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England:

National Climate Change Risk Assessment and Adaptation

Climate Risk and Resilience in China (CRR)

Project Overview

Name Climate Risk and Resilience in China

Commissioned by German Federal Ministry of Economic Cooperation and Development (BMZ)

The develoPPP project is jointly implemented by
GIZ and Swiss Re

Focus area
Climate Risk and Climate Resilience in urban centers and their rural surroundings in China

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Introduction

The UK Climate Change Act was passed in 2008 and is the primary legislation that underpins action to address climate change by the UK. It provides a comprehensive framework for climate change mitigation and adaptation, underpinned by legally binding emissions targets for 2050 and the coming 15 years. It assigns clear duties and responsibilities for action based around independent expert advice and monitoring. The Act is credited with helping the UK to deliver sustained reductions in greenhouse gas emissions alongside a growing economy. The Act has received widespread support from business and enabled a positive narrative on UK climate action. This case study sets out the Climate Change Act and the Climate Change Risk Assessment that it drives. It reviews the background to these activities and the lessons learnt from 12 years of implementation since 2008.

1. Climate Change Act 2008: An introduction

The UK Climate Change Act was passed in 2008 and was a world-first national 'framework' legislation providing a comprehensive and overarching law setting out the UK's approach to reducing emissions and preparing for the impacts of climate change. The notion behind the Act was that while politicians might disagree on how to respond to climate change, they shouldn't disagree on whether to respond. The Climate Change Act provides an overall framework for climate mitigation and adaptation action across the UK. This framework has four key pillars (**Figure 1**) as discussed in turn below.

(1) A long-term goal. The Act contains a legally binding goal for reducing UK greenhouse gas (GHG) emissions by 2050. Initially (in 2008), this was 'at least 80%' below 1990 levels, based on advice from CCC. In 2019, in recognition of the 2015 UN Paris Agreement and following Climate Change Committee (CCC) advice, the long-term goal was updated to 'at least 100%' below 1990.

(2) A pathway to the long-term goal. 'Carbon budgets' set legally-binding limits for UK GHG emissions over five-year periods as interim milestones on the pathway towards the long-term emissions goal (**Figure 2**). On adaptation, the Act requires the Government to set out its objectives for adaptation and a programme to meet them.

- The carbon budgets are legislated twelve years in advance of the budget start date to provide enough time for Government to develop and enact policies and for businesses to invest.

- A five-year period was chosen rather than annual targets to provide greater flexibility - for example, to accommodate a particularly cold winter leading to increased heating emissions in a particular year.

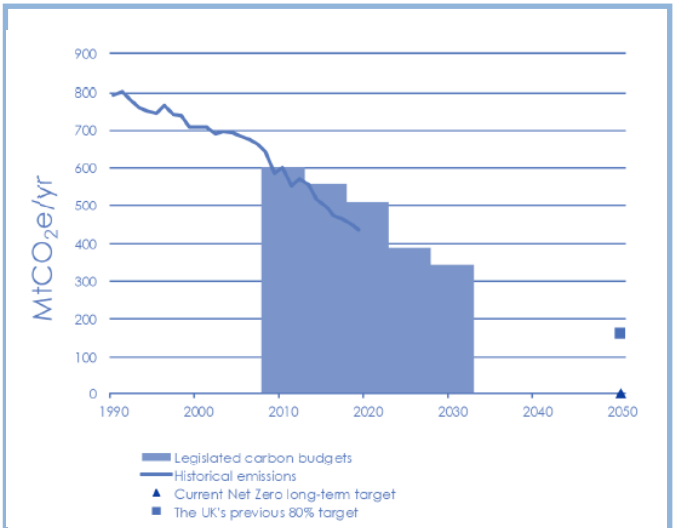

Figure 2: Emissions pathways to carbon budgets and the Net Zero target [1]

