climateXchange

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

A monitoring and evaluation framework for the second SCCAP

Anna Moss, University of Dundee

June, 2019

Summary

The Adaptation Committee, in their final assessment of Scotland's first Climate Change Adaptation Programme (SCCAP)[1], identified five high level recommendations for the Scottish Government in preparing the second SCCAP. These included the need to

- *Introduce an effective monitoring regime, to allow the impact of actions and delivery of each objective to be properly assessed.*

This report outlines principles for developing a monitoring and evaluation (M&E) methodology informed by current research and best practice. It responds to the requirements of the outcomes-based approach planned for the second SCCAP. The report is structured around the advice requested by Scottish Government on:

- Development of a measurable, outcomes-based, programme structure
- Addressing risks within an outcomes-based approach
- Integrating M&E within the programme structure
- Identifying potential indicators to populate the M&E framework

Monitoring and Evaluation Principles

Scotland's Climate Change Plan (2018-2032) sets out six principles for the design and development of its associated monitoring framework[2]. ClimateXChange (CXC) were asked to draft a similar set of principles for a new SCCAP M&E framework.

These draw on the research and recommendations from the CXC reports *Developing adaptation monitoring and evaluation in Scotland*[3] (Moss 2017) and *Integrating monitoring and evaluation in the Scottish Climate Change Adaptation Programme*[4] (Moss 2018).

---

[1] https://www.theccc.org.uk/publication/final-assessment-of-scotlands-first-climate-change-adaptation-programme/

[2] https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/

[3] https://www.climatexchange.org.uk/media/1938/developing_adaptation_monitoring_and_evaluation_in_scotland.pdf

[4] https://www.climatexchange.org.uk/media/3139/integrating-monitoring-and-evaluation-in-sccap2.pdf

1) How M&E would work once operational was not an intrinsic part of the process to develop the first SCCAP. As a result the system was not entirely fit for purpose, as highlighted by the independent assessment by the Adaptation Committee of the Committee on Climate Change (Moss 2017).

   ***PRINCIPLE 1**: Indicators to measure progress will be considered at the same time that planned outcomes are identified. This will encourage the development of measurable objectives to enable:*

   - *external evaluation of progress*
   - *internal evaluation of delivery and progress*
   - *timely changes to the programme in response*

2) Adaptive management requires the ability to check that policies and interventions are on track. This makes process monitoring essential. By demonstrating that an action has been taken or a stage of implementation reached, process indicators support accountability in the short term. In addition, given that climate changes unfold over a long timeframe, beyond usual programme cycles, process indicators can also monitor effort towards achieving longer-term aims (Moss 2017).

   ***PRINCIPLE 2**: The adaptation process will be monitored to assess whether the programme actions are taking place and that policies and interventions are on track. Process indicators support accountability in the short term, but also monitor the implementation of actions which are aimed at achieving long-term outcomes outwith the usual programme timeframes.*

3) Reporting for the first SCCAP was largely based on qualitative information and largely in the form of listing process and actions that have occurred against each policy/proposal (Moss 2017). To evaluate the effectiveness of the Programme in delivering progress, it is essential that we can clarify the links between the adaptation process and outcomes (Moss 2018).

   ***PRINCIPLE 3**: The framework will link the adaptation process to adaptation outcomes and aims to discourage the listing of policies and actions without considering their potential effectiveness.*

4) The Adaptation Committee highlighted the difficulty in assessing progress within the first SCCAP due to the lack of clear, measurable objectives and identification of associated milestones and targets. Terminology against which evaluation occurs, is often very open-ended e.g. 'Increase awareness…', 'Improve understanding…'; 'Publish resources…', without clearly identifying what achievement against these terms means (Moss 2018).

   ***PRINCIPLE 4**: The identification of outcome and process milestones will be encouraged to assess interim progress. Routinely identifying milestones and targets, specifying a timetable and considering potential effectiveness, will aid the reporting process and enable the delivery of flexible adaptation strategies*.

5) To encourage mainstreaming of adaptation, adaptation M&E needs to be integrated into and/or utilise existing M&E structures where relevant and practical. Connecting with existing processes can also facilitate ownership, reduce costs and encourage future use (Moss 2017)

***PRINCIPLE 5**: Existing indicators and monitoring frameworks will be utilised where appropriate. This will facilitate integration of adaptation across other policy areas, help to align M&E mechanisms and minimise duplication of reporting effort.*

6) Indicators should not be entirely 'data driven'. The monitoring framework should ensure that gaps are clearly highlighted and the data need and ambition of the monitoring framework is apparent (Moss 2017).

***PRINCIPLE 6**: Improvement and learning underpins the framework- by identifying what we need to measure not just what we know we can, the framework can be used as a tool to highlight monitoring gaps which could be filled by future adaptation measures.*

Contents

1 Developing a measurable, outcomes-based, programme structure

In contrast to the risk-based approach of the previous SCCAP, the aim for the second Programme is to construct an outcomes-based approach, which aligns with both the UN Sustainable Development Goals[5] and Scotland's own National Performance Framework[6] .

An outcomes-based approach should not only provide clarity regarding what we expect to achieve and how we expect to achieve it, but also set out how we will know whether we are achieving it. The ability to systematically quantify adaptation progress is a central strength of a properly implemented outcomes approach and is increasingly being used at both national and international levels (Ford et al 2013; Klostermann et al 2018). For example:

- International climate funds and development strategy (USAID Climate Change and Development Strategy[7]; The Adaptation Fund established by the Parties to the UN Framework Convention on Climate Change[8])
- National-level assessment of adaptation (WRI's National Adaptive Capacity Framework[9])
- Community-based adaptation (CARE Community-based adaptation toolkit[10])

Outcome-based approaches are also increasingly being applied in the Scottish context. For example:

- National Health and Wellbeing Outcomes[11]
- Monitoring the outcomes of planning: a research study commissioned by Scottish Government[12]

The outcome based approach to monitoring and evaluation can provide a solid framework for strategic planning and management as it sets out to improve learning and accountability by linking the adaptation process to the outcome via a results or logical framework, or a 'Theory of Change' model (Bours et al 2014; Brooks & Rowley 2015; STAP 2017; Klostermann et al 2018; C40 Cities 2019), and would provide a robust approach for the development of the SCCAP.

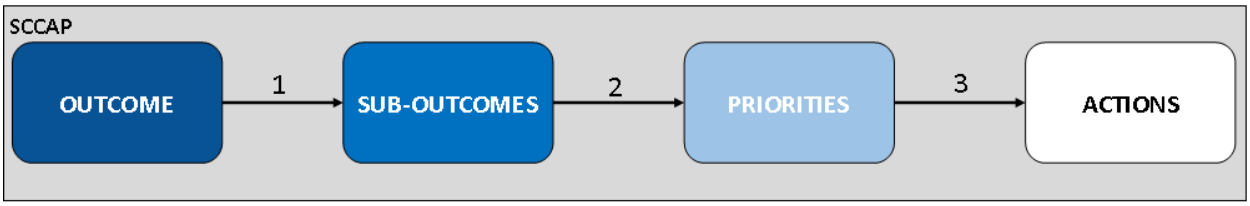
This approach maps backwards from the high-level outcomes to identify the steps needed to achieve it, thereby establishing a causal pathway from actions on the ground. Monitoring is associated with all levels of the downward cascade. This ensures that there is a traceable pathway which connects the monitoring of actions ('are we doing what we agreed to do?') with the monitoring of outcomes ('are we achieving our goals?') and therefore would allow

---

[5] https://nationalperformance.gov.scot/sustainable-development-goals
[6] https://nationalperformance.gov.scot
[7] https://www.climatelinks.org/sites/default/files/asset/document/GCC%20Adaptation%20RF%20w%20narrative%20030713.pdf
[8] http://www.adaptation-fund.org/wp-content/uploads/2015/01/Results%20Framework%20and%20Baseline%20Guidance%20final%20compressed.pdf
[9] https://wriorg.s3.amazonaws.com/s3fs-public/pdf/ready_or_not.pdf
[10] https://careclimatechange.org/wp-content/uploads/2015/04/CBA_Framework.pdf
[11] https://www2.gov.scot/Topics/Health/Policy/Health-Social-Care-Integration/National-Health-WellbeingOutcomes
[12] https://www.gov.scot/publications/monitoring-outcomes-planing-research-study/

us to evaluate the contribution of the Programme's measures (policies and actions) towards the Programme's outcomes (Principle 3). The resulting framework measures, and can respond to, the results being achieved- with monitoring enabling our actions to be responsive and flexible (Principles 1 & 4).

Figure 1 sets out the key questions that need to be answered to form a coherent framework and ensure that the Programme clearly articulates what the key levers of change will be and where effort should be focussed.



1. What are the necessary pre-conditions (building blocks) that must be achieved before the long-term outcome can be reached?
2. What are the priority areas for each sub-outcome where attention should be focussed?
3. What do we need to do? What are the policies and actions that are required?

