its own REA approach further and will apply it again to future policy issues. Contact: Sandra Marks.

Agriculture

13. Review of options for cattle slurry management

Researchers at SRUC assessed the greenhouse gas abatement potential from a range of measures to [manage slurry](#) in Scotland. The project responded directly to evidence needs articulated by Scottish policy makers and has informed policy thinking on outcome 4 (chapter 14) of the draft Climate Change Plan. Contact: Gordon Struth.

Transport

14. Car club member analysis: exploring differences in motivations, preferences and mobility patterns amongst new members

A CXC researcher at the University of Leeds published a [policy note](#) on car club member analysis to explore the differences in motivations, preferences and mobility patterns amongst new members. Increasing the use of car clubs is an opportunity to reduce carbon emissions from transport in Scotland. This research analysed survey data to better understand members' motivations for joining car clubs and has been brought into the evidence base used by Transport Scotland officials and analysts. Contact: Drew Hill, Transport Scotland.

4.3 Stakeholder engagement

Cross-Cutting

1. Links with the National Centre for Resilience

CXC's Policy Director, Andy Kerr chairs the Research and Training Working Group of the [National Centre for Resilience](#) (NCR) and, working with the CXC and NCR Secretariats, has been seeking to align the NCR's and CXC's research programmes. CXC has engaged with the NCR Secretariat to help develop research project specifications and ensure maximum synergy with CXC's research and value for money for funders.

Energy

2. CXC-UKERC Heat Summit

Building on its strong relationship with the UK Energy Research Centre (UKERC), and the seminar series held in 2015/16, CXC co-hosted with UKERC a [summit](#) in Edinburgh in September 2016, bringing together Scottish policymakers and leading UK researchers on heat transitions. The summit identified priority areas for research, policy and practice to support the decarbonisation of Scotland's heat supply and demand in the context of emerging Scottish policies.

3. Local energy systems in the UK: Taking stock and looking forward

In September 2016, CXC [convened](#) researchers, policymakers, community energy practitioners, and other private, public and third sector stakeholders to discuss examples and exchange knowledge on the transition towards local energy systems. The conference produced a set of key research questions that are being taken up across multiple institutions, in particular through a collaborative project between CXC and the Centre for Sustainable Energy on barriers and solutions in local energy economies.

4. Public engagement with energy

CXC organised a [workshop on public engagement](#) with energy issues in Scotland, in March 2017. The [workshop](#) explored what is already happening on citizen engagement with energy in Scotland, the range of activities already underway, and what the potential modes of engagement with the draft Scottish Energy Strategy might be. The workshop produced a scoping note that Scottish Government officials are considering as part of their planning for the public consultation on the draft Strategy and potentially more concerted public engagement on energy issues in the period thereafter.

5. Energy Roundtable with UKERC and Scottish Government

CXC Co-Director Andy Kerr, Programme Manager Ragne Low, PIs Mark Winskel (University of Edinburgh) and Keith Bell (University of Strathclyde), and CXC researchers Simon Gill (University of Strathclyde) and Niall Kerr (University of

Edinburgh) participated in a roundtable discussion with UKERC and the Scottish Government. The roundtable reviewed developments in Scottish energy and climate change policy, as well as the UK Industrial Strategy green paper, the forthcoming Clean Growth Plan (formerly the Emissions Reductions Plan) and Brexit. The roundtable set out a number of clear priorities for further research collaboration and expert advice provision to the Scottish Government on energy policy.

6. CXC transport emissions modelling

CXC convened a [meeting with Transport Scotland to discuss the Scottish Transport Energy and Air Pollution Model](#) (STEAM). CXC researcher Craig Morton (University of Leeds) facilitated the dialogue between academics from CXC and UKERC, and policy and analytical staff from Transport Scotland. They agreed the potential capabilities and data requirements of such a model for Scotland and the scope for application of the STEAM model in support of transport emissions reduction policy development following publication of the draft Climate Change Plan.