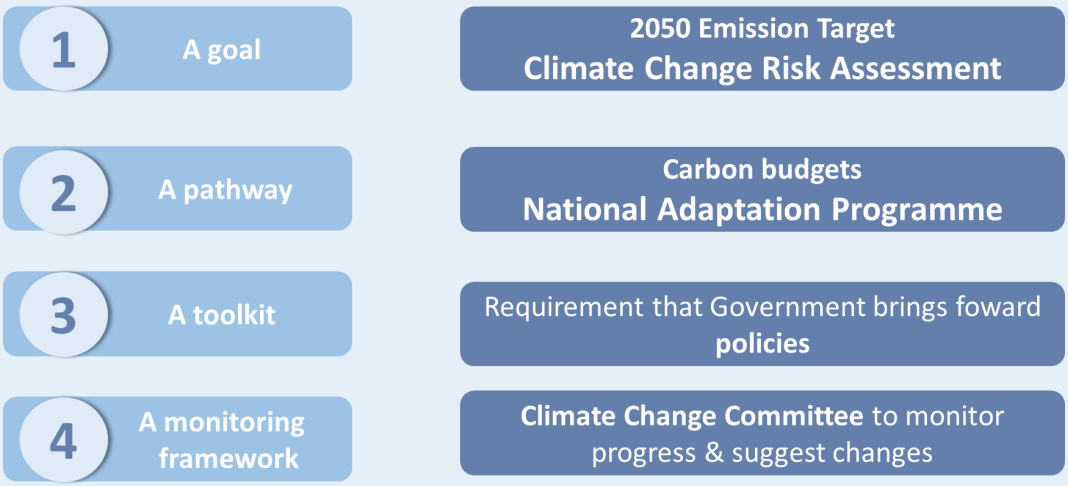

Figure 1 The four pillars of the UK Climate Change Act [1]

(3) A requirement for policies to deliver the pathways. The Act obliges the Government to develop and publish policy programmes to deliver the legislated emissions reductions and to address the risks identified in the latest climate change risk assessment.

(4) An independent advisory body - the Climate Change Committee (CCC). The Act created the CCC as the independent statutory adviser. The CCC includes two sub-Committees (effectively boards) covering mitigation and adaptation. Members are expert and politically impartial and supported by an analytical secretariat. The CCC advises on the appropriate level of UK carbon budgets, and on key climate risks facing the UK. The CCC also monitors progress on reducing emissions (every year) and adapting to climate change (every two years). The Government is obliged to respond to the CCC's assessments, creating an annual cycle of policy development.

The provisions of the Act balance the primacy of elected representatives in making decisions with the use of independent advisers in interpreting evidence:

(1) The Act prescribes several factors to consider in setting carbon budgets. Budgets must have a view to meeting the 2050 target and consider: climate science, international circumstances, technology, the economy and competitiveness, taxation and spending, fuel poverty, energy supplies, and differences in devolved administrations. The Act does not exclude other factors or prescribe how to consider these factors, but their inclusion in the Act ensures that the CCC's advice reflects political priorities.

(2) The CCC is only advisory – the final decisions on the legislated targets and on all policies to meet them rests with the Government. The Government must take account of the CCC advice and if it diverges from the CCC proposed targets the Government must set out the reasons why.

There are limited penalties in the Act for non-compliance. This is deliberate. Instead, it creates a framework for maximum scrutiny and transparency should a Government not honour its climate commitments. This provides a powerful lever for action, so long as public opinion favours climate action. The Act also provides a legal route for challenge of specific policy decisions should these be inconsistent with the obligations in the Act. Judicial review cases can be brought by members of the public and other interested parties with legal standing (viewed broadly in the context of climate). Government's decisions have been subject to legal challenge in the past.

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2. UK Climate Change Risk Assessment

2.1 Overview

The Act imposes a legal obligation on the Government for a five-yearly assessment of the risks and opportunities facing the UK from current and future climate change, which the Climate Change Committee (CCC) provides advice on as part of its legal remit. Two national Climate Change Risk Assessments (CCRAs) have taken place to date and the third is underway (with much of the underlying evidence already produced, see for example the assessment of future flood risks, Sayers et al, 2020). In general, the Government tasks the CCC with compiling the detailed independent report on the evidence of climate risks and opportunities, which forms its advice.

The advice provided is based on an exploration of future risks and opportunities (using a combination of expert review, climate modelling as well as risk, opportunity and cost modelling) with the finding couched using a framework that is relevant to decisions being made today (**Figure 3**).

Using this framework, understanding the expected future risks from a changing climate are immediately relevant to decisions being made today, in particular:

- **Low and no regrets actions to reduce vulnerability and exposure.** Some actions can help reduce national vulnerability and exposure to climate impacts whilst providing significant wider benefits and limited costs. For example, enhancing urban greenspace will help to reduce the risks from extreme heat and flooding, support biodiversity and improve health.

- **Adaptations with long lead-times.** Some decisions take years to implement from planning to completion (such as wholesale changes to the healthcare system, land use change, or designing and building new reservoirs) which means that by the time the decision is implemented, the climate will have changed, and this needs to be considered from the beginning of the process.

