



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

**ClimateXChange**  
**Centre of Expertise on Climate Change**

**Annual Report 2019-20**



## Contents

|  |           |
|--|-----------|
| <b>Report structure.....</b>                     | <b>4</b>  |
| <b>List of acronyms .....</b>                    | <b>5</b>  |
| <b>1. Executive summary.....</b>                 | <b>7</b>  |
| <b>2. Highlights .....</b>                       | <b>10</b> |
| <b>3. ANNEX A: Summary of all projects .....</b> | <b>14</b> |
| <b>3.1 Energy .....</b>                          | <b>14</b> |
| 3.1.1 Energy systems and policy.....             | 14        |
| 3.1.2 Energy efficiency and heat .....           | 15        |
| <b>3.2 Transport .....</b>                       | <b>17</b> |
| <b>3.3 Agriculture .....</b>                     | <b>18</b> |
| <b>3.4 Forestry.....</b>                         | <b>20</b> |
| <b>3.5 Peatlands and soils.....</b>              | <b>21</b> |
| <b>3.6 Adaptation .....</b>                      | <b>22</b> |
| <b>3.7 Behavioural and social change.....</b>    | <b>23</b> |
| <b>3.8 General – climate policy .....</b>        | <b>24</b> |
| <b>3.9 Industrial decarbonisation.....</b>       | <b>25</b> |

## Report structure

The ClimateXChange (CXC) 2019-20 Annual Report has been prepared in line with the 'Centre of Expertise Annual Report Guidance' provided by our funder, the Scottish Government Rural and Environment Science and Analytical Services (RESAS).

**Section 1** is a summary of major changes to CXC's external landscape, and changes to the activities or staffing of CXC in 2019-20.

**Section 2** captures CXC's key highlights in 2019-20, covering what has been delivered and what impact this has had.

**Annex A** provides a summary of all CXC's projects in 2019-20. A short summary is provided for each project, setting out the progress made, outputs, and outcomes and impacts that have arisen for both policy teams and wider stakeholders.

## List of acronyms

BECCS – Bioenergy with Carbon Capture and Storage  
CAV – Connected and Autonomous Vehicles  
CCC – Committee on Climate Change  
CCF – Climate Challenge Fund  
CCP – Climate Change Plan: Third Report on Proposals and Policies 2018 – 2032  
CEP – Centre for Energy Policy  
CGE – Computable General Equilibrium  
CoEs – Centres of Expertise  
COP – Conference of the Parties  
CREDS – Centre for Research into Energy Demand Solutions  
CREW – Centre of Expertise for Waters  
CXC – ClimateXChange  
DACCS – Direct Air Capture with Carbon Capture and Storage  
DOI – Digital Object Identifier  
DNOs – Distribution Network Operators  
ECCI – Edinburgh Centre for Carbon Innovation  
EES – Energy Efficient Scotland  
EPIC – Centre of Expertise on Animal Disease Outbreaks  
ETP – Energy Technology Partnership  
FR – Forest Research  
GGR – Greenhouse Gas Removal  
GHG – Greenhouse Gas  
HEI – Higher Education Institutions  
LCA – Land Capability for Agriculture  
LHEES – Local Heat and Energy Efficiency Strategies  
MaaS – Mobility as a Service  
MACC – Marginal Abatement Cost Curve  
MASTS – Marine Alliance for Science and Technology for Scotland  
M&E – Monitoring and Evaluation  
NCR – National Centre for Resilience  
OCEA – The Scottish Government Office of the Chief Economic Advisor  
PDRF – Post Doctoral Research Fellow

RESAS – The Scottish Government's Rural and Environment Sciences Analytical  
Services

SCCAP – Scottish Climate Change Adaptation Programme

SEDM – Scottish Electricity Dispatch Model

SEFARI – The Scottish Environment, Food and Agriculture Research Institutes

SEPA – Scottish Environment Protection Agency

SRUC – Scotland's Rural College

SUPER – Scottish Universities Partnership for Environmental Research

TIMES – The Integrated MARKAL-EFOM System for energy system modelling

UKCP18 – UK Climate Projections 2018

UKERC – UK Energy Research Centre

ULEV – Ultra-Low Emission Vehicle

## 1. Executive summary

In 2019-20 CXC has supported the Scottish Government as it stepped up its commitment to address climate change and ensure a just transition to a low-carbon economy. The key policies and initiatives for which we have delivered analysis and expert evidence include:

- The Climate Change Plan (CCP) – supported development of the plan's update including research into approaches taken elsewhere to develop national climate plans, agricultural mitigation options, transport and industrial decarbonisation, and public engagement and behaviour change.
- The Scottish Climate Change Adaptation Programme (SCCAP) – focused on monitoring and evaluation.
- Scotland's Energy Strategy - focused on heat decarbonisation, particularly around heat networks to inform the Heat Networks (Scotland) Bill, and supporting the implementation of Energy Efficient Scotland.
- COP25 and COP26 – supported engagement plans including organising and hosting events on wetlands and on managing carbon in Scotland to coincide with COP25, and a COP26 planning meeting with other Centres of Expertise (CoEs) and colleagues at The Scottish Environment, Food and Agriculture Research Institutes (SEFARI).