7. Scottish Energy Association Conference

Andy Kerr, CXC Policy Director and PI Karen Turner (University of Strathclyde) provided keynote presentations at the [Scottish Energy Association conference](#), February 2017. Both presentations provided insights into and interpretation of the draft Scottish Energy Strategy and helped to set the agenda for discussions with industry partners at this annual energy industry stakeholder conference. Andy presented on the Energy Strategy in a world of disruptive innovation and Karen presented the move from the Energy Strategy to new policy.

Adaptation

8. UKCP18 Non-Government Users' Group

Several CXC members sit on the UK Climate Projections 2018 Non-Government Users' Group convened by the Met Office Hadley Centre. Ragne Low (CXC Programme Manager), PI Chris Ellis (RBGE), Kairsty Topp (SRUC) and Mike Rivington (JHI) collectively represent Scottish interests on the Group and engage with stakeholders from the wider UK Group. Ragne Low has worked to guide the UKCP18 consultation process towards an improved representation of Scottish stakeholders and convened a separate Scottish stakeholder group meeting, bringing UKCP18 Project Team to Edinburgh to present and consult. That engagement has generated two demonstration projects from Scotland, which have been approved by the UKCP18 Project Team and will form a key part of the road-testing of UKCP18.

Natural Environment

9. Work with SNH on indicators finalisation

CXC adaptation researchers from the University of Dundee, RBGE and JHI worked closely with SNH in the finalising of adaptation indicators for the SCCAP Natural Environment theme. This engagement included technical discussions with SNH

scientists to ensure academic rigour. The indicators and accompanying narratives were shared with a number of SNH specialists for expert verification and feedback prior to publication. Discussions were also held to identify ways forward in developing the CXC indicators to enhance their usability.

Agriculture

10. Preparation of the draft Climate Change Plan

CXC hosted and facilitated a workshop of farming industry stakeholders in October 2016 to provide insights and feedback to the Scottish Government on the proposed content of the draft Climate Change Plan for agriculture. The CXC secretariat created a safe space for constructive dialogue between industry, government and third sector voices, contributed to the design of the workshop, provided facilitation and supported the write-up and translation of the workshop outputs into a series of actions, including for further research. Researchers from SRUC also provided support.

4.4 Benefits to other stakeholders

General

1. Outreach and education

The CXC Secretariat worked to share best practice on how science can inform policy making. One of the ways CXC has approached this is through presenting lectures to MSc students studying technological, environmental and social issues connected to climate change and energy.

CXC has also worked to promote Scotland's Centres of Expertise as exemplars of science-policy knowledge exchange. In particular, we promoted CXC itself and the learning from our first five-year programme through a series of [publications](#) and presentations to academics and students as well as to other research centres and research funders. The CXC secretariat has held a number of training workshops and seminars with early career researchers on working at the science policy interface, including students involved in the NERC E3 DTP hosted at Edinburgh, and including supporting the Scottish Crucible series for young researchers run by Heriot Watt University.

In addition, the CXC secretariat hosted a very successful NERC internship to provide the intern with experience of working in research for policy impact.

Energy

2. A Citizen-Centred Low Carbon Transition

In collaboration with Innovate UK, BEIS, Cardiff University, the University of East Anglia and UKERC, CXC has been a founding member of an initiative to create a UK centre to work on the social dimension of the low carbon transition. CXC Programme Manager Ragne Low was part of the working group that has developed the business case for the centre, representing Scottish interests and ensuring a link to the Scottish Government's Energy and Climate Change Directorate. The initiative has already

gained traction with UK Ministers. There is keen interest from a range of Scottish stakeholders in academia and the third sector who see clear benefits to their work on the low carbon transition.