- **Adaptations with long lifetimes.** Much infrastructure being constructed today has an intended lifetime of centuries. Changes in the climate need to be considered to prevent the lock-in of long-lived infrastructure or buildings that are not resilient to a range of possible future climates (e.g. planning decisions regarding the location of new housing developments or power stations).

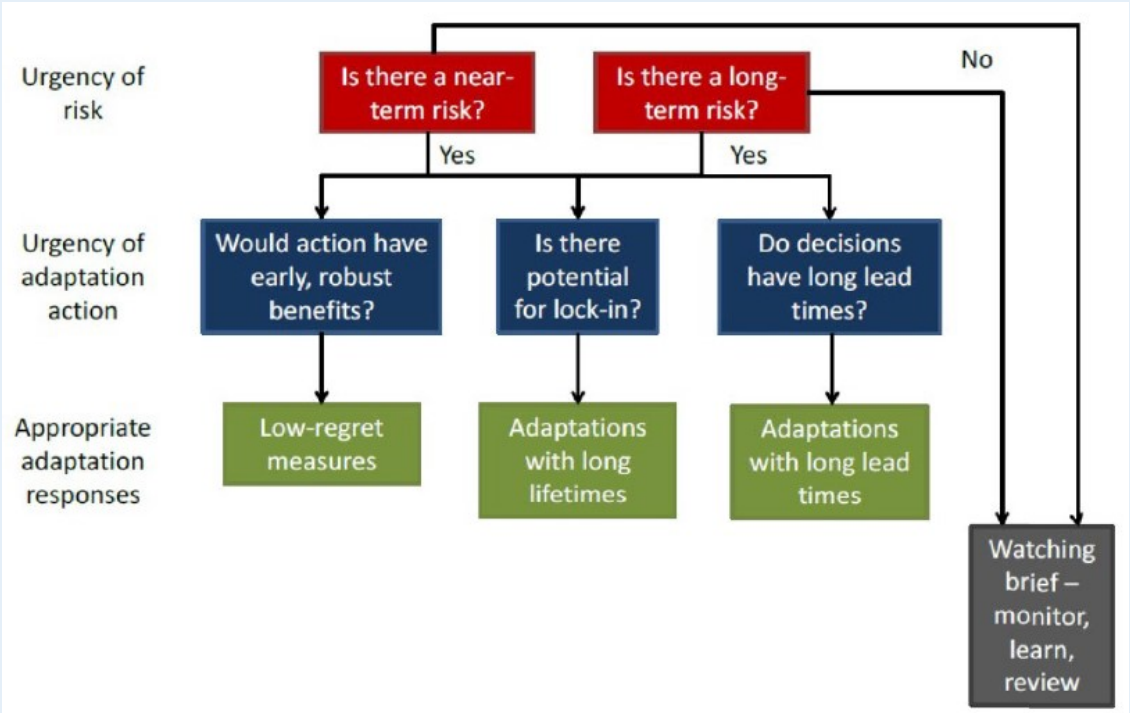

Figure 3: Risk assessment evidence is presented in decision meaningful manner [2]

2.2 Conducting a Climate Change Risk Assessment

The UK Climate Change Act requires a regular five-yearly Climate Change Risk Assessment (CCRA) of the range of climate risks and opportunities facing the UK from current and predicted climate change. There are three elements to a CCRA under the UK Climate Change Act as introduced below:

(1) A detailed Evidence Report on the range of risks and opportunities. The first step in this approach is to identify a manageable set of risks and opportunities to consider. This 'risk listing' approach is done in close consultation with Government officials. For the first CCRA, an initial list of 700 potential risks and opportunities. This was simply too many to be impactful and reduced to a summary list of just over 100. The more recent assessment are seeking to reduce this still and consider 60 metrics covering the natural environment and natural assets, infrastructure, people and the built environment, business, and international dimensions [3].

(2) Assessing the urgency of climate risks. The CCRA uses a three-tier framework to assess the 'urgency' of the action needed based on the following questions:

- What is the current and future level of risk/opportunity in the absence of further adaptation? This step assesses risks and opportunities to the UK under the current and future climates (considering a range of possible climates and socio-economic outcomes) for different time periods (e.g. present day, 2050s and 2080s). This assessment rates the magnitude of each potential risk as 'high', 'medium', 'low' or 'unknown', as well as the confidence ('high', 'medium', 'low') in the available evidence base. No further adaptation measures are assumed to be deployed except those in place today for this step.