CXC research was also used by Scottish Government stakeholders, for example, in the Committee on Climate Change (CCC) 2019 Progress Report to the UK Parliament and in the World Wildlife Fund's Delivering Net Zero: Scottish Agriculture report.

During the year, addressing climate change assumed a greater urgency, moving up the policy agenda, both nationally and globally. The school strikes, led by Swedish teenager Greta Thunberg and replicated around the world, were a factor behind the Scottish Government's decision to call a climate emergency in April 2019. An influential CCC report, Net Zero: The UK's contribution to stopping global warming, recommended new targets for net zero greenhouse gas emissions of 2050 for the UK and of 2045 for Scotland, both of which were passed into law.

However, the UK policy context was also characterised by the challenges and uncertainty caused firstly by Brexit and its implications for climate policy and research, and latterly by the COVID-19 pandemic. The pandemic delayed both COP26 and the publication of an update to the CCP to reflect the new emissions targets. At the time of writing, CXC directors and staff were engaged in various discussions linked to supporting a "green recovery".

### Organisational changes

We have been continuing to work to a five-year plan agreed with RESAS in 2016, based on recurrent one-year funding awards. In light of the COVID-19 situation, in April 2020 the Scottish Government confirmed that the current programme would be extended by one year to 2022. In 2019-20, overall CXC resource was maintained for 2020-21.

Due to the pandemic, the secretariat transitioned to working remotely in March 2020, with relatively limited impact on our outputs to date. We have reviewed our ongoing research projects and assessed the potential impact of the crisis on their delivery. Projects requiring stakeholder engagement may experience some delays, as might finalisation of some reports.

We continue to work closely with the Scottish Government Climate Change Division, RESAS and the Office of the Chief Economic Advisor (OCEA) on the development of CXC's programme of research. The Climate Change Division has coordinated a process of research project prioritisation, informed by evolving policy requirements and discussed with members of the CXC Directorate and Secretariat. This provides the CXC Secretariat with solicited project requests early in the financial year, ensuring we are able to plan across the year and respond flexibly as required.

### **Directorate and staff changes**

Prof Dave Reay (Chair in Carbon Management and Education, School of Geosciences, University of Edinburgh) took up the role of Director of the Edinburgh Centre for Carbon Innovation (ECCI) on 1 February 2020. He remains as CXC Principal Investigator, and also assumes the role of CXC Policy Director, which had been undertaken on an interim basis by Dr Mark Winskel (an existing member of the CXC Directorate and Senior Lecturer in the School of Social and Political Science, University of Edinburgh) since January 2019.

Sarah Govan, has joined the CXC secretariat as Climate and Land Use Project Manager, having been on secondment from the Scottish Government since 2014. Virginia Marsh has taken up a short-term post as CXC Communications Officer. Michelagh O'Neill left CXC to take up a permanent position in the Scottish Government's Flood Risk Management team.

### **Mid-Programme Review**

We are continuing to develop and implement approaches in response to recommendations made in the Mid-Programme review. In response to a recommendation around improving the governance of project identification and prioritisation to improve transparency, engagement and influence for Scottish Government policy customers we have worked with the Scottish Government to develop and implement a new approach and this is now in the second year of operation.

Responding to a recommendation to share learning, best practice and collaboration between CoEs we have strengthened the co-ordination between CXC and the Centre of Expertise for Waters (CREW) around adaptation to climate change and water, organised a joint CoEs/SEFARI discussion around COP26, contributed to successful SEFARI Gateway Responsive Opportunity Fund initiatives and developed a CXC handbook.

In response to a recommendation to keep our range of partners under review and ensure we are well placed to bring in new expertise as required we have strengthened our engagement with the UK Energy Research Centre (UKERC) and the National Centre for Resilience (NCR), hosted discussions with the recently formed Centre for Research into Energy Demand Solutions (CREDS) and agreed to participate in a newly formed Transport Challenge Forum group established by the Energy Technology Partnership (ETP).

### **Longer term impacts**



The nature of CXC's knowledge exchange model means that the impacts of our work often takes some time to become evident. We spent time this year reflecting on this, and how we measure our impact beyond the annual reporting cycle. We produced the *CXC Measuring Impacts* paper, an internal document which summarises the metrics we record to report on: in-financial year activities via annual narrative and metric reports to Scottish Government (RESAS) and; CXC's longer term impact on policy development in Scotland.

We have also taken the step to apply a Digital Object Identifier (DOI) number to all CXC outputs to help with standardising archiving and attribution. It is our hope that this will aid us, and our research partners, in tracking the impact of the research produced by CXC.

## 2. Highlights

In 2019-20, providing information to support the development of the Climate Change Plan update has been a big focus of our work. This has included: providing updated estimates of practical cost-effectiveness for a selection of agricultural mitigation options, for use in the Scottish Government's Integrated MARKAL-EFOM System for energy system modelling (TIMES); a workshop on TIMES CGE (Computable General Equilibrium) modelling and; providing an update of the Scottish Electricity Dispatch Model (SEDM) that Scottish Government will use to support analysis for future iterations and updates of the Climate Change Plan and associated policy development. Our research in areas such as transport and industrial decarbonisation has also expanded in response to rising urgency around the need to address emissions from these sectors.

We have developed 40 projects, drawing on the expertise of research partners from SEFARI institutes, Higher Education Institutions (HEIs) and the private sector, to feed into these key climate change and energy policy developments.