Adaptation

3. The UK Climate Change Risk Assessment

CXC Programme Manager Ragne Low and CXC researcher Kairsty Topp (SRUC) were part of the author team that produced the Evidence Report for the Climate Change Risk Assessment 2017. The Risk Assessment project was managed by the Committee on Climate Change's Adaptation Sub Committee (ASC) and involved a large number of contributors and reviewers from institutions across the UK. In the process of contributing to the Evidence Report, CXC consulted a range of Scottish stakeholders - including Adaptation Scotland and Scottish Water, as well as academics at the University of Dundee and RBGE - to ensure that the Report reflected Scottish interests, policy landscape and particular geographies and social patterns of risk. The resulting Report is well aligned to Scottish stakeholder needs.

Forestry

4. Climate change adaptation in the forestry sector

A practical metric for assessing tree species diversity at local, regional and national scales was developed by CXC researcher Kate Beauchamp (FR) working with FCS, in order to encourage forest managers to measure forest tree species diversity, and increase it, as an adaptation action. The metric and simple spreadsheet application was publicised to the forestry sector through an article 'how diverse is your forest' in the ICF 'Chartered Forester' magazine in November, triggering substantial interest from managers.

Agriculture

5. Aggregate Demand for nitrogen in Scottish agriculture

CXC facilitated urgent dialogue between Scottish Government and SRUC around the potential for nitrogen budgeting in Scotland. This issue has been raised as a potential tool to reduce nitrogen emissions from inorganic fertilisers, but a workable solution is difficult to identify. Useful discussions confirmed the need for further work to realise practical potential.

4.5 Collaboration and multidisciplinary working

Cross-Cutting

1. Links with CKEI

CXC and the Centre for Knowledge Exchange and Impact (now renamed SEFARI-GATEWAY – the knowledge exchange arm of the Scottish Environment, Food and Agriculture Research Institutes) worked together with the other centres of expertise (CREW and EPIC) to coordinate management and communication approaches. The

CKEI and CXC Secretariats share office space and proactively collaborate to ensure alignment of research plans and communication with both MRP researchers and external stakeholders.

2. Climate Conversations

The Scottish Government initiated the Climate Conversations project to encourage discussion about climate change with the Scottish public. Following CXC's involvement as provider of the underpinning research for the toolkit, CXC then worked with the Surefoot Effect, Sniffer and the Scottish Government to plan and run a [seminar](#) on 2 March 2017 to identify key lessons learned from 20 real-world climate conversations across Scotland over summer and autumn 2016. CXC was instrumental in facilitating this event together and in drawing out conclusions and lessons for future application of the Conversations model.

Energy

3. Socio-economic impacts of local energy projects

CXC researchers from University of Edinburgh, University of Strathclyde and JHI worked together on a multi-disciplinary project to measure the economic and social impacts of projects funded under the Scottish Government's Local Energy Challenge Fund. The project involved mixed methods and cross-disciplinary synthesis work to produce a single evaluation framework and way of reporting socio-economic impact. The framework will have lasting impact through application to a further range of local energy projects and uptake of results by analysts and policy makers in the Scottish Government.

4. Scotland's Energy Efficiency Programme Evaluation

CXC researcher Ruth Bush and PI Jan Webb (University of Edinburgh) collaborated with the Energy Saving Trust on a project to evaluate the technical, behavioural and institutional impacts of ten pilot projects under Scotland's Energy Efficiency Programme (SEEP). This collaborative project involved multidisciplinary working to produce a coherent dataset that can be used for both the technical and behavioural & institutional sides of the evaluation, and the coordination of research plans and engagement with practitioners and stakeholders. The Scottish Government is using the outputs from the project to shape its investment in a future round of pilot projects and in decision making about the scope and content of the final SEEP to be launched in 2018.

Adaptation

5. Edinburgh Adapts

CXC researcher Ruth Monfries, RBGE, is the Chair of the Edinburgh Adapts Steering Group, which leads the Edinburgh Adapts initiative and reports on progress to the Edinburgh Sustainable Development Partnership. This provides ongoing engagement with practitioners including Edinburgh Council, public and private sector organisations and NGOs across the city; effectively embedding CXC in implementing adaptation.