Figure 1 The central components and steps in establishing an outcomes-based adaptation programme

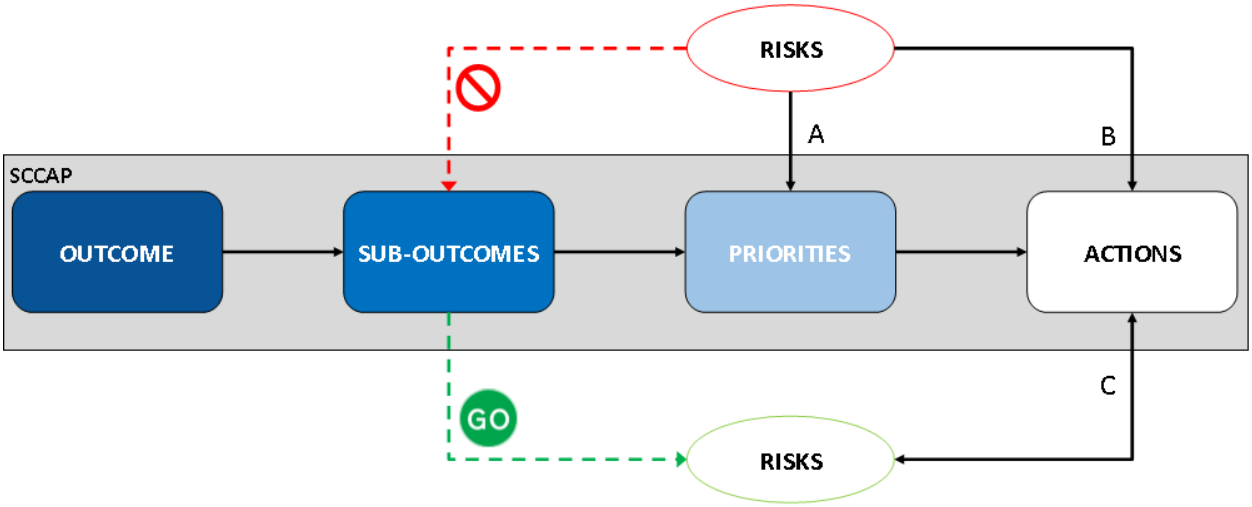
The supporting sub-outcomes, by setting out the key elements or pre-conditions of the outcomes, should therefore clarify what it really means to be 'resilient to' or 'adaptable to' the changing climate as set out in the ambition of the Programme's outcomes. This sub-framework needs to be sufficiently well defined to enable progress to be measurable. Ideally the sub-framework will also enable the often short-term focus of departmental or organisational objectives to be accommodated within the long-term scope of the high-level outcomes. This would reduce the likelihood of a timing-mismatch and encourage a move away from purely aspirational undefined outcomes (Watkiss et al 2019).

2 Addressing risks within an outcomes-based approach

The Adaptation Committee's recommendation (in their advisory letter regarding development of an outcomes-based approach[13]), highlighted the importance that in developing the new SCCAP, consideration needed to be given as to how the programme would address the key risks identified by the Climate Change Risk Assessment (CCRA)[14] (Principle 1).

[13] https://www.theccc.org.uk/publication/asc-writes-to-scottish-government-about-outcomes-based-approach-for-the-sccap/
[14] https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf

The risks can be considered as barriers to achieving the outcomes and will determine many of the assumptions underpinning the context in which decisions are being taken (Stein & Valters 2012; Bours et al 2014).They should provide the focus for identifying priorities within the sub-structure of the programme and be addressed by specific actions to enable the risks to be managed whilst maintaining direction towards the outcomes (Principles 2 & 3). Monitoring should then focus on whether the sub-outcomes were accomplished and the risks avoided. Figure 2 illustrates how consideration of the risks as potential barriers is an essential step which sits around the central process of development of the main structure ('outcomes', 'sub-outcomes', 'priorities', 'actions'). This in turn should enable the identification of additional priorities and specific actions.



A. Consider how the risks will act as barriers to the outcome. Does this identify additional priority areas?

B. Are specific actions required to remove these barriers?

C. Consider how this outcome could help address barriers to other outcomes. Are specific actions required to maximise the potential to remove barriers to other outcomes?

Figure 2 Consideration of the risks as potential barriers to the outcomes

This process should consider the relationship between the risks and outcomes in a cross-cutting way, acknowledging that multiple actions and a cross-sectoral approach may be required to remove the barriers and identifies not just where the impact of the risks will be felt but also where the risk will be addressed (Holman et al 2016; CCC 2017). For example:

- **Risks to transport networks due to flooding** will impact on business supply chains (SCCAP economy outcome), but the direct actions to reduce flooding of the network will be associated with the infrastructure sector.
- **Risks to health and wellbeing from high temperatures** will impact on vulnerable groups (SCCAP climate justice outcome), however this is an issue which would be addressed as much by actions focussed on building standards, city planning and green infrastructure, as on actions which focus on dealing with the impact of raised temperatures on health.

Failing to acknowledge the cross-sectoral/ cross-outcome linkages of these risks (and opportunities) not only has consequences with regard to effective management, but will limit the ability of the monitoring to lead to effective evaluation of the programme. It is

recommended that stakeholders across all policy areas should be consulted to ensure that the cross-sectoral linkages are understood and identified, and to identify existing/facilitate creation of linkages between sectoral monitoring frameworks (Miller et al 2012; Christiansen et al 2016; Mathew et al 2016).

Appendix 1 provides examples of CCRA risk-mapping to the SCCAP outcomes to facilitate this process.

3 Integrating M&E within the programme structure

Monitoring and evaluation are central to any outcomes-based approach (Ford et al 2013; Klostermann et al 2015; Christiansen et al 2016). The selection of indicators to measure progress needs to be considered at the same time that planned outcomes are identified to ensure that the central role of the monitoring framework is clearly defined from the start (Ford et al 2013; Bours et al 2014) (Principle 1).

Metrics should be identified for monitoring both the primary level general outcomes and more specific secondary and tertiary level goals (Anderson 2009; Bours et al 2014). Whilst some sub-outcomes may initially lack suitable data, one aim of the M&E framework is to make apparent those areas where we are currently unable to adequately measure progress. This then becomes a tool for sectors and organisations to identify gaps that need to be addressed as part of their adaptation measures (Moss 2018) (Principle 6).

In addition to outcome monitoring, process monitoring assesses whether the programme actions are taking place and that policies and interventions are on track. By demonstrating that an action has been taken or a stage of implementation reached, process indicators support accountability in the short term (Moss 2017). Process indicators can also monitor the implementation of adaptation measures which focus on achieving long-term goals beyond usual programme cycles (Principle 2) (Leiter 2015).

Process-based indicators: Monitor the development of adaptation policies and the implementation of adaptation actions

Outcome-based indicators: Monitor the effectiveness of adaptation policies and measures

The recommended monitoring framework developed for the SCCAP would therefore encompass both process and outcome indicators (Figure 3).

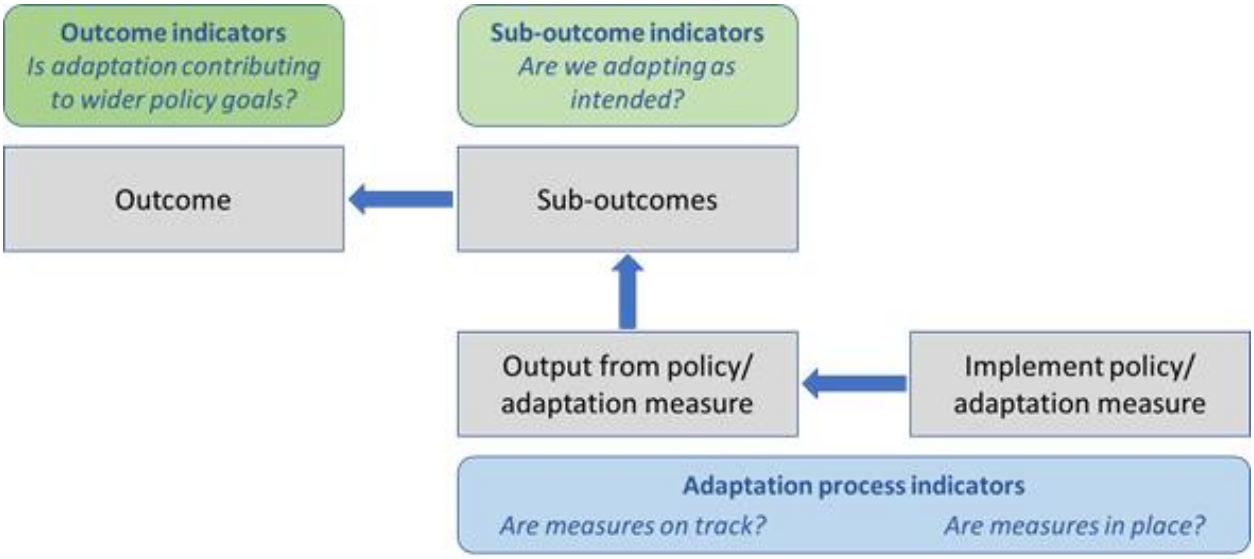


Figure 3 Basic components of the monitoring framework proposed for the second SCCAP

In the absence of a Programme framework that provides a causal pathway between policies and actions on the ground and the high-level outcomes, it would be necessary to develop a structure within the monitoring framework *itself* which could connect the process monitoring with the outcomes monitoring. Appendix 2 outlines a potential methodology for developing such a structure based on identifying monitoring 'themes'.

3.1 Setting out milestones and timescales

Milestones describe what you want to have delivered and what you hope that has achieved at a certain point in time. They provide a clear indication of interim progress and would clearly set out the ambition of the Programme. A lack of clear policy milestones, quantified objectives and associated timescales, would limit the ability to assess programme delivery. This is recognised in the high-level recommendations by the Adaptation Committee in the final assessment of the first SCCAP[15], where they identify the need to:

> *List the specific actions that will be taken to achieve each objective together with appropriate milestones and timescales*

Consideration of milestones should be included at all stages of programme and monitoring development. Both outcome and process milestones encourage going beyond merely specifying a direction of travel by providing a clarity to what is understood by 'good' or 'poor' progress. This would clearly set out the ambition of the programme, facilitate the assessment of interim progress and would enable the delivery of a managed adaptive approach (Moss & Martin 2012) (Principle 4).