- To what extent is the risk/opportunity going to be managed under current and expected plans? This step assesses the extent to which future risks or opportunities would be reduced or realised by existing Government commitments for new adaptation measures (and adaptation that might reasonably be expected to happen unprompted).

- Are there benefits to further action over the next five years? This involves identifying if there are benefits (e.g. avoided costs, avoiding lock-in, substantial co-benefits) for additional action over the next five years in areas where current plans are expected to lead to adaptation shortfalls.

This framework is illustrated in **Figure 4** below.

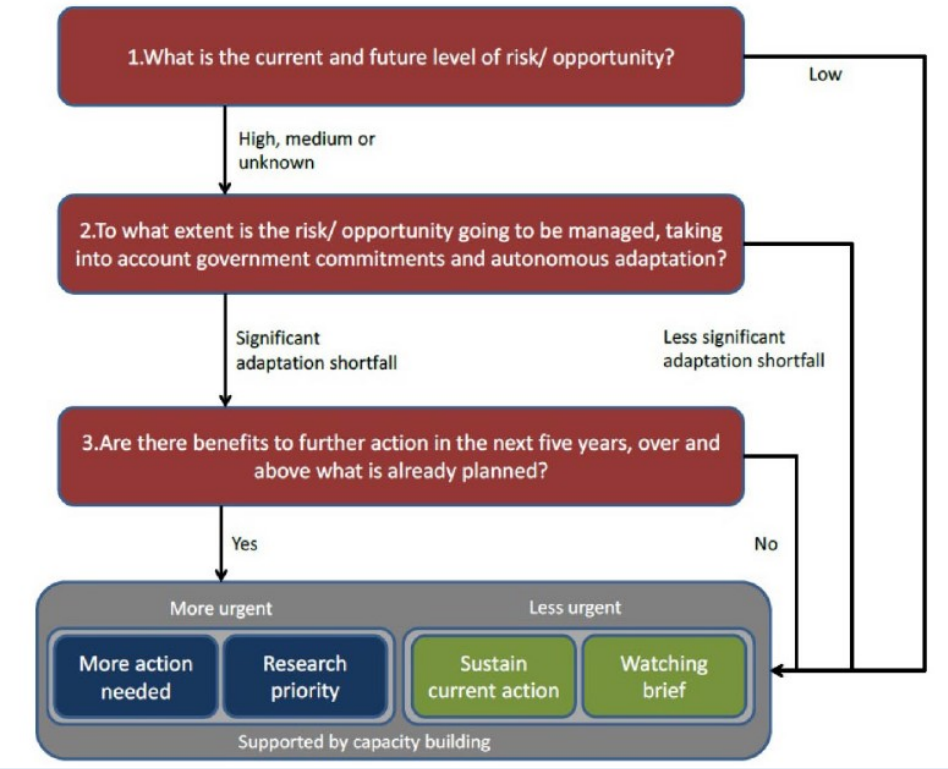

Figure 4 Categories of risks considered by the UK Climate Change Risk[2]

2.3 Assessment Research supported evidence report

As part of the CCRA a limited number of supported 'deep - dive' evidence reports are typically commissioned to provide updated quantified analysis of some of the most important risks. For example, in support of the CCRA3 (due for publication in 2021) the CCC commissioned six such studies (**Figure 5**), namely:

Figure 5 Evidence reports produced to support the Third UK Climate Risk Assessment

(1) Projections of Future Flood Risk[4]. This project updates those projections for the CCRA3 Evidence Report to take into account the new UKCP18 climate projections and the latest understanding of flood risk calculations and flood risk management policies. The project looks at river, coastal, surface water and groundwater flooding, and takes into account climate change, population growth and adaptation to project various metrics of flood risk (e.g. properties, people and assets exposed as well as annual expected damages) in the mid and late century for each of the four UK countries.

(2) Projections of Future Water Availability[5]. This project updates those projections for the CCRA3 Evidence Report to take into account the new UKCP18 climate projections and the latest plans from water companies. The project looks at both the demand for and supply of water, and takes into account population growth and climate change to project how much water will be available in the mid and late century for each of the four UK countries. The project reports results for the public water supply and also for 'all sectors' which includes the demands of agriculture, energy generation, industry and the environment.

(3) Understanding how behaviours can influence climate change risks[6]. This project addresses a key evidence gap from the CCRA2 Evidence Report on how the behaviour of individuals, communities and businesses affects vulnerability and exposure to a range of climate change risks, including flooding, heat, drought, and storms. It includes a set of case studies from locations around the UK.