The group has established an Action Plan setting out how they are working collaboratively to help Edinburgh meet the challenges of a changing climate now and in the future. They are also working to raise awareness of climate impacts and share knowledge to help realise the opportunities from being a well prepared, resilient city. This experience provides insight into on-the-ground issues in implementing adaptation to feeding back into CXC's policy work.

6. Engagement with the Committee on Climate Change's Adaptation Sub Committee (ASC)

CXC researchers from the University of Dundee and the RBGE, as well as CXC secretariat members, worked with members of the UK Committee on Climate Change's Adaptation Sub Committee (ASC) and its Secretariat to finalise the national suite of adaptation indicators for Scotland. The indicators were actively used by the ASC in the analysis that underpinned their independent assessment of progress against Scotland's Climate Change Adaptation Programme. In addition, CXC was part of a wider collaborative process to identify 'next steps for Scotland' on climate change risk and adaptation research, as part of a UK-wide consultative process run by the ASC.

7. The economics of climate change adaptation - Aberdeenshire flood risk

Building on previous work examining the costs of risk management for local authorities, this collaborative project with Aberdeenshire Council concentrated on what lessons could be learned from a specific flood 'event' during the winter of 2015/2016. [The project](#) explored the costs of dealing with the impact of the flooding, and suggested possible tools to support better informed decision-making.

Forestry

8. Woodland carbon

Collaboration between Forest Research, JHI and the University of Aberdeen on the CXC woodland planting and carbon stock analysis project combined expertise in soil carbon modelling, spatial modelling, forest growth and land use and soil type datasets. This project could not have been carried out without this combination of skills and information. The research assessed the net change in carbon stocks that could result from different afforestation across Scotland taking into account the carbon contained within both the trees and soils. Outputs generated through the project include maps of net change in above and below ground carbon stocks for a range of Forestry Management Alternatives.

5. PROGRESS REPORTS ON ACTIVITIES

5.1 Energy

CXC has been active in supporting a shift in Scottish policy focus over the past year, with emphasis crystallising around the themes of the draft Energy Strategy: a stable transition to a low carbon world, a whole systems approach, and local energy systems – and away from the primary focus on electricity and new renewable generation assets. There has been a divergence from the UK agenda on energy, with emerging questions also about the potential impact of Brexit. In addition, there is an effort to build further rigour – through whole system energy modelling, plus an emerging desire for co-benefits understanding.

5.1.1 Renewables

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- [Impacts of onshore wind farms on property values](#) (delivered October 2016).
- Geothermal synthesis report (delivered August 2016, not published yet).
- Scoping study on assessment practices for noise impacts from renewable technologies in Scotland (delivered March 2017, report being finalised).
- Review of light and shadow effects from wind turbines (delivered March 2017, report being finalised).
- Wave and tidal energy: state of the industry report (on track).

5.1.2 Local energy

Deliverable 1. Commissioned Projects (Sept 2016 rating: AMBER; April 2017 rating: GREEN)

- A review of current practice amongst local energy initiatives across the UK (on track).
- In spite of early delays in accessing data, particularly from Local Energy Challenge Fund projects, we were able to bring the project back on track for delivery in April 2017.

Deliverable 2. PDRF Research Project - Local Energy Economies: Measuring the social impacts of local and community energy projects (Sept 2016 rating: GREEN; April 2017 rating GREEN)

- This project is developing a practical and replicable framework for assessing the social impacts of local and community energy that could be employed across a variety of different projects.
- Local and community energy practitioners 'road tested' the framework and their experiences were incorporated in the refinement of the framework.

- An interim report was delivered in August 2016 and an end-of-year report is on track for April 2017.

Deliverable 3. PDRF Research Project - Local Energy Economies: understanding the economic impact of community and local energy (Sept 2016 rating: GREEN; April 2017 rating GREEN)

- This project focuses on developing an approach to measure the economic impact of local energy initiatives, with a particular focus on projects funded through the Scottish Government's Local Energy Challenge Fund, as well as other local energy projects funded through the Low Carbon Infrastructure Transition Programme.
- The project is being undertaken as a collaboration between the Fraser of Allander and JHI.
- Model inputs were developed to support the economic impacts of LECF projects on the local and Scottish economies. Effects on employment were tested. The possibility of broadening the existing dataset with other Scottish community energy projects was explored.
- An interim report was delivered in August 2016.