[15] https://www.theccc.org.uk/publication/final-assessment-of-scotlands-first-climate-change-adaptation-programme/

3.2 Identifying potential indicators to populate the M&E framework

3.2.1 Linking to wider government goals

The close connection between national adaptation response and other policy areas (e.g. broader sustainable development) is now widely accepted, and there is a need to develop a coherency with the systems tracking their progress (AusAID 2011; Vallejo 2017; Murphy 2019).

The SCCAP's high-level structure sets out a clear relationship between the Programme and the broad outcomes set out by the National Performance Framework (NPF) and the UN Sustainable Development Goals (SDGs) (Figure 4).

Figure 4 The outcomes of the SCCAP, NPF and SDGs

To support this integration of adaptation across Scottish Government policy, SCCAP indicators at this level should be clearly aligned with (and where possible draw directly from) these existing high-level monitoring frameworks.

Appendix 3 maps the alignment between the SCCAP monitoring framework and the monitoring already associated with the NPF and SDGs.

3.2.2 Utilising existing monitoring frameworks

To make best use of resources, existing indicators and monitoring frameworks should be used as far as possible and appropriate (Principle 5) (Bours et al 2013; Mathew et al 2016; Dinshaw 2018). The need to mainstream adaptation M&E is as critical as mainstreaming adaptation practice. This means that M&E of adaptation needs to be integrated into and/or utilise existing M&E structures and procedures where relevant and possible (UNFCCC 2014; Moss 2017). This also makes it easier to integrate adaptation across other policy areas, helps to align M&E mechanisms and minimises duplication of reporting effort. However, it is critical that the monitoring framework identifies what we *need* to measure and not just what we know we *can* (Principle 6). This will ensure that any areas where we are currently unable to adequately answer the questions 'what are we doing?' and 'is it working?' will remain apparent.

In 2016, CXC published over 100 indicators to support Scottish Government adaptation policy[16]. These indicators provided a monitoring link between the objectives of the first SCCAP and the risks identified by the first Climate Change Risk Assessment (CCRA)[17], and provided an evidential base to inform the independent assessment of the SCCAP. Where appropriate, it is recommended that these indicators should be utilised in order to provide some continuity between the evidential bases of the first SCCAP, the independent assessments and the second SCCAP.

With the development of a second SCCAP which was tasked with responding to the second CCRA, it was necessary to assess the relevance of the suite of existing CXC adaptation indicators to the new CCRA. This assessment mapped the indicators against the new CCRA and identified where there were significant evidence gaps[18]. These evidential gaps could be used to help focus sector discussions around available indicator data for the second SCCAP.

Mainstreaming adaptation M&E will be aided by linking other reporting mechanisms to the Programme sub-structure and /or monitoring themes. This will allow wider adaptation measures (at national, regional and local levels) and specific case studies, which are not identified within the SCCAP, to be captured as evidence for evaluation of adaptation process and progress. Where existing reporting mechanisms already make reference to adaptation and the SCCAP (e.g. Public Bodies Climate Change Duties), consideration should be given to specifically align this reporting to the SCCAP monitoring structure.

---

[16] https://www.climatexchange.org.uk/research/indicators-and-trends/
[17] http://randd.defra.gov.uk/Document.aspx?Document=10069_CCRAforScotland16July2012.pdf
[18] See Appendix 1 https://www.climatexchange.org.uk/media/3139/integrating-monitoring-and-evaluation-in-sccap2.pdf

3.2.3 Stakeholder engagement to develop M&E

Stakeholder engagement can be an effective mechanism to develop an integrated M&E framework(Pringle 2011; Bours et al 2014; Klostermann et al 2015).

Those working in the sectors covered by the programme can be critical for the development of a coherent structure and to identify the presence and suitability of existing data. Their expert knowledge should be used to answer:

- What evidence will we need in order to know if a <measure> is being adequately implemented? Are there specific outputs (final products, goods or services) that could be monitored?
- What evidence will we need in order to know that the <process> is working?'

There is a risk that the evolving framework structure is dictated by currently available data. It is therefore important to facilitate a process that focuses on 'What do we need to measure?' rather than simply 'What do we know we can? (Principle 6).

Just as the national adaptation framework needs to acknowledge the role and capability of sub-national (local and community level) adaptation, it is important that this vertical integration also continues into the M&E (Dazé et al 2016). Stakeholder engagement is critical for identifying and utilising evidence from sub-national levels to evaluate progress, and encouraging data collection to be connected and coordinated. This will also enable sub-national actors to more clearly identify how local adaptation is linked to high-level national outcomes.

Appendix 4 sets out potential initial indicators.

3.3 Further work to implement M&E

The following section sets out recommendations for implementing an effective M&E framework for the SCCAP.

3.3.1 **Knowledge gaps** (Principles 5 & 6)

The populated frameworks can highlight monitoring gaps. These should be used to:

- consider how sufficient the identified indicators are for monitoring each theme;
- add any existing monitoring not yet identified which can fill gaps;
- consider what simple adjustments could be made to existing data collection to improve utility and make it suitable for monitoring the SCCAP; and
- identify action/research priorities to fill remaining gaps (and potential resource requirement and commitment).

3.3.2 **Action gaps** (Principles 2 & 3)

The process monitoring themes can identify action gaps - where are we not doing enough?

- Tag all policies/actions to relevant monitoring themes to highlight action gaps.

3.3.3 **Milestones and timescales** (Principle 4)

As per the Adaptation Committee's recommendations, milestones and timescales need to be an integral process of the SCCAP.

- Identify process and outcome milestones throughout the framework.
- Link milestones to other internal monitoring and reporting frameworks.

3.3.4 **Standardised reporting approach** (enable Principles 1-4)

A standardised reporting approach will simplify the reporting process and collation of evidence across policy areas. It enables interim evaluation of critical adaptation issues at reporting intervals and improves flexibility of the Programme.

- Develop a standardised reporting framework that:
    - clearly links policies/actions to the Programme structure and monitoring framework;
    - sets out milestones;
    - highlights risk of non-achievement; and
    - documents dependency or potential positive and negative impacts on other policy areas.

3.3.5 **Mainstreaming the monitoring structure** (Principle 3)

Maximise the potential for the monitoring themes to enable internal and external evaluation by:

- tagging actions/policies to the themes;
- promoting the use of the monitoring themes across non-SCCAP reporting mechanisms to capture adaptation measures (and case studies) not identified within the Programme; and
- considering specific alignment of other key reporting mechanisms (e.g. Climate Change Reporting Duties) with the SCCAP M&E framework.

References

Anderson, A.A. (2009) The Community Builder's Approach to Theory of Change: A Practical Guide to Theory Development. The Aspen Institute. https://www.aspeninstitute.org/publications/community-builders-approach-theory-change-practical-guide-theory-development/

AusAID (2011) Australia-Vietnam Climate Change delivery Strategy 2011-2016. http://dfat.gov.au/about-us/publications/Documents/vietnam-climate-change-strategy-2011-16.pdf

Bours, D., McGinn, C. and Pringle, P. 2013. Monitoring & evaluation for climate change adaptation: A synthesis of tools, frameworks and approaches. SEA Change CoP, Phnom Penh and UKCIP, Oxford. https://www.ukcip.org.uk/wp-content/PDFs/SEA-change-UKCIP-MandE-review.pdf

Bours, D., McGinn, C., and Pringle, P. (2014). The Theory of Change approach to climate change adaptation programming. SEA Change CoP, Phnom Penh and UKCIP, Oxford. https://ukcip.ouce.ox.ac.uk/wp-content/PDFs/MandE-Guidance-Note3.pdf

Brooks, N.; Rowley, J. Rapid Scoping of Climate Change Indicator Methodologies. Summary Report. Garama 3C Ltd, Norwich, UK (2015) 43 pp. https://www.gov.uk/dfid-research-outputs/rapid-scoping-of-climate-change-indicator-methodologies-summary-report

C40 Cities 2019 MEASURING PROGRESS IN URBAN CLIMATE CHANGE ADAPTATION Monitoring - Evaluating - Reporting Framework. https://ramboll.com/-/media/178c6570dafe4fce8d564ccbb1e95830.pdf

Christiansen, L., Schaer, C., Larsen, C., & Naswa, P. (2016). Monitoring & Evaluation for climate change adaptation: A summary of key challenges and emerging practice. Understanding, discussing and exemplifying the key challenges of M&E for adaptation. https://orbit.dtu.dk/files/157400902/MandE_challenge_guidance_note_01_07_16.pdf

Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report. https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/

Dazé, A., Price-Kelly, H. and Rass, N., 2016. Vertical Integration in National Adaptation Plan (NAP) Processes: A guidance note for linking national and sub-national adaptation processes. International Institute for Sustainable Development. Winnipeg, Canada. Available online at: www.napglobalnetwork.org

Dinshaw, A. (2018) Monitoring and Evaluating Mainstreamed Adaptation to Climate Change: A synthesis study on climate adaptation in development cooperation. Report produced on behalf of the IOB. http://www.oecd.org/derec/netherlands/IOB-Monitoring-Evaluating-Mainstreamed-Adaptation-Climate-Change.pdf