We have also developed four new post-doctoral research fellow (PDRF) projects on: future mobility systems; carbon sequestration in permanent grassland, sustainable security of electricity supply and; Land Capability for Agriculture (LCA) – a new digital platform. Several of our PDRFs have been seconded to Scottish Government on a part-time basis over the year to help provide detailed and technical expertise to policy teams.

In addition to delivering this research and knowledge base, CXC has been invited to contribute to several strategic initiatives and programmes. CXC Programme Manager, Dan Barlow, is a member of the steering group for the Scottish Science Advisory Council decarbonising manufacturing project. He has worked closely with the Scottish Government's Chief Scientific Adviser for Environment, Natural Resources and Agriculture, Prof Andrew Miller, to support COP25 engagement plans, and was asked to host a BEIS workshop on the industrial decarbonisation fund.

Anne Marte Bergseng, CXC Knowledge Exchange Manager, sits on the steering group for the NCR and Project Manager, Sarah Govan, is a member of the Scottish Government's Agriculture and Climate Change Strategic Group

CXC has also responded to requests from the Scottish Government to organise and host highly relevant events such as an academic heat decarbonisation workshop with the Danish Government, and an event on wetlands to coincide with COP25.

CXC Policy Director, Dave Reay, was invited on to the Cabinet Secretary for Environment, Climate Change and Land Reform's Climate Change Plan group. Dave and CXC Director Deb Roberts, are also members of the Scottish Government's advisory panel for the future of rural policy in Scotland.

### Adaptation

We have continued to support development of the SCCAP, with particular focus on monitoring and evaluation. CXC has also delivered projects for Community Resilience, Flooding, Land Use, Agriculture and Forestry, with a particular focus on cross sector collaborations and policy action that considers both climate mitigation and adaptation.

Through our resilience work, we are increasing our reach, and focusing on cross-sector collaboration to tackle the climate emergency. In addition, we have further developed methodologies to assess flood risk and using climate projection in developing flexible adaptation pathways.

## Energy

CXC's energy research continues to support the implementation of policy such as Energy Efficient Scotland, as well as the update to the CCP and future policy development. Research topics around energy systems and energy efficiency continue to form a big part of our work, with heat decarbonisation becoming a big area of focus this year. Highlights include:

- Heat networks: CXC research is currently seeking to identify waste heat sources, not currently in use, which could be used in heat networks in Scotland. The research aims to characterise the heat sources and analyse its proximity to potential users. CXC has also been working on collating information from past district heating feasibility studies on heat sources, users, network routes, and extracting the most policy-relevant lessons.
- Decarbonisation of off-gas grid: CXC supported the Scottish and Danish Governments in bringing together academics and policy makers to discuss policy-relevant lessons from recent research on heat decarbonisation (gas) for off-gas grid residential buildings. As a result of workshop discussions, a forward research agenda on heat decarbonisation, aligned with policy priorities, was developed.
- CXC Policy Director, Mark Winskel, co-convened and co-chaired two panel sessions at the All Energy and Decarbonise conference in Glasgow in May 2019 on the challenges of meeting net zero.

## Transport

In the past year, CXC has established new working relationships within the Low Carbon Economy Directorate of Transport Scotland. As a result, our work in this area has grown and CXC Project Manager, Ciara O'Connor, was invited to join the Transport Challenge Forum, established by the ETP at the request of Scottish Government. Highlights in this area include:

- New research in future mobility systems: Through discussions with colleagues in Transport Scotland, research requests around public perceptions and attitudes towards shifting transport modes were packaged into a PDRF project on future mobility systems. This research got underway at the beginning of 2020 at the University of Leeds.
- Building evidence to support the transition to Ultra-low emission vehicle (ULEV) deployment in Scotland: In order to support the delivery of the Scottish Government's 2017 Programme for Government commitment to phase out the need for new petrol and diesel cars by 2032, CXC has commissioned research to explore the market for ULEVs in Scotland, the potential economic impact from such a transition, and what lessons can be gleaned from policy interventions made in other countries around ULEVs.

## **Climate change policy**

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 which amends the Climate Change (Scotland) Act 2009 and sets targets to reduce Scotland's emissions of all Greenhouse Gases (GHGs) to net zero by 2045 gained Royal Assent on the 31 October 2019. CXC Policy Director, Dave Reay, and Directorate member, Mark Winskel, gave evidence to the Scottish Parliament's ECCLR committee on the Bill.

CXC undertook research into approaches used by other countries and jurisdictions to develop national plans to implement climate mitigation commitments, in order to provide insight as the Scottish Government develops plans to meet these targets.

In addition, CXC has developed an evidence base around GHG removal technologies and their potential for use in Scotland, and a study of behaviours to support the Scottish Government's climate change public engagement strategy.

## **Agriculture**

CXC's agriculture research this year has focused on delivering the outcomes set out in the Climate Change Plan. Highlights include:

- **Facilitating discussions on Scottish agriculture systems change:** The CXC secretariat were asked by Scottish Government to organise and facilitate a workshop to start discussions on the potential for Scottish agricultural practices to change in response to climate change. Members of the Scottish Government's Agriculture and Climate Change Strategic Group and the Minister for Rural Affairs and Natural Environment attended.
- **Nitrogen accounting tools for agriculture:** In response to a request from Scottish Government, we explored the potential for on-farm accounting tools to help reduce GHG emissions in Scottish agriculture. We evaluated the strengths and weaknesses of different models, their practical potential for application to Scottish farm businesses, and their potential to support policy decisions.
- **Feasibility of establishing a manure/ slurry exchange in Scotland:** The CCP commits to exploring cost-effective options that will help to reduce emissions from agriculture. Working with the Scottish Government policy team, we examined the evidence for successful use of such exchanges in other countries, and considered how key factors might apply to Scottish circumstances.