(4) Climate-driven threshold effects in the natural environment[7]. This project assesses a key evidence gap from the CCRA2 Evidence Report on climate-driven threshold (i.e. non-linear) effects within the natural environment, and the role of adaptation (natural and human responses) in moderating those threshold effects. A threshold is defined in the study as "the point at which a non-linear change in an ecosystem component occurs as a result of change in a climate driver". The report assesses threshold effects in the following habitat types; freshwater, farmland and grasslands, peatlands, woodlands, marine and coastal margins.

(5) Interacting risks in infrastructure, the built and natural environments[8]. This project assesses a key evidence gap from the CCRA2 Evidence Report in understanding how climate change affects the interaction of risks across the infrastructure, built environment and natural environment sectors. The project has created 12 interlinked systems maps showing principal interactions within and between the three sectors. Developed alongside the 12 systems maps is an interactive online tool, which visualises a single (combined) 'mega map' where users can select different climate inputs to identify pathways that are of interest (**Figure 6**).

(6) A consistent set of socioeconomic dimensions[9]. This report has produced consistent socioeconomic datasets to be used by the CCRA research teams and authors. The socioeconomic metrics considered are population, GDP, GVA, employment, labour productivity, land use, R&D expenditure, energy generation by technology and household size

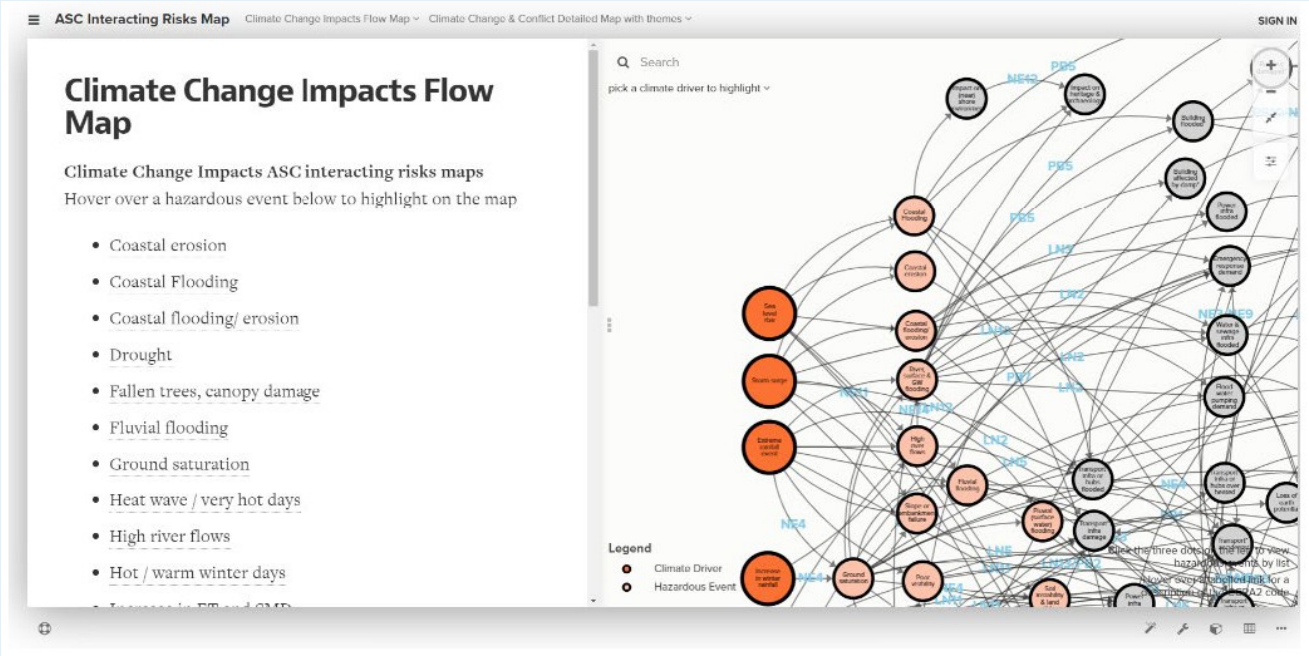

Figure 6 Example of the interactive risks tool interface

2.4 What type of evidence is provided: Example Future flood risk projections

To illustrate the type of contribution the Evidence Reports provide to the CCRA this section provides a very highlight summary of the assessment of future flood risks (more detail is provided in Sayers et al, 2020). The Future Flood Explorer (FFE, developed by Sayers) was used to provide an estimate of future flood risk across the UK using the latest UKCP18 climate projections (from the UK Met Office). The FFE provides a hybrid emulation and physics model of the UK flood risk system and its response to future change (climate change, population growth and adaptation) within a highly efficient computational framework. This enables multiple future scenarios to be explored. Here this includes two future epochs (2050s and 2080s); two climate futures (a 2°C and 4°C rise in Global Mean Surface Temperature (GMST) by 2100 relative to pre-industrial times); and