5.1.3 Energy policy, systems and markets

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- [A review of current research on citizen values and attitudes towards whole system energy change](#) (delivered March 2017).
- Hydrogen assumptions in Scottish TIMES (delivered November 2016, not published yet).

Deliverable 2. PDRF Research Project – Scotland and the European Union (Sept 2016 rating GREEN; April 2017 rating GREEN)

- This project is assessing European energy policy developments in terms of their possible implications for Scottish and UK energy system transitions, including markets and trading, infrastructure, and low-carbon investments.
- The research team has conducted 15 expert interviews and participated in energy seminars.
- Outputs from the project to date include blogs produced for the CXC website, conference papers, and a database of key evidence on GB, Scottish, and EU energy interconnection scenarios.
- As of January 2017, for a period of 10 months, the postholder changes from Antti Silvast, to Peter Zeniewski, Chancellor's Fellow at the University of Edinburgh School of Social and Political Science.

Deliverable 3. PDRF Research Project - The energy system implications of a shift to more localised energy production (Sept 2016 rating GREEN; April 2017 rating GREEN)

- This research is investigating the technical and regulatory implications of moving to a local, decentralised energy system, in particular frameworks that will enable local energy balancing and how emergent local systems will interact with national energy systems.
- To date, the postholder has completed a description of the contemporary centralised energy system model, and the current technological and regulatory constraints on local energy and distributed generation. A definition of spatial and temporal aspects of local energy systems using local energy infrastructures has also been produced.

Deliverable 4. PDRF Research Project - [Energy system modelling and security of electricity supply](#) (delivered March 2017)

- This research focused on understanding the role of electricity generation and the transmission network in providing security of electricity supply to Scotland.
- The project examined changes in the electricity generation landscape in Scotland and northern England, due to the closure of large dispatchable power stations and the continued growth of renewable generation.
- The research developed methodologies to consider the role of transmission interconnection between regions as well as the availability of flexibility from demand, storage and generation, and to use them to analyse future Scottish electricity.

Deliverable 5. PDRF Research Project – Energy decentralisation in Scotland (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- This research project will focus on the socio-economic aspects of energy decentralisation in the UK-Scottish context.
- The researcher works with UKERC, and its interdisciplinary capability on decentralised energy pathways.
- The stakeholder groups that the researcher is focussing on through this project are Scottish policy makers, representatives of the energy industry based in Scotland, NGOs, and other civil society groups engaged in Scottish energy policy.
- The researcher has recently conducted fieldwork, in the form of stakeholder interviews; which will build on previously completed analysis of relevant literature.

Deliverable 6. PDRF Research Project – Energy system impacts of interventions (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- This research is developing and improving models for testing the paths to decarbonisation of energy in Scotland, including: improved renewable

resource datasets, spatiotemporal heat modelling and advanced carbon emissions modelling.

- To date, the researcher has developed solar PV resistance profiles for inclusion in existing Scottish dispatch models.

5.1.4 Energy efficiency

In response to requests from Scottish Government policy makers, we have initiated a number of research projects through our commissioning budget focussed on Scotland's Energy Efficiency Programme, which is due to launch in 2018. In addition, we have delivered research on the potential impacts of electrifying a proportion of heat demand, and examined specific technology types to support this.

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating GREEN)

- [Electrification of heat demand in Scotland](#) (Delivered April 2016).
- Landscaping R&D study into heat generation technologies available to deliver Scotland's Energy Efficiency Programme (on track).
- Landscaping R&D study into energy efficiency technologies available to deliver Scotland's Energy Efficiency Programme (on track).
- Landscaping R&D study into smart energy technologies available to deliver Scotland's Energy Efficiency Programme (on track).
- Technical monitoring of the SEEP pilot programme (on track).