## **Land use and land use change**

Our work in this area was directed by the proposals in the Climate Change Plan and the commitments made in the updated Climate Change (Scotland) Act. Highlights include:

- **Sustainable expansion of bioenergy crops and their implications for land use:** Following a request from the Scottish Government policy team, we explored a range of potential implications should there be an expansion of land use for the production of bioenergy crops. This will inform the development of an integrated approach to land use policy.
- **Access to peatland for restoration – physical limitations:** The Scottish Government has committed to a programme of peatland restoration in Scotland. This short project examined snow cover data against our understanding of access issues to

estimate the proportion of time in an average year that restoration would not be possible.

### **Communications and outreach**

In 2019/20 CXC published 17 reports, and continues to publish all research on the CXC website. The CXC publication library serves as a repository for the knowledge and evidence supporting policy which emerges from our research projects.

Members of the CXC secretariat continue to be sought out as facilitators for events and workshops, including a meeting for senior members of RESAS, and the Agriculture and Climate Change Strategic Group.

We have provided training to post-graduate students on communicating research as part of the Hydro Nation Scholars training programme, Marine Alliance for Science and Technology for Scotland (MASTS) and Scottish Universities Partnership for Environmental Research (SUPER) Doctoral Training Partnership. In addition, the secretariat leads on the organisation of “learning hours” at the Scottish Government, coordinating and shaping themes and topics of the most relevance for Government staff.

CXC has led the organisation of several events which have facilitated discussion around policy issues, served as a mechanism for research dissemination and to develop new research ideas which would support policy makers. We co-hosted with the Centre for Energy Policy (CEP) an energy conversation on decarbonising residential heat. The event was hosted at ECCI, the first time one of the energy conversations was held outside of the University of Strathclyde.

CXC supported the Scottish and Danish Governments in hosting an academic workshop on decarbonising heat in off-gas buildings. In addition, we co-hosted a workshop with UKERC to explore potential future UKERC evidence review topics, and hosted Prof Nick Eyre and members of the CREDS team at ECCI for discussions around potential future collaboration, and a public lecture on energy demand policy in a net zero UK.

Connecting to international climate change policy and research agendas, CXC hosted with the Scottish Government an event on Peat, soil and sea: Managing carbon in Scotland, to coincide with COP25 which was held in Madrid in December 2019. The CXC secretariat was also represented at the Scottish Government's COP26 stakeholder engagement event in Glasgow, February 2020 and members of the CXC secretariat presented at the European Climate Change Adaptation conference in Lisbon.

### **Working with SEFARI and other CoEs**

Engaging in quarterly meetings is one way that CXC continues to work closely with other CoEs and SEFARI Gateway. CXC and CREW jointly hosted an information stand at Scotland's Flood Risk Management Conference in January 2020. The CXC secretariat also organised, hosted and presented at a COP26 planning meeting with CoEs and SEFARI colleagues. In addition, members of the CXC secretariat were involved in an impact workshop organised by the Centre for Expertise on Animal Disease Outbreaks (EPIC) and supported the SAGES conference on Global Climate Challenges for a Blue Green Economy in November 2019.

### 3. ANNEX A: Summary of all projects

#### 3.1 Energy

In 2019-20, CXC's energy work continued to include a focus on heat decarbonisation, particularly around heat networks, with the Scottish Government publishing a Bill on heat networks in March 2020.

Our analysis in this area is supporting the update of the CCP and associated policy developments, and we continue to support the implementation of Energy Efficient Scotland (EES) with research being commissioned to explore lessons learned from the Local Heat and Energy Efficiency Strategies (LHEES) programme.

CXC's energy PDRFs continued work on: evaluating the EES pilots; reviewing the evidence around phase-out in the energy sector; soft-linking TIMES with economic models and; sustainable security of electricity supply. These PDRFs continue to work closely with policy leads in Scottish Government, with two post-holders taking up secondment opportunities at Scottish Government.

##### 3.1.1 Energy systems and policy

###### Commissioned Project – Principles for battery storage (Contact: Craig Frew, Stephen Corrie)

- This research was commissioned to provide an evidence base and inform energy policy development in Scotland, detailing the roles that grid-scale battery storage could play in providing a resilient, affordable electricity network over the period to 2030 and 2045.
- The draft report produced shows: (i) how batteries bring value to electricity systems, (ii) presents evidence on sustainability, environmental and safety issues associated with grid-scale battery storage projects and (iii) assesses key spatial criteria associated with the siting of grid-scale battery storage projects.

###### Commissioned Project – Electricity model development (Contact: Stephen Cox)

- The SEDM is a tool used by the Scottish Government to analyse the current and future GB electricity system, and the implications for Scotland.
- CXC was commissioned to provide an update of the SEDM that Scottish Government can use to support analysis for future iterations and updates of the Climate Change Plan and associated policy development.

