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Climate change and Scottish businesses – scoping likely direct and indirect impacts, and the sector's awareness, approaches and risk assessment procedures

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1 The need for research on climate change risk to businesses in Scotland

The exposure of Scottish businesses to climate hazards and their ability to respond and recover is not well understood. Consequently, the risk to the Scottish economy is unknown. This gap in knowledge limits our ability to develop climate, business and economic policies to address that risk. This is particularly relevant in developing the second Scottish Climate Change Adaptation Programme (SCCAP2). The absence of either policy or proposal in this area in the first SCCAP (2014) was one of the key areas for action identified by the Committee on Climate Change in their independent assessment of the Programme in 2016.

This research has been undertaken to develop a method to create the evidence base required to inform policy-making in order to reduce risk. Risk is a function of likelihood, hazard, vulnerability, exposure and value. The method will focus on improving our understanding of *exposure* and the implications that exposure has on *value*, i.e. its economic impact. It sets out a process to identify:

- The number of businesses in each of the six key sectors identified in the Scottish Economic Strategy that are at risk of flooding (pluvial, fluvial, coastal) for climate related return periods: high risk (30 years) and medium risk (200 years).
- The number of businesses in each sector at risk of coastal erosion now (2018), mid-century (2050) and later (2050^{+}).
- An estimate of the direct and indirect damages that could be anticipated in each of these scenarios.
- An estimate of the preparedness of businesses to respond to and recover from these threats

While responsibility for the actions needed to address this risk will be identified by SCCAP2, candidate indicators for monitoring progress might include:

1. Improvement in preparedness to respond to and recover from climate hazards, measured on a maturity scale.
2. The corresponding reduction in exposure of Scottish businesses to climate hazards as a result of improved preparedness, perhaps using estimates of direct and indirect damages as a proxy.
3. The reduction in the exposure of infrastructure as a result of protection and resilience measures implemented and/or the corresponding increase in spend.

The development of the suggested method is iterative, synthesising new evidence as it becomes available, and learning from the insights presented through the analysis it makes possible. In its first iteration the method will focus on the risk presented by just two climate hazards - flooding and coastal

erosion - to businesses operating in the six growth sectors identified in the Scottish Economic Strategy (2015) - creative industries, finance and business services, food and drink, sustainable tourism, and energy. This also recognises the need to contribute to the development of SCCAP2, which is currently scheduled to be published in Q2 2019.

The method extends the current work of SEPA (2nd National Flood Risk Assessment (NFRA2), 2018) and Dynamic Coast (2nd National Coastal Change Assessment (Dynamic Coast: NCCA2), 2019), providing an integrated assessment that further strengthens the evidence base.

The Scottish Government (Energy & Climate Change Directorate and the industry sector teams), SEPA, CREW and CXC will need to collaborate to deliver the method. This collaboration also responds to the systems framing of risk recommended by the Adaptation Sub-Committee in their independent assessment of the SCCAP (2016).

The method itself is in two parts: understanding the exposure of Scottish businesses to climate related hazards and understanding their preparedness to respond to them and recover from their impact.

2 Understanding exposure

The first part is secondary, desk-based research. It will consider the extent to which a business's location (by sector) exposes it to two identified climate hazards: flooding and coastal erosion, and the corresponding distributional impacts that these hazards may have on the economy.

2.1 Identified datasets

- **Flooding:** Ordnance Survey MasterMaps (Topography Layer [Buildings Theme], Sites, GreenSpace Layer); Ordnance Survey AddressBase Plus; NFRA2 (SEPA Property Dataset (2018), SEPA PVA (2018))
- **Coastal Erosion:** Ordnance Survey Six-inch County Series 2nd Edition (1898-1904); Ordnance Survey National Grid; CREW Future Coast; Historic Environment Scotland Land-use Assessment
- **Business Locations:** ONS Inter-Departmental Business Register (IDBR) / Business Structure Database (BSD) segmented for companies operating in the six growth sectors of the Scottish economy.