two population projections (low and high). These are combined with three alternative adaptation portfolios representing: (i) a continuation of Current Levels of Adaptation (CLA), assuming current policies continue to be implemented; (ii) an Enhanced Whole System (EWS) adaptation approach, assuming more ambition adaptation is implemented, and (iii) a Reduced Whole System (RWS) approach, assuming a less ambition adaptation (**Figure 7**).

The analysis yielded several important insights, including for example:

How might flood risk change in the future if we continue to manage flood risk as at present? Assuming a continuation of Current Levels of Adaptation, Expected Annual Damages (EAD, including direct economic damage to residential and non-residential properties and associated indirect damages) are set to increase from present-day levels. Under a 2°C future EAD rises from £2bn today to between £2.7-3.0bn in the 2080s (depending upon associated population growth). Under a 4°C future risks rise to between £3.5-3.9bn.

What is the relative importance of different flood hazards on future flood risk? Fluvial flood risk is dominant today when looking at the UK as a whole and remains so in the future; rising from an EAD of ~£1.1bn today to between ~£1.2bn (2°C low population growth) and ~£1.6bn 4°C high population growth) by the 2080s assuming a continuation of Current Levels of Adaptation. The increase in fluvial flood risk is, however, proportionally less than for either coastal or surface water flooding. Surface water and coastal risks more

than double under a 4°C high population growth future (surface water risks rising from ~£0.6bn to ~£1.2bn by the 2080s and coastal risks increasing from ~£0.4bn to ~£1.0bn). Groundwater flooding remains a small proportion of the UK risk (rising from £54m to £95m).

What is the relative influence of climate change, population, and adaptation on future flood risk? Climate change is the dominant influence in driving up future risk (increasing Expected Annual Damages EAD - direct and indirect – by £4.2bn under a 2°C future and £6.9bn under a 4°C future in the absence of any adaptation). The influence of climate change is greatest at the coast; especially when the rise in Global Mean Surface Temperature (GMST) exceeds 2°C, with EAD rising by a further 70% under a 4°C rise in GMST compared to 2°C. For comparison, the risks associated with all other flood sources increase by ~20% between a 2 and 4°C future. The influence of population varies with the projection of growth. Assuming a low population growth the additional impact on risk is limited (although not insignificant, adding