Deliverable 2. PDRF Research Project - Energy systems impacts of energy efficiency (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- This research will explore the impacts of energy efficiency changes linked to the SEEP and consider how TIMES and AMOS (the Scottish Computable Generalised Equilibrium model) may be used to provide additional insights on co-benefits of energy efficiency improvements.
- The postholder has produced an interim report of strengths and limitations of the Scottish TIMES in terms of analysing the energy system impacts of changes in efficiency including recommendations on how Scottish TIMES may be used in its current form with further developments, and/or alongside other modelling platforms.

Deliverable 3. PDRF Research Project – Scotland's Energy Efficiency Programme (Project commenced October 2016; April 2017 rating: GREEN)

- This project involves the evaluation of the Local Authority-led integrated energy efficiency pilots taking place as part of SEEP.
- The research will look at project governance, management, partnership structure, and resulting behavioural impacts.

- A householder survey has been developed, piloted by Shetland Council, and circulated to Local Authorities; as well as a workshop for Local Authorities covering the evaluation process and householder survey.

5.2 Transport

The transport focussed PDRF project has continued since the PI and postholder moved to the University of Leeds in 2016. The postholder has been working closely with Transport Scotland, and members of the National Low Emissions Framework, to inform the development of low carbon transport policy in Scotland, and indeed has become embedded in several advisory groups and networks supporting Transport Scotland analysts.

Deliverable 1. PDRF Research Project - Low carbon transport futures (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- This research investigated the spatial diffusion and uptake of various low carbon transport technologies across Scotland. A second strand of work is considering how the energy demand and emissions profile of Scotland's transport sector may change over time.
- A new work programme for this research has been developed to feed into the Cleaner Air for Scotland strategy.
- The postholder has been continually interacting with Transport Scotland and SEPA on the pre-appraisal of the introduction of Clean Air Zones; and through his interaction with members of the National Low Emissions Framework, has ensured his expertise with spatial modelling of Scotland's car fleet feeds into the formation of this policy.

5.3 Forestry

5.3.1 Woodland expansion

CXC's woodlands expansion work, led by a collaboration of researchers from JHI, the University of Aberdeen and Forest Research, aims to identify the net GHG emission reduction benefits of converting existing land use to different types of woodland under different management scenarios. The research team and the CXC Secretariat have worked closely with Forestry Commission Scotland (FCS) through a dynamic policy environment, with this phase of work now coming to a close.

Deliverable 1. Programmed work (Sept 2016 rating: GREEN; April 2017: AMBER)

Summary report: Analysis of the net change in carbon stocks from future forestry planting in Scotland. A summary report will be published shortly to mark the end of this phase of work – there have been delays in engaging policy officials in final sign-off of the work. The project results have been presented to Forestry Commission Scotland, who welcomed the recognition of a complex picture in which carbon sequestration is dependent on tree species and soil types. They also see potential for this work to inform future policy and guidance.

Deliverable 2. Programmed work (Sept 2016 rating: GREEN; April 2017: GREEN)

Silvo-pastoral agroforestry systems in Scotland – summary brief (Published)
Researchers at JHI and FR produced a [policy brief](#) that explores the potential for carbon savings from agroforestry options in Scotland.

5.3.2 Forest adaptation

The work is led by a post-doctoral research fellow based at Forest Research. The focus of this work is to support forest sector adaptation to climate change by developing research and resources to support forest policy decision making and delivery of Scotland's Climate Change Programme. It will promote exchange between science, policy, practitioners and the wider forest sector through Scotland's demonstration forest, and additional demonstration resources.

Deliverable 1. PDRF Research Project – Adaptive forest management (Sept 2016 rating: GREEN; April 2017: GREEN)

- The work this year has developed and publicised a method for assessing tree diversity for forest managers, and started to examine the implications of forest adaptation actions to future provision of ecosystem services for the public forest estate.
- The postholder has produced a cross-cutting report for FCS policy advisors, on 'The Impact of Adaptation Management Options and Future Climate Scenarios on the Standing Carbon Stock of Scotland's National Forest Estate'.
- FR has started to compile a list of forest stands in Scotland that are exemplars of different practices that may increase resilience and demonstrate potential adaptation measures. This has in part been collaboration with new work compiling similar information by the Royal Scottish Forestry Society. It is planned to develop an online resource to feature these exemplars.