  This segmentation will require Standard Industry Classification (SIC) codes to be mapped to each growth sector using the definitions provided by Scottish Government.

2.2 Spatial intersection of datasets

- ArcGIS will be used to map business location point data to building/facilities polygons in the SEPA Property Dataset, using the spatial relations defined in the OS Spatial Relations ontology. This will extrapolate the IDBR/BSD point data to the actual buildings/facilities used.
- A similar method will be used to identify those buildings/facilities potentially at risk of flooding for different return periods based on the proximity of the business-relevant polygons to SEPA flood extents.
- The same method will be used to identify those buildings/facilities potentially at risk of coastal erosion (2018, 2050, 2050^{+}) using CREW coastal cells.
- The extent of exposure for each of the growth sectors can be determined by aggregating the buildings/facilities at risk for each sector.

We suggest a small number of indicators to monitor progress in reducing exposure both to the businesses themselves and the infrastructure on which they rely. Existing ClimateXChange recommendations on monitoring and evaluation for adaptation should be followed.

The baseline for exposure and the equivalent direct and indirect damages should be established in advance of SCCAP2.

2.3 Baseline of exposure

- Number of businesses at risk of flooding by (growth) sector for climate related return periods: 30-year (30CC) and 200-year (200CC).
- Number of businesses at risk of erosion of the soft coast 2018, 2050, 2050^{+}

The potential damages arising from those impacts will be evaluated following the approach used in the second National Flood Risk Assessment (NFRA2), which uses datasets and algorithms from the Flood Hazard Research Centre's (FHRC) Multi-Coloured Manual. Both direct losses resulting from damage to property plant and equipment, and indirect losses associated with the loss of (industrial) production are included, together with indirect damages arising as a result of the loss of (access to) infrastructure services.

2.4 Economic impact

- Direct damages relate to damage to property, plant and equipment. They are calculated from the product of the floor area of buildings/facilities and the depth/damage data for different classes of building/facility, so-called 'bulk' categories.
- NRP categories include: retail, offices, warehouses, leisure, public buildings and industrial sites; together with playing fields, sports centres, marina, sports stadia, car parks and substations.
- Indirect damages cover the loss of production processes and disruption caused by different types of infrastructure failure; there are 8 'sub-sectors' defined. The damages for each are calculated from sub-sector specific data that has been captured by the FHRC over the last 40 years.
- NFRA2 estimates cover disruption to road, rail, water and wastewater treatment infrastructure.[1]

2.5 Baseline of direct and indirect damages

- Estimate of total ***direct*** damages for each (growth) sector for different climate related return periods: 30-year and 200-year.
- Estimate of total ***direct*** damages for each growth sector as a result of coastal erosion (2018, 2050, 2050^{+})
- Estimate of total ***indirect*** damages for each growth sector for different for different climate related return periods: 30-year and 200-year.
- Estimate of total ***indirect*** damages for each growth sector as a result of coastal erosion (2018, 2050, 2050^{+})

2.6 Monitoring

Monitoring of progress will need to be cognisant of both the actual change in climate and the implementation of resilience measures (Flood Risk Management Plans and Shoreline Management Plans) in attributing progress to business preparedness actions.

Two candidate indicators covering business and infrastructure exposure include:

[1] The draft NFRA2 property also includes an assessment of indirect damages associated with health and evacuation. It is not yet clear whether these will be populated in the final dataset.

1. *Reduction in the exposure of Scottish businesses to risks from (pluvial, fluvial and coastal) flooding and coastal erosion as a result of improved preparedness* monitored through:
   - estimates of direct and indirect damages
   - reductions in insurance claims data, recognising that gaining access to insurance data is far from straightforward.
   - reductions in the number of days for businesses to recover (business activity restarting), data potentially available from Local Authorities.
   - increase in the application of BCM across the supply chain (ISO22301) which could be determined through the preparedness surveys.
     Segmentation by (growth) sector and Local Authority would provide additional detail that could inform the targeting of policy.