###### PDRF Project – Energy Policy effectiveness (Contact: Gareth Fenney, Suzie LeMiere)

- For the past year, the post-holder has been working on part-time secondment to the Scottish Government, as part of the Heat and Energy Efficiency team.
- As part of this secondment, the post-holder has supported: Scottish Government analysis on heat technology assessment and; a consultation exercise on 'The Future of Low Carbon Heat in Off Gas Buildings' (2019).
- The post-holder was invited to present his research at the Scottish Retrofit Conference and the Northern Irish Heat Decarbonisation conference. The latter has

led to a developing relationship and ongoing research dissemination with the Northern Ireland Department of Economy.

- A project update, and draft evidence review of phase-out policy in the energy sector were submitted to the project advisory group for review in April 2020.
- A new evidence review and meeting of the project advisory group have been planned for autumn 2020.
- A previous review that was conducted as part of this research has been published as a journal paper in *Renewable and Sustainable Energy Reviews*.

PDRF Project – Energy system implications of a shift to more localised energy production (Contact: Simon Gill, Ragne Low, David Hawkey)

- This research was commissioned to provide quantification regarding the value of 'local' energy system provision in Scotland. The focus of current research activity is on how electricity networks will be impacted by electric heat uptake to strengthening the links between technical output and policy outcomes.
- The most recent reporting highlighted the nature of investment that may be required within electricity networks across Scotland to meet future needs of a decarbonised energy system.
- An [interactive toolkit](#) has been developed that enables government and academic stakeholders to model supply and demand characteristics under different local energy scenarios.
- The project has seen very good collaboration with a range of stakeholders, including local authorities, Distribution Network Operators (DNOs) and a number of teams within the Scottish Government to integrate whole system energy network thinking into the Scottish Government's flagship Local Energy Planning project LHEES.
- The post-holder, who is new to this project since 2020 is on part-time secondment to Scottish Government Whole System Energy Team.

### 3.1.2 Energy efficiency and heat

Commissioned Project – Identifying waste heat sources for heat networks in Scotland (Contact: David Hawkey)

- This research was commissioned by OCEA and the Scottish Government's heat planning and delivery team to identify potential usable sources of waste heat, which aren't currently being used in Scotland.
- An assessment of the heat source characteristics was also undertaken, as well as a mapping exercise to assess how realistically they could be used in district heating networks.
- The final report is expected to be published in June.

Commissioned Project – LHEES evaluation (Contact: Jack Causley)



- An evaluation commissioned to identify lessons from the 11 Phase 2 LHEES pilot projects in order to inform the future development of this programme.
- The evaluation focussed on the organisational and social aspects of the LHEES pilots, as well as a review of the reports and other outputs generated.
- A dissemination of draft findings with the project stakeholders is scheduled to take place in May 2020.

Commissioned Project – Mapping district heating feasibility studies in Scotland (Contact: David Hawkey, Andrew Walker)

- OCEA and the Scottish Government's heat planning and delivery team commissioned this research to help establish a database that can underpin a new layer in the Scottish heat map, showing areas for which district heating feasibility studies have been undertaken.
- The feasibility studies were analysed to extract lessons in why projects have not progressed or to identify success factors where projects have been developed. This will help targeting of further district heating support.
- The final report is expected to be published in June.

Commissioned Project – [Workshop on heat decarbonisation in off-gas buildings](#) (Contact: Ragne Low)

- Supported by CXC, the Scottish and Danish Governments brought together academic and policy communities to consider policy-relevant lessons from recent research on heat decarbonisation (gas) for off-gas grid residential buildings.
- Attendees explored deployment pathways and technology options available for decarbonisation of heat in buildings that are not currently gas-heated, as well as looking at scenario modelling, approaches to heat planning and the challenges of implementation at various scales. A forward research agenda on heat decarbonisation, aligned with policy priorities, was developed as a result of the workshop discussions.

PDRF Project – Evaluation of the Energy Efficient Scotland pathfinder pilots (Contact: Kathleen Robertson, Jack Causley)

- This research is evaluating the Phase 1, Phase 2 and Transition Programme stages of the Scottish Government's Energy Efficient Scotland programme.
- The post-holder has engaged closely with Scottish Government officials, local authority officials and staff from charities, third sector organisations and consultancies through the course of their research activities.
- A [report](#) on the social and organisational implications of delivering LHEES was published in September 2019. A Final Social Evaluation Report was also completed in 2020.
- The researcher responded to the Scottish Government's "Local Energy Policy Statement: A Consultation". and to the Scottish Government's "Energy Efficient Scotland – March 2019 Consultation"

PDRF Project – Energy system impacts of energy efficiency (Contact: Sasha Maguire)



- The post-holder was been working on TIMES electric vehicle analysis and soft-linking with economic models. This work has allowed collaboration with Scottish Power Energy Networks (SPEN) and other stakeholders such as Ofgem.
- As part of this research, the post-holder hosted a workshop on TIMES-CGE modelling with members of the Scottish Government modelling team and other international experts.
- Outputs from this research include a paper published in *Energy Policy*, a paper in its second round of review in *Energy Strategy Reviews* as well as policy briefs published on the [CEP website](#). A report on the challenges and next steps in the TIMES CGE soft-linking process has also been submitted to Scottish Government and CXC.