Ford, J. D., L. Berrang-Ford, A. Lesnikowski, M. Barrera, and S. J. Heymann. 2013. How to track adaptation to climate change: a typology of approaches for national-level application. Ecology and Society 18(3):40.

http://dx.doi.org/10.5751/ES-05732-180340

Holman, I.P., Harrison, P.A. & Metzger, M.J. (2016) Cross-sectoral impacts of climate and socio-economic change in Scotland: implications for adaptation policy. Regional Environmental Change 16: 97-109 https://link.springer.com/article/10.1007%2Fs10113-014-0679-8

Klostermann, J., van de Sandt, K., Harley, M. et al. (2018) Towards a framework to assess, compare and develop monitoring and evaluation of climate change adaptation in Europe. Mitig Adapt Strateg Glob Change (2018) 23: 187. https://doi.org/10.1007/s11027-015-9678-4

Leiter, T. (2015) Linking Monitoring and Evaluation of Adaptation to Climate Change Across Scales: Avenues and Practical Approaches. In D. Bours, C. McGinn, & P. Pringle (Eds.), Monitoring and evaluation of climate change adaptation: A review of the landscape. New Directions for Evaluation, 147, 117–127. http://onlinelibrary.wiley.com/doi/10.1002/ev.20135/abstract

Mathew, S., Trück, S.,Truong, C., and Davies, P., 2016: Monitoring and evaluation in adaptation. National Climate Change Adaptation Research Facility, Gold Coast. https://www.nccarf.edu.au/sites/default/files/tool_downloads/Monitoring%20and%20Evaluation%20in%20adaptation%20final.pdf

Miller K., Harley M., Kent N. and Beckmann K. 2012. Climate change adaptation related indicators https://www.sniffer.org.uk/Handlers/Download.ashx?IDMF=d02dc1fd-abf3-4458-9fb2-0edea63eaa68

Moss, A. (2017) Developing adaptation monitoring and evaluation in Scotland. A ClimateXChange report for Scottish Government. https://www.climatexchange.org.uk/media/1938/developing_adaptation_monitoring_and_evaluation_in_scotland.pdf

Moss, A (2018) Integrating monitoring and evaluation in the Scottish Climate Change Adaptation Programme. A ClimateXChange report for Scottish Government. https://www.climatexchange.org.uk/media/3139/integrating-monitoring-and-evaluation-in-sccap2.pdf

Moss. A & Martin, S (2012) Flexible Adaptation Pathways. A ClimateXChange report for Scottish Government. https://www.climatexchange.org.uk/media/1595/flexible_adaptation_pathways.pdf

Murphy, D. (2019) Adaptation Actions in NDC Partnership Plans: Opportunities for Alignment with NAP Processes. NAP Global Network Report. http://www.napglobalnetwork.org/resource/adaptation-actions-in-ndc-partnership-plans-opportunities-for-alignment-with-nap-processes/

Pringle, P. 2011. AdaptME: Adaptation monitoring and evaluation. UKCIP, Oxford, UK. https://www.ukcip.org.uk/wp-content/PDFs/UKCIP-AdaptME.pdf

STAP (2017). Strengthening Monitoring and Evaluation of Climate Change Adaptation: A STAP Advisory Document. Global Environment Facility, Washington, D.C. https://www.thegef.org/sites/default/files/council-meeting-documents/EN_GEF.STAP_.LDCF_.SCCF_.22.Inf_.01_M%26E_of_CCA.pdf

Stein, D. & Valters, C. (2012) Understanding theory of change in international development. The Asia Foundation and The Justice And Security Research Programme. https://assets.publishing.service.gov.uk/media/57a08a64ed915d622c0006ff/JSRP1-SteinValtersPN.pdf

UNFCCC (2014) Fifth meeting of the Adaptation Committee Bonn, Germany, 5–7 March 2014: Report on the workshop on the monitoring and evaluation of adaptation. Available online at http://unfccc.int/files/adaptation/cancun_adaptation_framework/adaptation_committee/application/pdf/ac_me_ws_r eport_final.pdf

Vallejo, L. 2017. Insights from national adaptation monitoring and evaluation systems, Climate Change Expert Group, Paper No.2017 (3), OECD, 2017. https://www.oecd.org/environment/cc/Insights%20from%20national%20adaptation%20monitoring%20and%20evaluation%20systems.pdf

Watkiss, P., Cimato, F., Hunt, A. and Moxey, A. for the CCC (2019). The impacts of climate change on meeting government outcomes in England. https://www.theccc.org.uk/publication/impacts-of-climate-change-on-meeting-government-outcomes-in-england-paul-watkiss-associates/

Appendix 1 CCRA risks mapped to the SCCAP outcomes (NB outcomes are worded as per Sept 2018 draft)

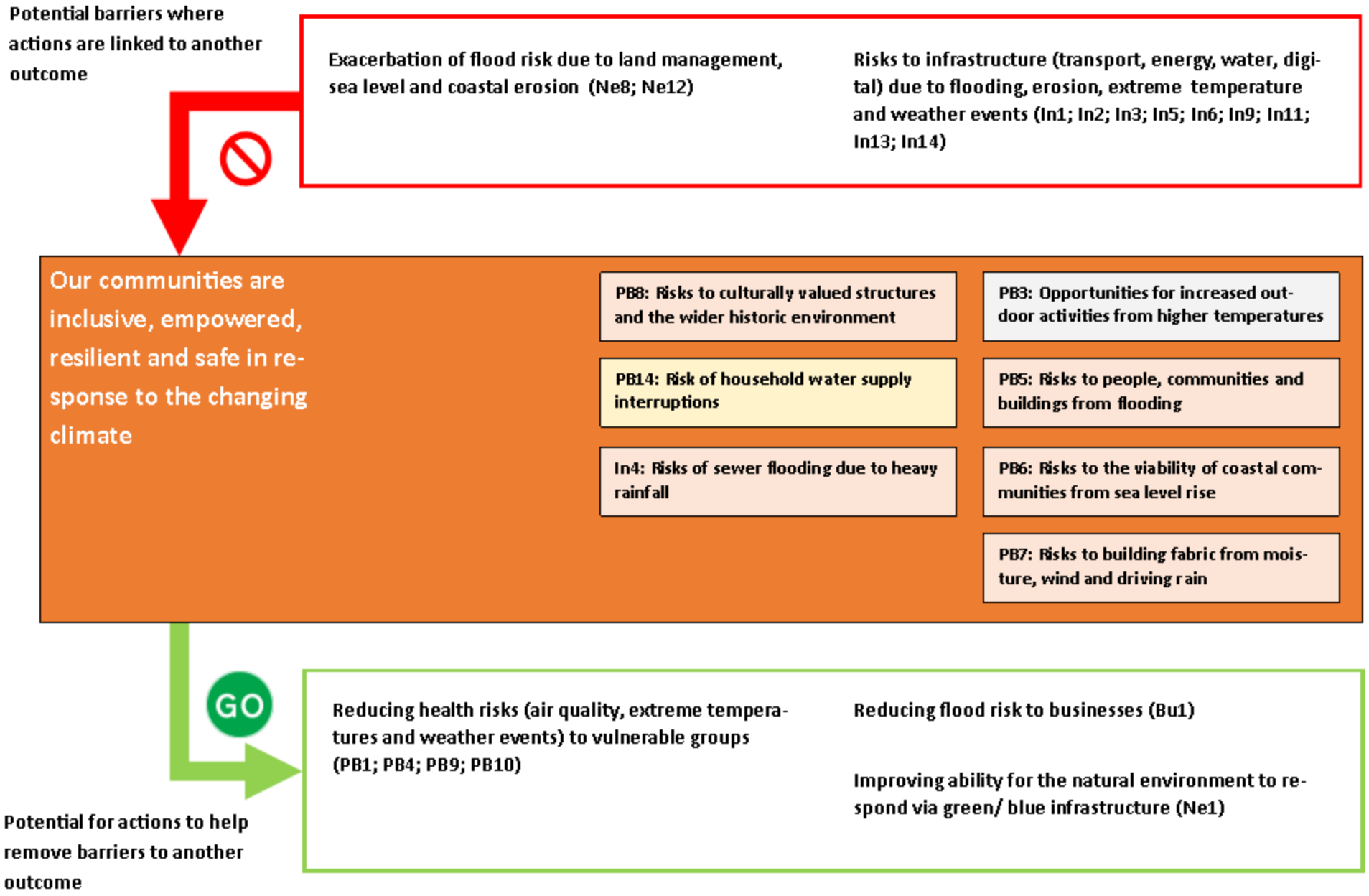
The following approach to mapping the CCRA risks to the SCCAP outcomes has endeavoured to distinguish between:

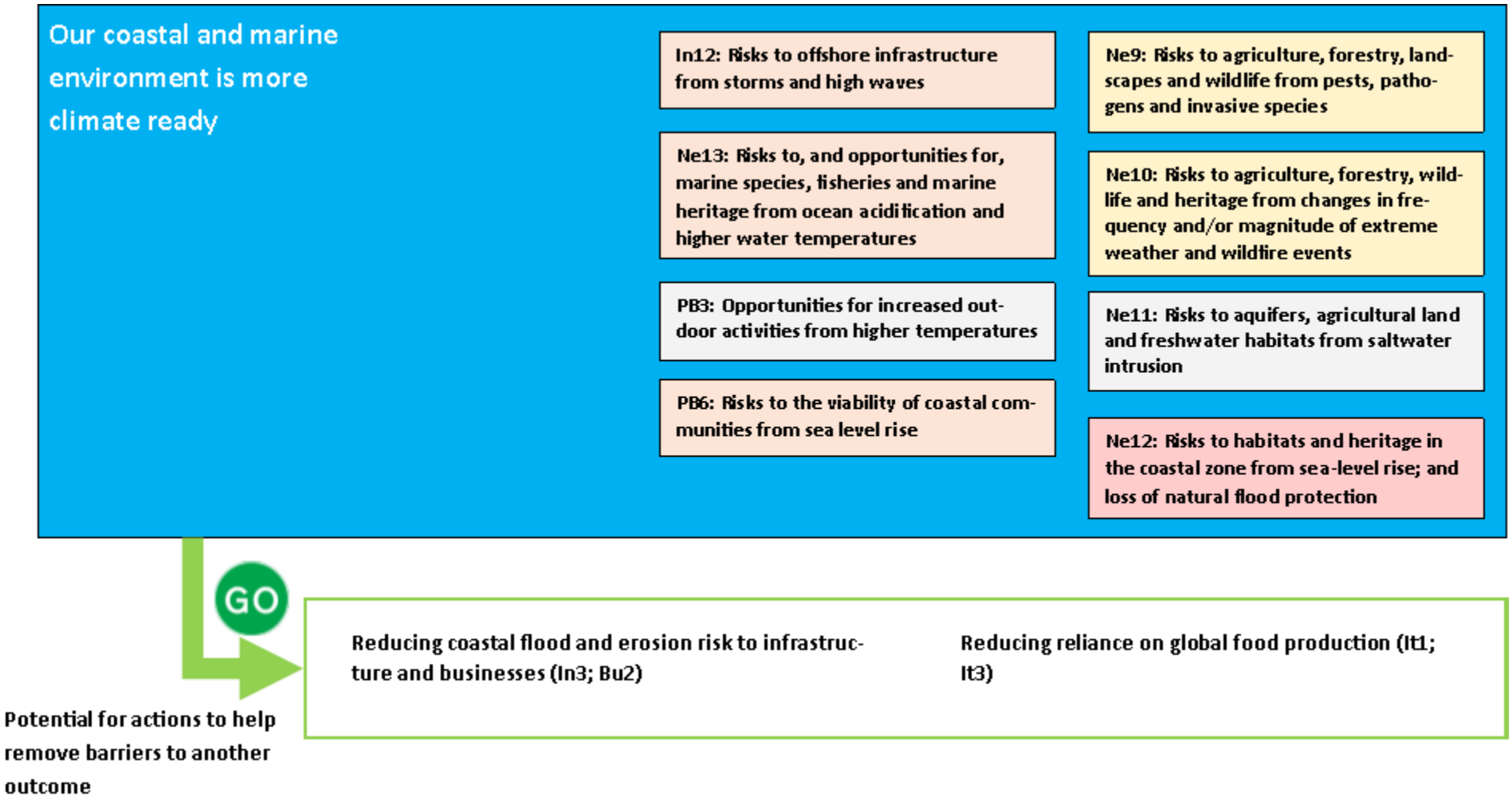
- Risks which act as potential barriers to the outcome and where actions associated with that outcome are likely to help address the risk
- Risks which act as potential barriers to the outcome but where actions associated with that outcome are unlikely to help address the risk
- Risks which do not act as barriers to the outcome but where actions associated with that outcome are likely to help address the risk

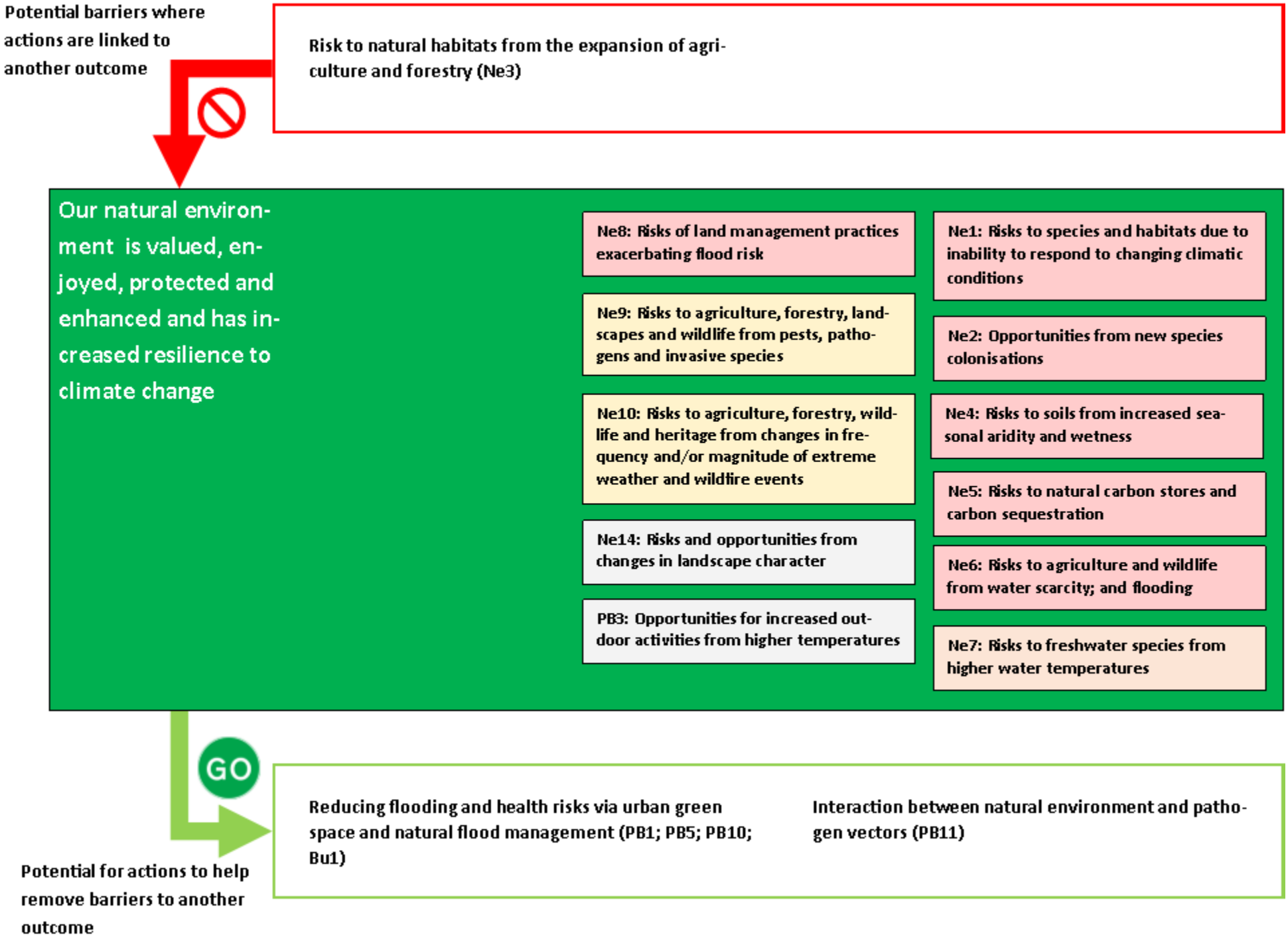
The Climate Change Risk Assessment (CCRA) uses four urgency ratings for risks. These have been distinguished below utilising the following colours:

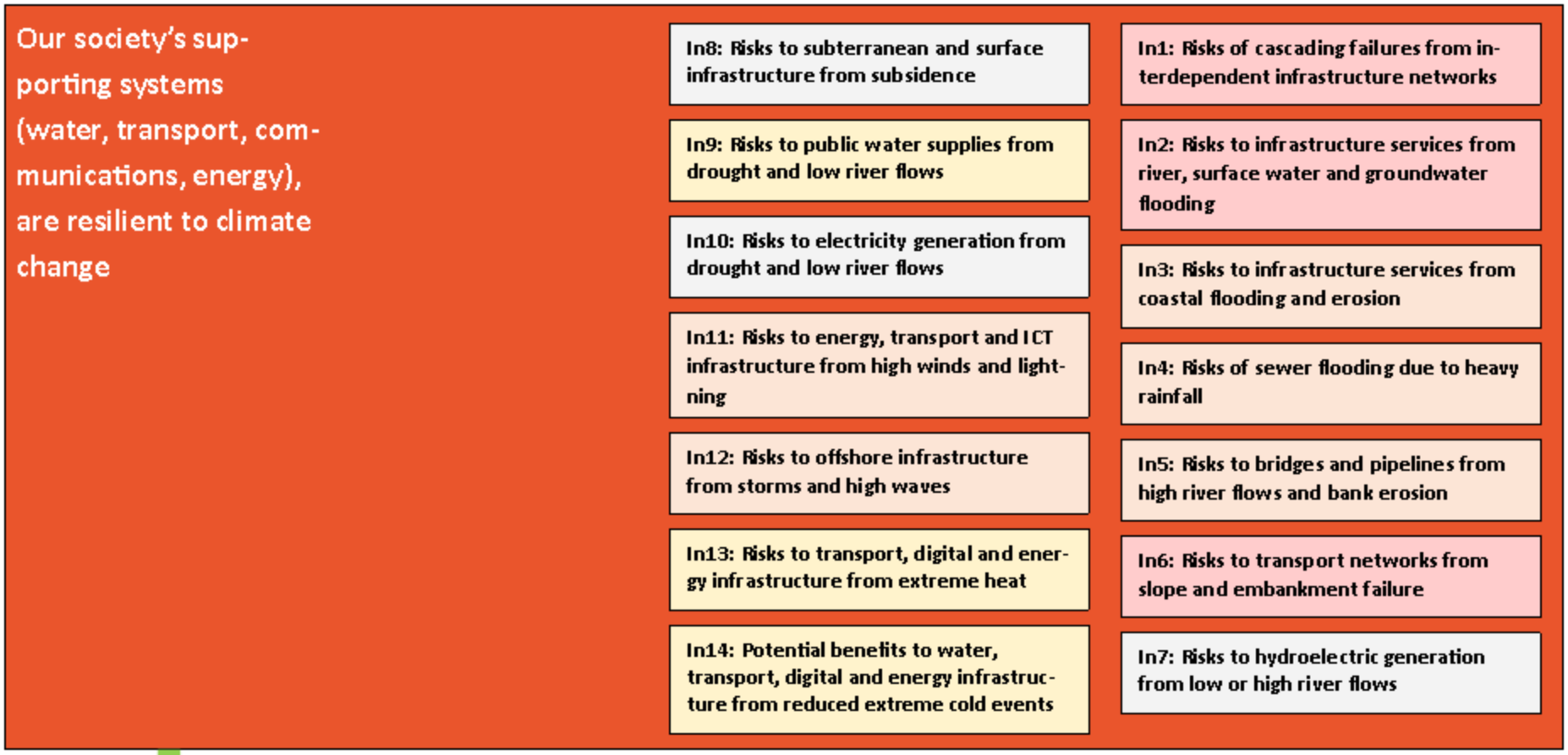
More action needed	Research priority	Sustain current action	Watching brief