5.4 Natural environment

5.4.1 Peatlands

Significant progress has been made in support of peatlands this year. We met with key stakeholders at an early stage to discuss key priorities, which were delivered during the financial year. *[NOTE - one project – an REA of Nitrous Oxide – was not taken forward, partly because we are waiting for related work completed through DECC to be published to avoid repeating work]*

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating GREEN)

- [Peatland Action: Lessons Learned – report exploring experience from the peatland action programme 2012-16.](#) (Delivered January 2017).

- [Peatland Action: Use of data collected – research to explore the potential use of data collected as part of the Peatland Action Programme, and inform guidance for future phases of funding support.](#) (Delivered January 2017).
- [Muirburn, Peatland and Peat Soils – Commissioned by SNH to inform review of the Muirburn Code.](#) (Delivered March 2017).
- Peatland Carbon Facts and Figures – SNH commissioned text for a public information leaflet to raise awareness of the importance of peatland restoration in the wider context of climate change and carbon emissions in Scotland. (Completed – awaiting final publication by SNH).

Deliverable 2. Programmed work (Sept 2016 rating: GREEN; April 2017 rating: GREEN) Detection of Peatland Drainage with remote sensing – Commissioned by Scottish Government to explore potential for remote sensing of peatland drainage. Work is completed and final draft report received in Secretariat. Publication expected shortly.

5.4.2 Biodiversity – Assessing climate risk to notifiable features

CXC has been working with SNH since 2012 to develop an analytical procedure for prioritising climate change adaptation measures for Scotland's protected areas. Following delivery of an assessment framework in 2016, we explored how it could support the incorporation of climate change into the advice provided by SNH's species and habitats experts, and into future planning for species conservation. A decision tree is now being trialled by SNH staff, for review later in 2017.

Deliverable 1. Programmed work (Sept 2016 rating: GREEN; April 2017: GREEN)

Building on earlier phases and working closely with SNH staff, we developed a simple decision tree to help SNH staff make an initial assessment as to whether climate change was likely to be a threat to the species or habitats under consideration. This is now being tested. (Completed – report to be published shortly; workshop to review trial scheduled for Autumn 2017).

5.5 Agriculture

CXC has supported the agriculture and climate change division throughout the year, focused on how science can support the design and implementation of policies through the Climate Change Plan aimed at reducing emissions from the sector. This has focused on exploring emissions intensity within the sector, and mechanisms for supporting practical on-farm delivery.

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating GREEN)

- [Nutritional strategies to reduce livestock emissions – commissioned by Scottish Government to inform policy development under the Climate Change Plan.](#) (Delivered September 2016).

- [Reducing emissions from livestock through effective slurry management – commissioned by Scottish Government to inform policy development under the Climate Change Plan.](#) (Delivered November 2016).
- Emissions intensity from agriculture – working to design a baseline model to measure the carbon intensity of the main commodities produced by Scottish agriculture at a national level (on track).

5.6 Adaptation

CXC has completed work on over 100 indicators which support Scottish Government policy on exploring the risks and opportunities of climate change, and quantifying the impacts of climate change across Scotland. CXC Research Fellows at RBGE and University of Dundee have been involved in the further development of these indicators; work which will continue into 2017/18 through the extended funding of these roles.

In addition, CXC has commissioned 'issues papers' for Scottish Government, to identify the adaptation research priorities for Scotland, and what will be potentially helpful to policy teams in the near term in thinking about key research gaps.