### 3.2 Transport

During 2019/20 there has been an increase in requests for research from Transport Scotland's low carbon economy directorate. A focus of this research has been on exploring the development of the ULEV market in Scotland.

Working with the same policy team, CXC has also developed a PDRF project to understand public perceptions, user needs, and approaches to support the uptake of future low carbon mobility systems in Scotland.

#### Commissioned Project – [Identifying international leading practice in relation to enabling ULEV uptake](#) (Contact: Neil Ferguson)

- The Transport Scotland Low Carbon Economy team commissioned this research to learn from the practice and experiences of countries with significant progress in enabling ULEV uptake, for application to support Scotland's transition to ULEVs.
- Seven international case studies were developed to explore the level of ULEV adoption that has been achieved and how this has been done. Examples of leading practice in supporting the adoption of ULEVs was then matched against a range of ULEV market segments that had been identified through a separate CXC study on [ULEV market segmentation in Scotland](#)

#### Commissioned Project – [Identifying the economic impact from ULEV uptake](#) (Contact: Neil Ferguson)

- A project aimed at stimulating ULEV uptake and realising economic opportunities from ULEV uptake, this research was commissioned to identify potential economic impacts and develop an impact evaluation framework to enable future monitoring and evaluation.
- The research was commissioned by Transport Scotland's Low Carbon Economy team and had a steering group which included representatives of Scottish Enterprise and Transport Scotland economists.
- A final report has been received and will be published after the CCP Update has been published. The latter has been delayed due to the COVID-19 crisis.

Commissioned Project – [Scottish ULEV market segmentation](#)<sup>1</sup> (Contact: Neil Ferguson)

- This research was commissioned by the Low Carbon Economy team in Transport Scotland, to support the transition to ULEVs that is required to meet the Scottish Government's pledge to phase out the need for new petrol and diesel cars and vans by 2032.
- The aims of the study were to: (i) identify the barriers that currently exist to ULEV uptake; (ii) segment Scottish car, van and HGV buyers by the specific barrier each one faces; (iii) make recommendations to overcome these barriers and maximise the economic opportunity for Scotland.
- The report makes a series of policy recommendations which may address the identified barriers to ULEV uptake which were identified.

PDRF Project – Future mobility systems (Contact: Neil Ferguson, Rebecca Campbell)

- This research aims to increase understanding of public perceptions, user needs, and approaches to support the uptake of future low carbon mobility systems in Scotland, with a particular focus on ULEVs, Mobility as a Service (MaaS) and Connected Autonomous Vehicles (CAVs).
- This research grant was awarded to the University of Leeds with a PDRF being appointed February 2020. The post-holder attended a meeting for CXC PDRFs in March 2020 and a formal kick-off meeting between the post-holder, principal investigator and Transport Scotland took place in April 2020.
- It was agreed at this meeting that the research will incorporate lessons from the ongoing COVID-19 crisis. The principal investigator and post-holder have developed a research options paper for discussion with Transport Scotland in May 2020.

### 3.3 Agriculture

Agriculture accounts for the second largest proportion of GHG emissions in Scotland, and CXC's research has been focused on supporting the delivery of the outcomes set out in the CCP.

Workshop - [The Agriculture and Climate Change Strategic Group](#) (Contact: Keith McWhinnie)

- CXC were asked to facilitate a workshop to initiate a conversation around the potential for systems change in Scottish agriculture, in response to a changing climate, and based on the current science.

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<sup>1</sup> i.e. dividing the market into groups, or segments, based on different characteristics

- A note of the meeting has been prepared and will be published in due course.

Commissioned Work – [Comparative analysis of nitrogen accounting models with particular reference to agriculture](#) (Contact: Keith McWhinnie)

- This project compared nitrogen accounting tools to assess their potential application in Scottish agriculture, as a method for reducing GHG emissions from the use of fertilisers, livestock manures and other organic materials
- The report was focused on input-output models, and considered their strengths and weaknesses, their potential for application to Scottish farm businesses, and in supporting policy decisions.

Commissioned Work – Land use impacts of perennial energy crops in Scotland (Contact: Craig Frew, Lorna Orr)

- This report examines the potential for the sustainable expansion of perennial bioenergy crop production on low grade agricultural land or underutilised land. It focuses specifically on short rotation coppice, miscanthus and short rotation forestry with particular reference to Scotland.
- Publication is expected in May 2020.

Commissioned Work – Feasibility study for the establishment of a slurry and manure exchange in Scotland (Contact: Keith McWhinnie)

- One option for the reduction of GHG emissions from Scottish agriculture is the establishment of manure/ slurry exchanges in Scotland. This research assessed the current state of confident knowledge and examines feasibility for deployment in Scotland.
- Publication of the report is expected in May 2020.

Programmed Work – Efficacy of nitrogen inhibitors and urease (Contact: Keith McWhinnie)

- This research examined the value of nitrification inhibitors to reduce the GHG emissions in the use of fertilisers. It reviews the current state of knowledge and considers the potential to support emission reductions under Scottish circumstances and conditions, such as soils, crops, rainfall and temperature.
- Publication of the report is expected in May 2020.

Programmed Work – Soil carbon concentration (Contact: Keith McWhinnie)

- One practical method for minimising GHG emissions from agriculture is for a land manager to easily understand the carbon content in the topsoil. This project developed a free and easy-to-use tool to compare topsoil carbon content with typical values in the National Soil Map of Scotland.