Our international partners are more climate ready as a result of our support for adaptation initiatives and knowledge sharing
It6: Risks to international law and governance
It1: Risks from weather-related shocks to international food production and trade
It7: Opportunities from changes in international trade routes
It3: Risks and opportunities from long-term, climate-related changes in global food production
GO
Reducing risks to supply chains and business assets (It4; It5; Bu6)
Increasing food security and decreasing imported food safety concerns (It2; PB12)
Potential for actions to help remove barriers to another outcome

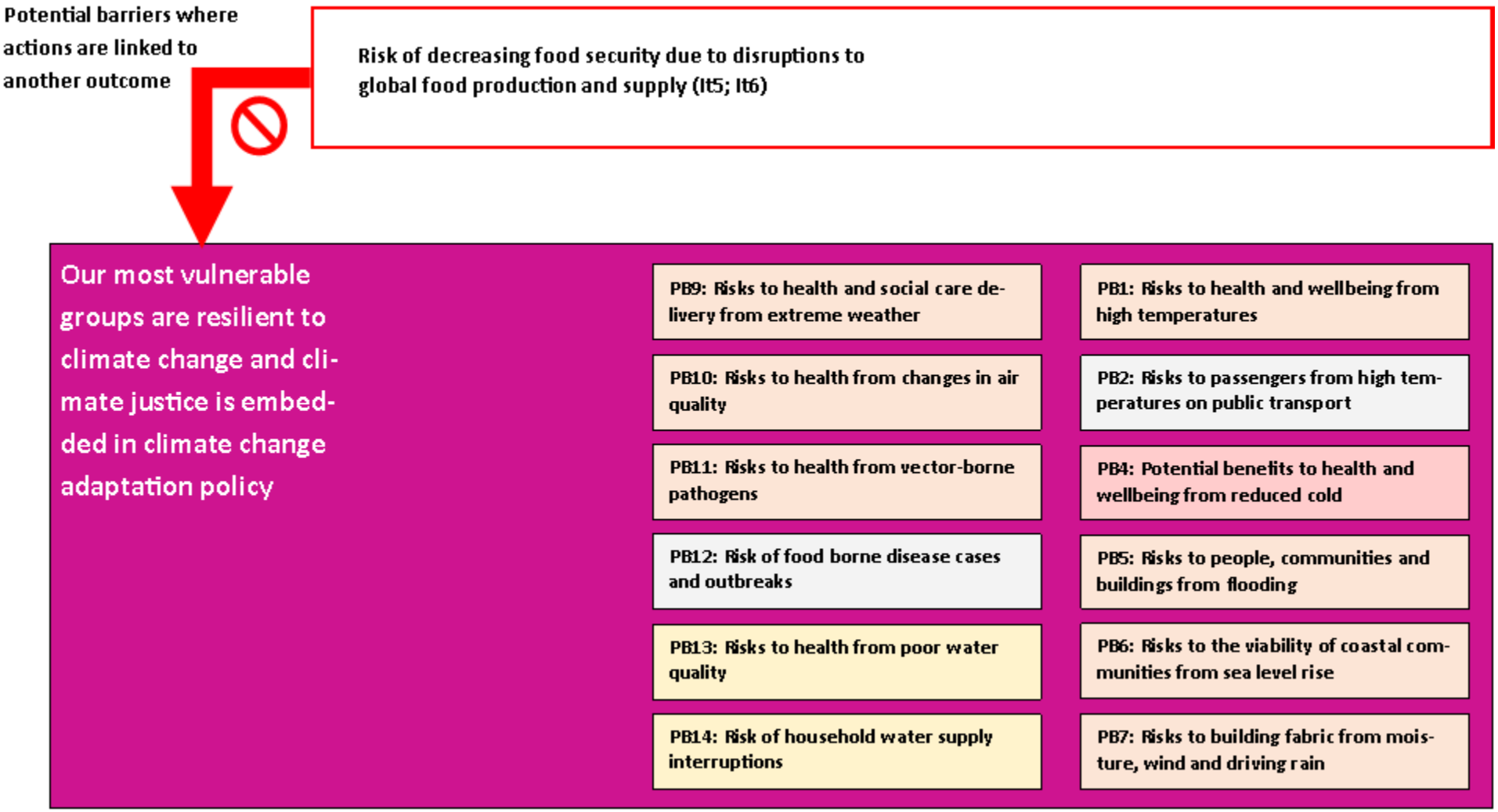

Potential barriers where actions are linked to another outcome
Exacerbation of flood risk due to land management, sea level and coastal erosion (Ne8; Ne12)
Risks to infrastructure (transport, energy, water, digital) due to flooding, erosion, extreme temperature and weather events (In1; In2; In3; In5; In6; In9; In11; In13; In14)
Our communities are inclusive, empowered, resilient and safe in response to the changing climate
PB8: Risks to culturally valued structures and the wider historic environment
PB3: Opportunities for increased outdoor activities from higher temperatures
PB14: Risk of household water supply interruptions
PB5: Risks to people, communities and buildings from flooding
In4: Risks of sewer flooding due to heavy rainfall
PB6: Risks to the viability of coastal communities from sea level rise
PB7: Risks to building fabric from moisture, wind and driving rain
GO
Reducing health risks (air quality, extreme temperatures and weather events) to vulnerable groups (PB1; PB4; PB9; PB10)
Reducing flood risk to businesses (Bu1)
Improving ability for the natural environment to respond via green/ blue infrastructure (Ne1)
Potential for actions to help remove barriers to another outcome


Our coastal and marine environment is more climate ready
In12: Risks to offshore infrastructure from storms and high waves
Ne13: Risks to, and opportunities for, marine species, fisheries and marine heritage from ocean acidification and higher water temperatures
PB3: Opportunities for increased outdoor activities from higher temperatures
PB6: Risks to the viability of coastal communities from sea level rise
Ne9: Risks to agriculture, forestry, landscapes and wildlife from pests, pathogens and invasive species
Ne10: Risks to agriculture, forestry, wildlife and heritage from changes in frequency and/or magnitude of extreme weather and wildfire events
Ne11: Risks to aquifers, agricultural land and freshwater habitats from saltwater intrusion
Ne12: Risks to habitats and heritage in the coastal zone from sea-level rise; and loss of natural flood protection
GO
Reducing coastal flood and erosion risk to infrastructure and businesses (In3; Bu2)
Reducing reliance on global food production (It1; It3)
Potential for actions to help remove barriers to another outcome


Potential barriers where actions are linked to another outcome
Risk to natural habitats from the expansion of agriculture and forestry (Ne3)
Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change
Ne8: Risks of land management practices exacerbating flood risk
Ne9: Risks to agriculture, forestry, landscapes and wildlife from pests, pathogens and invasive species
Ne10: Risks to agriculture, forestry, wildlife and heritage from changes in frequency and/or magnitude of extreme weather and wildfire events
Ne14: Risks and opportunities from changes in landscape character
PB3: Opportunities for increased outdoor activities from higher temperatures
Ne1: Risks to species and habitats due to inability to respond to changing climatic conditions
Ne2: Opportunities from new species colonisations
Ne4: Risks to soils from increased seasonal aridity and wetness
Ne5: Risks to natural carbon stores and carbon sequestration
Ne6: Risks to agriculture and wildlife from water scarcity; and flooding
Ne7: Risks to freshwater species from higher water temperatures
GO
Potential for actions to help remove barriers to another outcome
Reducing flooding and health risks via urban green space and natural flood management (PB1; PB5; PB10; Bu1)
Interaction between natural environment and pathogen vectors (PB11)