Deliverable 1. Commissioned Projects (Sept 2016 rating: GREEN; April 2017 rating: AMBER)

- Adaptation Issues Paper – Society (Delivered March 2017, not published yet).
- Adaptation Issues Paper – Buildings and Infrastructure Networks (Delivered March 2017, not published yet).
- Adaptation Issues Paper – Natural Environment (Delivered March 2017, not published yet).
- Overheating risk in buildings housing vulnerable people in Scotland (Due to the end of financial year impacting upon the ability of representatives of NHS trusts to reply to requests for interviews, the project will be delayed by approx. 6 weeks).

Deliverable 2. PDRF Research Project – Adaptation decision making at the local level; a role for national level indicators? (Sept 2016 rating: GREEN; April 2017 rating: AMBER)

- This research has examined the needs of decision makers involved in planning and climate change adaptation at a local/regional scale (e.g. local authorities), and the potential for their delivery of national policy. The study used literature review, and delivered a complimentary case study examining adaptation within the Stirling Council 'City Deal' to explore 'Adaptation decision making at the local level; a role for indicators?'
- The postholder has also worked on further developing the adaptation indicators – mapping current indicators to CCRA2, assessing indicators for use in fulfilling ASC's monitoring recommendations, and identifying key areas for indicator development.

- There has been a delay of one month in finalising the report, but it is available in final form as of 1 May 2017.

Deliverable 3. PDRF Research Project – Monitoring and evaluation of adaptation (Sept 2016 rating: GREEN; April 2017 rating: AMBER)

- The postholder has assessed current indicators in relation to CCRA2, ASC recommendations, and identification of key areas for indicator development.
- The postholder has participated in continued dialogue with SEPA and other key stakeholders to ensure the publication of the Geddes reports and to maintain the momentum of data development.
- There has been a delay of one month in finalising the report, but it is available in final form as of 1 May 2017.

5.7 Cross-cutting activities

Deliverable 1. Programmed work (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

Communicating Climate Change with Visualisation Tools: Researchers at JHI produced a [guide for policy teams](#) interested in using visual representation (visualisation) to raise awareness of climate change impacts with a view to influencing behaviour change (Delivered May 2016).

Deliverable 2. Commissioned projects (Sept 2016 rating: GREEN; April 2017 rating: GREEN)

- Climate Challenge Fund longitudinal behaviours project, a multi-method study of behaviour change (on track).
- [Climate Change Public Conversation Series: Framework for Developing Conversations – Scotland Climate Change Public Conversations](#) (Delivered September 2016).
- [Climate Change Public Conversation Series: 'How to' Guide](#) (Delivered September 2016).
- EU Climate Change and Energy Policy Case Studies (Delivered February 2017, to be published May 2017).

List of acronyms

ASC – Committee on Climate Change Adaptation Sub Committee
CCC – Committee on Climate Change
CoE – Centre of Expertise
CXC – CXC
BEIS – Department for Business, Energy and Industrial Strategy
DEFRA – Department for Environment, Food and Rural Affairs
EA – Environment Agency
ESRC – Economic and Social Research Council
EV – Electric vehicle
FCS – Forestry Commission Scotland
FR – Forest Research
FSA – Financial Services Agency
IPCC – Intergovernmental Panel on Climate Change
JHI – James Hutton Institute
KE – Knowledge Exchange
KPI – Key Impacts Metrics
NCR – National Centre for Resilience
NGO – Non-governmental Organisation
NERC – Natural Environment Research Council
OCEA – the Office of the Chief Economic Advisor
OECD – Organisation for Economic Co-operation and Development
QEFP – Queen Elizabeth Forest Park
RESAS – The Scottish Government's Rural and Environment Sciences Analytical Services
SCCAP – Scottish Climate Change Adaptation Programme
SEPA – Scottish Environment Protection Agency
SNH – Scottish Natural Heritage
SRDP – Scottish Rural Development Programme
SRUC – Scotland's Rural College
UKERC – UK Energy Research Centre
UNFCCC – United Nations Framework Convention on Climate Change
WDR – Wetland Drainage and Rewetting
ZWS – Zero Waste Scotland