- The app is currently being tested and is expected to be made publicly available in May 2020.

Programmed Work – Alternative Marginal Abatement Cost Curve (MACC) (Contact: Keith McWhinnie, Andrew Mortimer)

- Building on the new Smart Inventory for [agriculture](#), this project developed updated estimates of practical cost-effectiveness for a selection of agricultural mitigation options, for use in the Scottish Government TIMES energy systems model.
- These estimates have been applied to the model runs, and publication of a report of the method and key results is expected in May 2020.

PDRF Project – Carbon sequestration in permanent grassland (Contact: Kim Gallacher)

- This two-year research project was commissioned in December 2019. It will identify the opportunities that might be found in the management of long-term managed grassland for GHG mitigation and carbon sequestration and is intended to inform the development of Scottish Government policy.

PDRF Project – Land Capability for Agriculture (LCA) – new digital platform (Contact: Keith McWhinnie)

- This two-year project will transfer the existing LCA tool to a digital platform.
- It will combine the underlying datasets (many of which are now digital) with knowledge and experience that is embedded within the map base, allowing the integration of the LCA with other spatial datasets.
- The primary aim is to use the platform to apply the Met Office's UK Climate Projections 2018 (UKCP18) climate change projections to estimate the potential change in climate constraints. It will not generate an update, but result in a more interactive version of the existing LCA.
- Completion is expected in July 2021.

### 3.4 Forestry

The CXC Forestry input in 2019-20 was concentrated around the woodland expansion targets, along with the continuing programme of adaptive forest management.

Programmed Work – Analysis of land suitability for woodland creation (Contact: Amy Nicholson, Helen Sellars)

- This project involved an initial re-analysis of the opportunities and constraints for woodland expansion in Scotland, building on the original study conducted by the Woodland Expansion Advisory Group in 2011.

- The key difference was the inclusion of prime agricultural land in the first step of assessment, and the use of updated spatial data for peat.
- Publication is expected shortly.

#### PDRF Project – Adaptive forest management (Contact: Amy Nicholson)

- Work on interpreting and applying latest climate change projections for use in forest adaptation models is ongoing.
- Project work underway to model wind risk to individual trees across Queen Elizabeth Forest Park, Aberfoyle based on LiDAR remote sensing, airflow modelling and ForestGALES decision support.
- Contributed to CXC “Briefing – Comparing Woodland Creation and Peatland Restoration as GHG abatement measures” for Scottish Government with JHI colleagues.
- CXC report “Diversifying conifers in productive forests: stakeholders’ perspectives” finalised and is expected to be published in May 2020.

### **3.5 Peatlands and soils**

Sustainable peatland and soil management continue to be a priority. Working across several teams in Scottish Government, we have focused attention on the detail, as well as the processes, for monitoring success and prioritising action.

#### Programmed Work – Peatland monitoring framework (Contact: Heather McCabe)

- Following on from the workshop in 2018, a scoping paper has been prepared that explores the potential for a peatland monitoring framework in Scotland and identifies the policy context and existing protocols on which to build.
- The report is due for submission to the Peatland Research and Monitoring Group in May 2020.

#### Programmed Work – Scotland's soils and climate change – assessing their vulnerability (Contact: Tom Russon, Heather McCabe)

- This research addresses a concern over the limited understanding of the vulnerability of Scotland's soils in the face of a changing climate. It also pulls together a list of potential indicators to inform further discussion on a suitable course of action.
- The report is currently in draft form and is expected to be published by the end of May 2020.

#### Programmed Work – [Access to peatland for restoration](#) (Contact: Helen Duncan)

- This short project used existing data on proxies of snow cover and degree of difficulty for access, to estimate the proportion of time in an average year that restoration would not be possible.

- Results suggest that, nationally, during periods of between 2 to 100 days per year, physical conditions could make sites physically inaccessible for carrying out peatland restoration, varying depending on location.

### 3.6 Adaptation

Through our adaptation research, we continue to support the development of the SCCAP and have used climate projections to develop flexible adaptation pathways. We have further developed methodologies around flood risk identification, and have brought a focus on cross sectoral collaboration.

#### Commissioned Project – [Encouraging collaboration across policy domains](#) (Contact: Ralph Throp)

- Community resilience and climate policy has the potential to be complimentary and mutually beneficial. However, there has been limited attention from both research and practice on how to capitalise on the opportunities such synergies provide for achieving more effective outcomes, and on how they can be maximised through policy development and implementation processes.
- This review identifies critical factors in creating a culture for deeper collaboration, and how this could be implemented in the Scottish Government.

#### Commissioned Project – [Delivering social care in a changing climate](#) (Contact: Sindra Jung (took over from Lorraine Gormley))

- Case study research to look at how providers of social care at home in Scotland respond to extreme weather events.
- Considers dimensions of how the sector is planning for, dealing with and learning from extreme weather covering high/low temperature, flooding, heavy snow and storms.
- The report will identify strengths and weaknesses in current planning and practice and make recommendations for national guidance to encourage improvements. It is expected to be published in May 2020.

#### Commissioned Project – [Property flood resilience – baseline study](#) (Contact: Debi Garft)

- A study to understand how many properties in Scotland might benefit from property flood resilience and what the current level of uptake is.
- The study will provide a baseline for the further work by the Flood Resilience Delivery Group, based on the Living with Flooding action plan.
- The report is expected to be published in May 2020.