Our society's supporting systems (water, transport, communications, energy), are resilient to climate change
In8: Risks to subterranean and surface infrastructure from subsidence
In9: Risks to public water supplies from drought and low river flows
In10: Risks to electricity generation from drought and low river flows
In11: Risks to energy, transport and ICT infrastructure from high winds and lightning
In12: Risks to offshore infrastructure from storms and high waves
In13: Risks to transport, digital and energy infrastructure from extreme heat
In14: Potential benefits to water, transport, digital and energy infrastructure from reduced extreme cold events
In1: Risks of cascading failures from interdependent infrastructure networks
In2: Risks to infrastructure services from river, surface water and groundwater flooding
In3: Risks to infrastructure services from coastal flooding and erosion
In4: Risks of sewer flooding due to heavy rainfall
In5: Risks to bridges and pipelines from high river flows and bank erosion
In6: Risks to transport networks from slope and embankment failure
In7: Risks to hydroelectric generation from low or high river flows
GO
Reducing the impact on communities and businesses by maintaining energy, digital and water supply and transport networks (PB5; PB14; Bu1; Bu3; Bu5; Bu6)
Reducing health risks to vulnerable groups (PB2; PB9; PB10; PB13)
Maintaining long-term viability of communities and businesses (PB6; Bu2)
Potential for actions to help remove barriers to another outcome


Potential barriers where actions are linked to another outcome
Risks to infrastructure (transport, energy, water, digital) due to flooding, erosion, extreme temperature and weather events (In1; In2; In3; In5; In6; In11; In13; In14)
Risk to international supply chains and business assets (It5; It6)
Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate
Ne6: Risks to agriculture and wildlife from water scarcity; and flooding
Ne8: Risks of land management practices exacerbating flood risk
Ne9: Risks to agriculture, forestry, landscapes and wildlife from pests, pathogens and invasive species
Ne10: Risks to agriculture, forestry, wildlife and heritage from changes in frequency and/or magnitude of extreme weather and wildfire events
Ne11: Risks to aquifers, agricultural land and freshwater habitats from saltwater intrusion
Ne13: Risks to, and opportunities for, marine species, fisheries and marine heritage from ocean acidification and higher water temperatures
Ne14: Risks and opportunities from changes in landscape character
PB3: Opportunities for increased outdoor activities from higher temperatures
Bu1: Risks to business sites from flooding
Bu2: Risks to business from loss of coastal locations and infrastructure
Bu3: Risks to business operations from water scarcity
Bu5: Risks to business from reduced employee productivity, due to infrastructure disruption and higher temperatures in working environments
Bu4: Risks to business from reduced access to capital
Bu6: Risks to business from disruption to supply chains and distribution networks
Bu7: Risks and opportunities for business from changes in demand for goods and services
Ne3: Risks and opportunities from changes in agricultural and forestry productivity and land suitability
Ne4: Risks to soils from increased seasonal aridity and wetness
PB8: Risks to culturally valued structures and the wider historic environment
PB12: Risk of food borne disease cases and outbreaks
It1: Risks from weather-related shocks to international food production and trade
It2: Imported food safety risks
It3: Risks and opportunities from long-term, climate-related changes in global food production
It7: Opportunities from changes in international trade routes


Potential barriers where actions are linked to another outcome
Risk of decreasing food security due to disruptions to global food production and supply (It5; It6)
Our most vulnerable groups are resilient to climate change and climate justice is embedded in climate change adaptation policy
PB9: Risks to health and social care delivery from extreme weather
PB10: Risks to health from changes in air quality
PB11: Risks to health from vector-borne pathogens
PB12: Risk of food borne disease cases and outbreaks
PB13: Risks to health from poor water quality
PB14: Risk of household water supply interruptions
PB1: Risks to health and wellbeing from high temperatures
PB2: Risks to passengers from high temperatures on public transport
PB4: Potential benefits to health and wellbeing from reduced cold
PB5: Risks to people, communities and buildings from flooding
PB6: Risks to the viability of coastal communities from sea level rise
PB7: Risks to building fabric from moisture, wind and driving rain

Appendix 2 Development of monitoring themes to facilitate connection of process and outcome monitoring

The early stages of the Programme development indicated that the framework would not provide the level of detail required for a 'Theory of Change' type approach. CXC therefore advised that the M&E framework should be adapted to provide some of that structure in order to facilitate the identification of suitable metrics and enable evaluation of the Programme. Following provision of illustrative structures for the Natural Environment and Communities outcomes based around monitoring 'themes', CXC were asked to develop similar structures across each of the Programmes Outcomes.

The monitoring themes were identified in response to preliminary stakeholder consultation and consideration of existing policies and strategies. During the development of the Programme, Scottish Government conducted a series of workshops specific to each outcome. These workshops brought together expertise from across government policy teams, local government, delivery agencies, industry and community groups. The output from these workshops provided good insight regarding:

- What are the priorities for each organisation, upon which progress towards the outcome depends?
- What actions are in place or needed to contribute towards those priorities

Grouping workshop responses into popular threads provided the initial basis for a sub-structure of 'monitoring themes' based on adaptation action/process ('what are we doing?') and progress towards the outcome ('is it working?').

Secondly, consideration was given to whether the themes would adequately capture priority areas resulting from risks identified as outcome barriers (see Figure 2). Thirdly, key policy and strategy documents related to each outcome were consulted to identify how these themes fitted with their priorities and, where appropriate, adjusting wording to align with the language already in use. For example:

- The 'Five E's' of the Resilient Communities Strategic Framework and Delivery Plan 2017-2021[19] (Communities and Climate Justice outcomes)
- Scottish Natural Heritage's 'Adaptation Principles' (Natural Environment and Marine outcomes)[20]

The adaptation process monitoring themes provide a structure to monitor the implementation of and output from adaptation policies and actions ('What are we doing?'). The sub-outcome monitoring themes highlight the key components of each sub-outcome and provide the structure for monitoring progress ('Is it working?').

The monitoring themes drafted for the Natural Environment Outcome are presented below.

Linking evidence to the monitoring themes

The framework and monitoring themes are intended to encourage the consideration of how policies and measures specifically contribute to the outcomes of the programme. By 'tagging' policies and measures to specific themes, and defining how and to what extent they are expected to contribute it will facilitate the:

- Collation of evidence for annual reporting

[19] https://www.readyscotland.org/media/1411/resilient-communties-leaflet.pdf
[20] https://www.nature.scot/adaptation-principles-helping-nature-adapt-climate-change

- Assessment of the risk posed by non-achievement of individual measures

Given the inherently cross-cutting nature of adaptation, measures may often contribute to multiple sub-outcomes and monitoring themes across different high-level outcomes.

The monitoring themes should provide a means to pull together not just evidence from the named policies within the adaptation programme, but also facilitate the reporting of other adaptation measures at national, regional and local levels. By identifying how they are contributing to named process or sub-outcome monitoring themes, organisations can more easily align their activities to the SCCAP and identify how they are contributing to national adaptation policy in Scotland. As use of the themes extends into other reporting mechanisms it will facilitate the ability of the SCCAP annual reporting process to draw upon evidence from across more broad policy areas, different geographical scales and to utilise case studies in addition to routine monitoring.

Process monitoring themes (What are we doing?)

Reducing non-climate pressures	Managing resources sustainably	Maximising health and wellbeing benefits	Increasing knowledge and understanding
Habitat restoration/ creation with co-benefits		Improving access to the natural environment	
Increasing collaboration & flexibility			

Sub-outcome monitoring themes (Is it working?)

Habitat extent and connectivity is protected and enhanced	Provisioning services are maintained	Cultural services are maintained	Understanding and recognition are increased
Habitat condition is protected and enhanced			
The diverse natural environment is protected and enhanced			
Regulating services are maintained / Supporting services are maintained			

Sub-outcomes

5.1.1 Regulating Ecosystem Services	5.1.2 Supporting Ecosystem Services	5.2.1 Provisioning Ecosystem Services	5.2.2 Cultural Ecosystem Services	5.2.3 Understanding and Recognition
5.1 Scotland's biodiversity, ecosystems and landscapes are adaptable to the changing climate		5.2 Scotland's natural environment and its contribution to wider societal adaptation is enjoyed, valued and maintained		

Outcome

Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

Appendix 3 Alignment of the SCCAP outcomes with the NPF and SDG indicator frameworks

National Performance Framework indicators	Sustainable Development Goals indicators
Outcome 1 Our communities are inclusive, empowered, resilient and safe in response to the changing climate	
• Social capital • Influence over local decisions • Perceptions of local area • Access to local greenspace • Places to interact • Journeys by active travel • State of historic sites • Satisfaction with housing	• Extent to which… education for sustainable development (including climate change education) are mainstreamed • Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies
Outcome 2 The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy	
• Social capital • Influence over local decisions • Perceptions of local area • Access to local greenspace • Premature mortality • Mental wellbeing	• Mortality rate attributed to household and ambient air pollution
Outcome 3 Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate	
• Natural capital • Sustainability of fish stocks • Productivity • Innovative businesses	• Proportion of agricultural area under productive and sustainable agriculture • Progress towards sustainable forest management • Number of companies publishing sustainability reports
Outcome 4 Our society's supporting systems are resilient to climate change	
• Quality of public services • Journeys by active travel • Access to superfast broadband • Access to green and blue space	• Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters
Outcome 5 Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change	

• Natural capital • Condition of protected sites • Access to green and blue space	• Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas • Coverage by protected areas of important sites for mountain biodiversity • Proportion of land that is degraded • Mountain Green Cover Index • Red List Index • Relevant national legislation and adequately resourcing the prevention or control of invasive alien species
Outcome 6 Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change	
• Sustainability of fish stocks • Clean seas	• Proportion of national exclusive economic zones managed using ecosystem-based approaches • Proportion of fish stocks within biologically sustainable levels • Coverage of protected areas in relation to marine areas
Outcome 7 Our international networks are adaptable to climate change	
• Food insecurity • International networks • Contribution of development support to other nations • International exporting (value of Scottish exports excluding oil and gas)	• Food price anomalies • Prevalence of moderate or severe food insecurity in the population • Total official international support to infrastructure • Number of least developed countries… receiving specialised support… for raising capacities for effective climate change-related planning and management

For some outcomes it was identified that there are other high-level monitoring frameworks which are also appropriate for alignment to monitoring of the SCCAP outcomes. For example:

- Outcome 5: Aichi Biodiversity Targets[21] (Progress towards Aichi targets)
- Outcome 6: Marine Strategy Framework Directive[22] (Good Environmental Status in Scottish waters)

[21] https://www.nature.scot/sites/default/files/2018-05/Aichi%20Report%20Interim%202017.pdf
[22] https://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm

Appendix 4 Populated monitoring framework for Outcome 5

Once the draft monitoring themes were developed, CXC were asked to populate the monitoring frameworks for each outcome with proposed indicators.