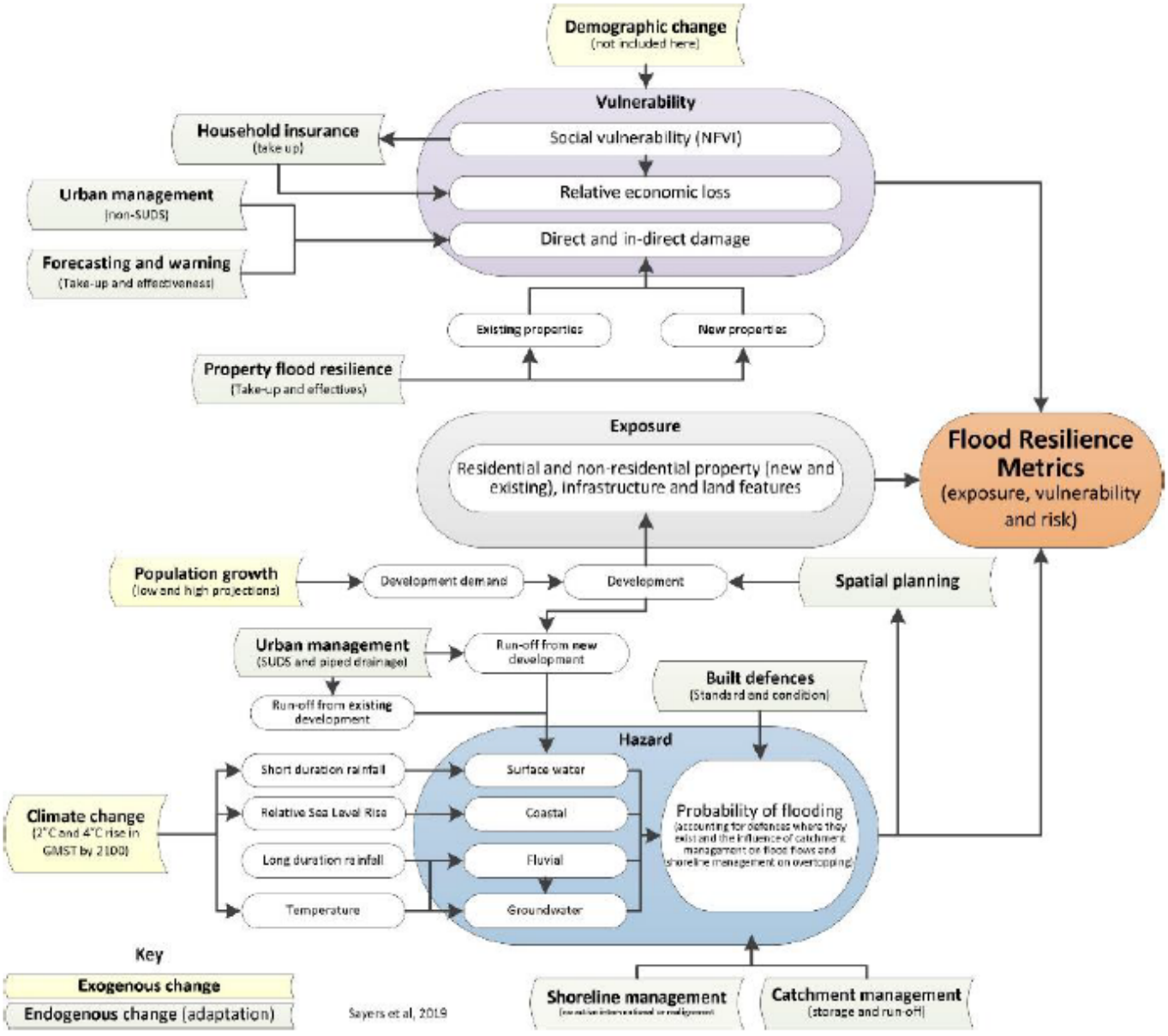

Figure 7 Framework of the Future Flood Explorer applied in the CCRA3

£364m to EAD), whereas a high population growth future has a much greater influence (adding ~£2.4bn to the EAD assuming a 4°C rise in GMST). By the 2080s the combination of a 4°C climate change and high population growth future drives an increase of ~£9.2bn EAD in the absence of adaptation. The future is therefore bleak in the absence of adaptation and mitigation. All three adaptation portfolios limit this increase. A continuation of Current Levels of Adaptation offsets ~£7.4bn of Expected Annual Damages in the 2080s (under a 4°C high population growth future) resulting in a net increase in risk of ~£1.8bn. An Enhanced Whole System (EWS) approach to adaptation offsets ~£8.2bn of EAD (total) in the same scenario; limiting the net increase in risk to ~£1.1bn. A Reduced Whole System (RWS) approach offsets much less (~£6.4bn); consequently, the net increase in risk much greater (~£2.8bn). **Figure 8** illustrates these disaggregated risks.

Positive bars show present-day and increases in present-day risks as a result of climate change or population growth by the 2080s. Negative bars show how the EAD for a 4°C, high population, scenario can be offset by applying the three adaptation portfolios. Grey shading: Present-Day risk. Lighter non-grey shading: Additional risk in the 2080s compared to present-day under a 2°C future; Darker non-grey shading: Additional risk under a 4°C future compared to a 2°C future.