#### Commissioned Project – [Measuring recovery from the extreme weather events](#) (Contact: Ralph Throp)

- A study to understand methods and data sources to assess recovery from extreme weather events based on recommendations made by the Adaptation Committee of the Committee on Climate Change in their assessments of the SCCAP.

- The study assesses international recovery monitoring frameworks for suitability in Scotland.
- Recommendations will consider Scottish datasets for a framework to cover the key monitoring categories in the international examples.
- A final report has been received and will be published once signed off by the steering group, who are experiencing a reduction in capacity due to the COVID-19 crisis.

Programmed Work – [Snow cover and climate change in the Cairngorms National Park](#)  
(Contact: Grant Moir)

- Snow cover is a key aspect of what defines the character of the Cairngorms National Park. This research used historic data to identify how temperature affects snow days and applied modelling techniques to identify some possible trends for the Cairngorms National Park.
- The report formed part of the Cairngorm National Park Authority's Board paper '[Net Zero With Nature](#)', and was discussed at their meeting in December 2019.

PDRF Project – Adaptation Science (Contact: Tom Russon)

- The research fellow has worked closely with the team developing the second SCCAP to identify principles for a monitoring and evaluation (M&E) methodology informed by current research and best practice.
- To support the SCCAP outcomes the report sets out six principles which are adopted in the programme.
- The project also identified potential indicators and how these could be used to populate a monitoring framework.
- This work was delivered in June 2019 and [published](#) in September 2019.

### 3.7 Behavioural and social change

Our work in this area this year has included a review of approaches for engaging the public on climate change and how categorising the public by their attitudes and behaviour could inform a public engagement strategy on climate change.

Programmed Work – [Climate Challenge Fund \(CCF\): three-year study of behaviour change outcomes](#) (Contact: Stewart Mathieson)

- This three-year action research project has examined the role of CCF community projects in supporting a transition to a low carbon economy in Scotland.
- Using five case studies, it has examined the success within specific projects and the potential to improve impact at the community level.
- A final report is expected in May 2020.



Commissioned Project – [Climate change behaviours segmentation study](#) (Richard Dryburgh, Emily Creamer)

- This research identified and evaluated different approaches to grouping, categorising or segmenting the public according to their attitudes and behaviours related to climate change. It also reviewed the dominant ideas on how to change behaviour.
- The findings will inform a review of the Scottish Government's climate change public engagement strategy.

Commissioned Project – Understanding and engaging the public on climate change (Contact: Emily Creamer, Richard Dryburgh)

- This review of the recent evidence and approaches used to engage the public on climate change will inform further development of the Scottish Government's approach to public engagement.
- It is expected to be published in June 2020.

### 3.8 General – climate policy

Over the year we have delivered projects in several other climate policy areas. This includes work to assess approaches used to develop climate plans elsewhere and a project to review the applicability in Scotland of potential approaches to remove GHG emissions from the atmosphere.

Commissioned Project – [A landscaping review of approaches used to develop national plans to implement climate mitigation commitments](#) (Contact: Sara Grainger, Eleanor McGhie)

- This study examined GHG emission reductions plans for 16 jurisdictions, comparing and contrasting how they are developed and monitored. The jurisdictions were selected based on criteria including the level of ambition in their climate policies, modelling approaches, sub-national links and innovative approaches taken.
- The research was commissioned to provide insight as the Scottish Government develops plans to meet its own targets.

Commissioned Project – [Greenhouse gas removal technologies](#) (Contact: Tom Russon)

- This research was commissioned to develop an evidence base on potential Scotland-specific issues and implementation pathways for emergent greenhouse gas removal (GGR) technologies.
- Short non-technical summaries, aimed at policy makers, were produced to describe: (i) biochar; (ii) soil carbon sequestration; (iii) enhanced terrestrial weathering; (iv) bioenergy with carbon capture and storage (BECCS); (v) direct air capture combined with CCS (DACCS). A review of each technology was also completed to explore readiness and potential implementation pathways in Scotland.



Commissioned Project – GHG emissions and infrastructure investment decisions Contact:  
Kat White, Sasha Maguire

- This report looked at approaches the Scottish Government could use to assess and report on the alignment between its infrastructure investment plan and Scotland's GHG emissions reduction ambitions.
- Based on a review of emerging global best practice and interviews with key Scottish Government and international stakeholders the report identifies four different types of assessment approach, which each give different information and are appropriate for answering different questions
- The draft report sets out where, and how, these could be applied to assess and report on the implications of infrastructure development decisions on GHG emissions.

### **3.9 Industrial decarbonisation**

Commissioned Project – Promoting project progression: creating a pipeline for industrial decarbonisation in Scotland (Contact: Stuart Watson)

- This research was commissioned by the energy industries division of Scottish Government to improve their knowledge of industrial decarbonisation and energy efficiency projects currently under development in Scotland. This information will help Scottish Government to coordinate industrial decarbonisation projects in accessing existing or pending sources of funding.
- Steering group members include stakeholder from Scottish Enterprise, Scottish Futures Trust, Scottish Local Authorities Economic Development Group and the Scottish Government's Economic Development Directorate.
- The final report is expected to be published in May 2020.