Where possible and appropriate, **existing indicators** were identified. These were identified via stakeholder engagement, assessment of relevance of existing CXC adaptation indicators, monitoring associated with policies identified under each outcome, and feedback from policy teams. In addition they detailed **potential indicators** for future development. These are either indicators known to already be under-development or suggested indicators which need to be developed which were identified as priorities during consultation. **Case studies** were also included where more appropriate or where metrics are currently unavailable.

These provide a starting monitoring structure which highlights evidential gaps and can be used to focus discussions with key stakeholders to identify additional metrics which should be included, consider adjustments to existing data collection to improve utility, and identify action or research priorities to fill remaining gaps where possible.

The table below presents, as an example, the monitoring framework for *Outcome 5 Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change.*

Process monitoring (What are we doing?)	
Reducing non-climate pressures	**Existing indicators:** ➢ Area of woodland with active, approved deer management plans (Scottish Forestry Strategy; CXC Adaptation indicator NF14) ➢ Freshwater bodies affected by diffuse pollution due to agriculture (SEPA River Basin Management Plans (RBMPs) pressure data; CXC Adaptation indicator NA14) ➢ Freshwater bodies with less than good morphological status (SEPA RBMPs classification data) ➢ Soil sealing (Ecosystem Health Indicator 13) **Potential indicators:** ➢ Management of Invasive Non-Native Species (Ecosystem Health Indicator 11- currently utilises presence data for a number of key species but '*In the future, absence records will show where these species have been effectively removed through management*') **Case studies:**
Habitat restoration/ creation with co-benefits	**Existing indicators:** ➢ Peatland restoration (Climate Change Plan indicators; Ecosystem Health Indicator 10) o Number of hectares of restored peatland per year o Number of hectares on the road to recovery o Number of projects approved for funding from the Peatland Action restoration project funding ➢ Native woodland and forest creation (Climate Change Plan indicators) o Number of hectares of woodland created o Area of new woodland created with grant scheme support o Area of new woodland created on the national forest estate ➢ Extent of urban greenspace (State of Scotland's Greenspace) ➢ Number of planning authorities with current Forest and Woodland Strategies (Climate Change Plan indicator) **Potential indicators:** ➢ Extent of Natural Flood Management schemes (NFM network) **Case studies:** ➢ Creation of pollinator friendly habitats (Pollinator Strategy progress reports)
Increasing collaboration & flexibility	**Existing indicators:** **Potential indicators:** ➢ Area of land under landscape scale conservation (CXC Adaptation Indicator NB7- based on 2014 data gathered by Scottish Forestry) ➢ Progress towards a National Ecological Network (SNH) **Case studies:** ➢ Place-based partnerships for sustainable land use

Managing resources sustainably	**Existing indicators:** ➢ Sustainability Certification Schemes (Aichi Target 7 monitoring) ➢ High Nature Value farming and forestry (Aichi Target 7 monitoring; Ecosystem Health Indicators; CXC Adaptation Indicators NA9 and NF3) ➢ Use of the Ecological Site Classification (ESC) decision support tool (Forest Research; CXC Adaptation Indicator NF6) **Potential indicators:** **Case studies:** ➢ Sustainable land management projects which protect and improve water quality in catchments. Sustainable management of natural resources is also considered under sub-outcome 3.1 in the Economy outcome.
Maximising health and wellbeing benefits	**Existing indicators:** **Potential indicators:** ➢ Prescriptions for Green Exercise (NHS Greenspace/ Our Natural Health Service Programme) ➢ Extent/ creation of greenspace in Air Quality Management Areas **Case studies:** ➢ Green exercise projects The health benefits of the natural environment are also considered under sub-outcome 2.2 in the Climate Justice outcome.
Increasing knowledge and understanding	**Existing indicators:** ➢ Number of land managers/ consultants trained through the Peatland Action programme (Climate Change Plan indicators) **Potential indicators:** **Case studies:** ➢ Citizen science monitoring programmes (e.g. Pollinator Monitoring Scheme) ➢ Natural capital approach on National Nature Reserves (SNH to pilot this to better communicate the socio-economic values of nature)
Improving access to the natural environment	**Existing indicators:** **Potential indicators:** ➢ Green Infrastructure funding (Green Infrastructure Strategic Intervention) ➢ Number of greenspaces improved and regularly used for outdoor learning (Outdoor Learning in Nature Fund) ➢ Extent and connectivity of green corridors for active travel (Sustrans)

	Case studies: ➢ Green Infrastructure projects (e.g. funded through the Green Infrastructure Strategic Intervention)

Sub-outcome monitoring (Is it working?)	
Habitat extent and connectivity is protected and enhanced	**Existing indicators:** ➢ Extent of deep peat habitat (JHI soil data; CXC Adaptation Indicator NB11) ➢ Extent of native woodland (CXC Adaptation Indicator NB10a based on the Native Woodland Survey Scotland) ➢ Functional habitat connectivity (Ecosystem Health Indicator 8) **Potential indicators:** **Case studies:**
Habitat condition is protected and enhanced	**Existing indicators:** ➢ Condition of native woodland (Ecosystem Health Indicator 3) ➢ Condition of freshwater bodies (Ecosystem Health Indicator 6; CXC Adaptation Indicator NB24) ➢ Invasive non-native species (Ecosystem Health Indicator 11; CXC Adaptation Indicators NB37 & NB39 specific for native woodland and freshwater INNS) **Potential indicators:** ➢ Condition of peatland (CXC Adaptation Indicators NB13- draws upon evidence from various sources, update sources to be determined) **Case studies:** ➢ Impact of extreme events on protected sites or key habitats The condition of protected sites is an NPF indicator considered at outcome level.
The diverse natural environment is protected and enhanced	**Existing indicators:** ➢ Abundance of wintering water birds (Scotland Biodiversity Indicator; CXC Adaptation Indicator NB6b/NB17b) ➢ Abundance of specialist and generalist butterfly species (Scotland Biodiversity Indicator; CXC Adaptation Indicator NB16b) **Potential indicators:** ➢ Changes in species suite (under-development as an Ecosystem Health Indicator) ➢ Measurement of genetic diversity (under-development to enable assessment of Aichi Target 13) **Case studies:**

Regulating services are maintained	**Existing indicators:** ➢ Pollinator monitoring (Indicators of Ecosystem Services in Scotland; Pollinator Strategy) ➢ Soil organic carbon stocks (Indicators of Ecosystem Services in Scotland; Ecosystem Health Indicator 7) ➢ Carbon sequestration (Scottish natural capital: ecosystem service accounts) ➢ Air pollutant removal by vegetation (Scottish natural capital: ecosystem service accounts) **Potential indicators:** **Case studies:**
Supporting services are maintained	Monitoring will draw on the cross-cutting themes above on habitat extent, condition and diversity.
Provisioning services are maintained	**Existing indicators:** ➢ Area of class 1 agricultural land available (JHI Land Capability for Agriculture; CXC Adaptation Indicator NA2) ➢ Abstraction of water for irrigation (SEPA Water Resources Data Returns System; CXC Adaptation Indicator NA13) ➢ Natural regeneration in native woodland (Native Woodland Survey Scotland; CXC Adaptation Indicator NB23) **Potential indicators:** ➢ Contribution of woodlands, forests and the forest sector to the Scottish economy ➢ Volume of available wood fibre **Case studies:** Provisioning services are also considered under sub-outcome 3.1 in the economy outcome.
Cultural services are maintained	**Existing indicators:** ➢ Outdoor recreation visits (Scotland's People and Nature Survey, SNH; Scottish Household Survey) **Potential indicators:** ➢ Combined health and ecosystem indicator (under development by NHS Scotland, SNH and SEPA) ➢ Numbers of visits to forests and woodlands (Scotland's People and Nature Survey) **Case studies:**
Understanding and	**Existing indicators:**

recognition are increased	➢ Attitudes towards the natural environment/ Identification of benefits gained from visits to the outdoors (Scotland's People and Nature Survey/ Scottish Nature Omnibus, SNH) ➢ Numbers of people taking active steps to improve the natural environment (Scottish Nature Omnibus, SNH) **Potential indicators:** ➢ Evidence of public understanding of ecosystem services **Case studies:** ➢ Examples of businesses considering the environment (and its value) in decision-making

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

info@climatexchange.org.uk
+44(0)131 651 4783
@climatexchange_
www.climatexchange.org.uk

ClimateXChange, Edinburgh Centre for Carbon Innovation, High School Yards, Edinburgh EH1 1LZ