   Additionally, a refresh of the baseline could be aligned with the 6-yearly refresh of the National Flood Risk Assessment.

2. *Reduction in the exposure of infrastructure*: improvement in infrastructure protection and resilience measures and/or increase in spend.

   Data could be derived from Public Bodies Duties reporting for devolved powers, including transport, and Adaptation Reporting Power for reserved powers, including electricity and gas generators and distributors, national rail and airports.

   Public Bodies Duties reporting is currently administered by SNIFFER[2] and Adaptation Reporting Power by DEFRA.[3]

   Additional detail may be available through Lead Authorities in the context of their implementation of Flood Risk Management Plans (schemes), validating the assessments of uptake of resilience measures outlined in (i) above.

   Developing and maintaining this indicator may be more challenging, and costly, than the others.

3 Understanding preparedness

The second part of the method is primary research that will canvass businesses to understand their preparedness to respond to and recover from the impact of climate related hazards. It will be informed by the results of the first phase. The approach is based on a survey/questionnaire. The depth of enquiry will need to consider the burden the survey will impose on businesses in responding as well as the cost of analysing of those responses.

For this reason a relatively simple survey is preferred, recognising that more detailed analysis may require additional information from specific target groups.

3.1 Survey design

- The survey design is based on the findings from earlier academic and industry studies. An assessment of preparedness will be based on an 8-level maturity scale. This allows tick box responses, limiting both the burden of responding and cost of analysis
- Additional questions will be added to cover the data collection required to populate the Action Indicators that will be used in monitoring progress.
- The survey should ensure that it includes a statistically significant proportion of businesses exposed to climate-related hazards, as determined by the exposure assessment.

[2] Sustainable Scotland Network: www.sniffer.org.uk/sustainable-scotland-network
[3] Adaptation Reporting Power 2nd Round www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports and Plans for the 3rd Round are in development consult.defra.gov.uk/environmental-quality/adaptation-reporting

- The results of the analysis should deliver a confidence level of at least 95%. There are 80,660 businesses operating across the six growth sectors. A sample population of between 560 (±10%) and 2,082 (±5%) businesses will therefore be required, representing between 0.7% and 2.6% of businesses overall, although these rates vary within sectors.

3.2 Business engagement

Business engagement has proved challenging in the past; some recommendations are made on developing an engagement strategy, informed by academic and professional studies undertaken previously.

- To reach this audience support will be required from the Scottish Government sector teams, the professional and trade associations for the key sectors, Scottish Enterprise, Federation of Small Businesses, CBI, Scottish Chambers of Commerce, etc.
- Findings from industry studies of Business Continuity Management may be useful in raising awareness of the benefits of preparedness for extreme weather events

3.3 Baseline

A baseline of preparedness should be decoupled from the exposure baseline. This baseline should be established as early as possible in the lifecycle of SCCAP2, ideally within the first year in order to inform the first annual progress report. It will benefit from the improved understanding provided by the exposure baseline, particularly in informing and targeting businesses at risk. Existing ClimateXChange recommendations on monitoring and evaluation for adaptation should be followed.

The preparedness baseline would provide a simple assessment of maturity by sector based on the analysis of the initial survey. Some additional analysis could be provided on distributional differences using other IDBR business characteristics (employment, turnover, etc.)

3.4 Monitoring

A single indicator covering protection and resilience measures

- *Improvement in preparedness*

  A frequency distribution of maturity, segmented by (growth) sector and Local Authority would provide an indicator of progress against the desired outcome of increasing business resilience.

  An assessment of the uptake of protection measures (individual company activity), both planned and implemented.

  Changes in the number of businesses included in the boundaries of Flood Risk Management / Shoreline Management Plans/schemes (resilience measures). This would also contribute to the evidence base for *evaluating* policy in those areas.

A complete description of the method and the related work that informed its development will be available at https://www.climatexchange.org.uk/research/projects/measuring-the-resilience-of-scottish-businesses/