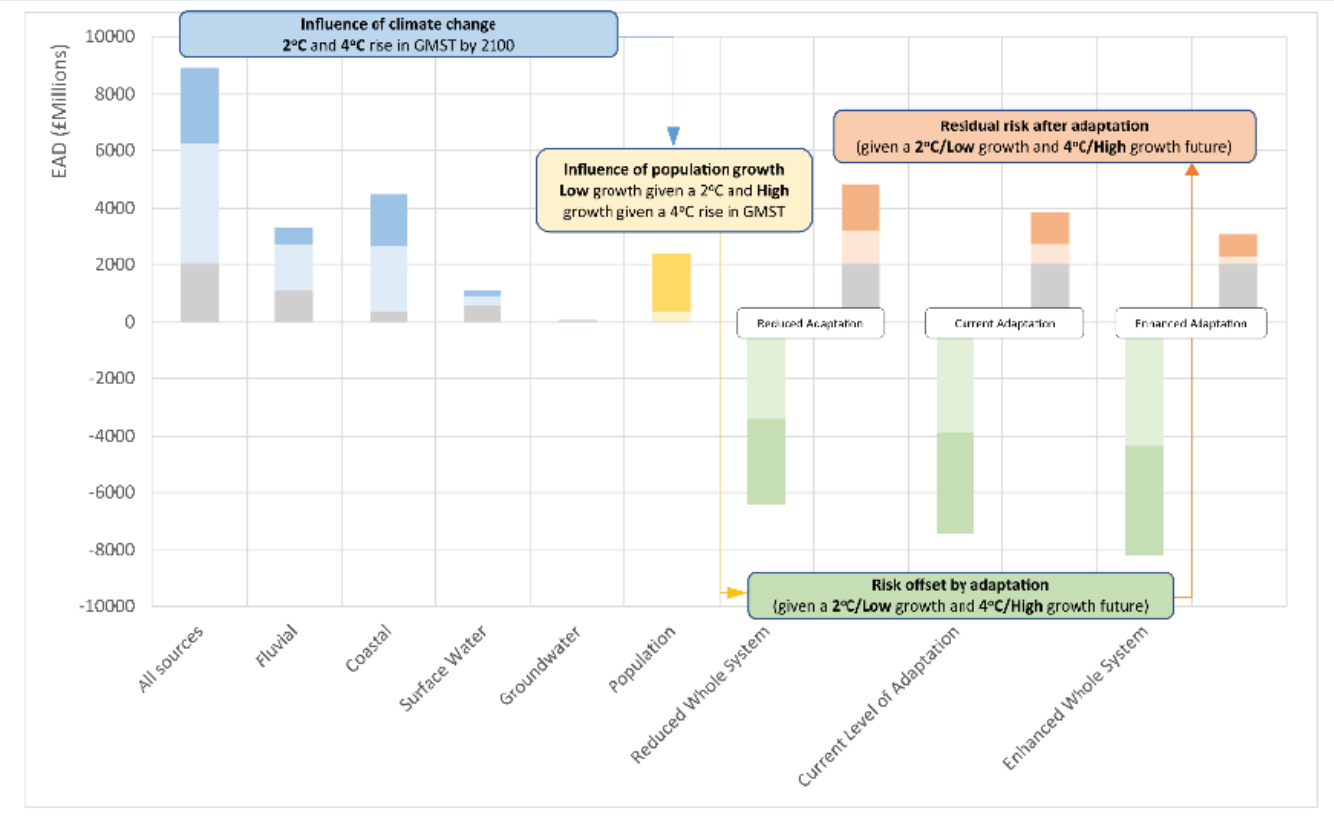

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Figure 8 Drivers of changes in risk by 2080s – Expected Annual Damage (total)

3. Learning from 12 years of implementation

3.1 Maximizing the influence of a Climate Change Act

Several areas where the framework of the UK Act works well have been apparent over the twelve years of its existence:

- **The long-term target has focused minds.** The initial 80% greenhouse gas reduction target, and particularly the recent Net Zero target, have focused policymakers and businesses on engaging in the challenges ahead. It has also ensured that policy is designed with a longer time horizon in mind, as is appropriate for the energy sector where investments have long lifetimes. The Climate Change Risk Assessment has improved understanding of climate risks.

- **Clearly assigning duties and responsibilities has raised the profile of climate change.** The clear legal obligations on a specific Minister, as well as the Act's status as primary legislation, has helped climate change to receive more regular attention at the highest levels of Government.

- **The inclusion of adaptation within national climate laws can help create the necessary legal and support frameworks required to factor a changing climate into policy decisions.** A regular evidence-based process to identify the most important risks and opportunities in each sector is an essential part of this process (such as the Climate Change Risk Assessment).

- **A medium-term pathway and regular progress assessment has helped improve policy making.** The CCC has become a natural focal point for the UK's knowledge network around climate change and has formed a bridge between researchers, businesses and policymakers. The setting of carbon budgets twelve years in advance is sufficiently short to provide a useful focal point for decision making today, whilst also being far enough away to make setting ambitious targets politically easier.

- **The presence of an independent adviser has helped resolved political differences.** When politicians disagreed on the appropriate level for the 2050 target before the Act was finalised in 2008, it was set on the CCC's advice. When new coalition partners disagreed in 2010 on the role of renewables and nuclear in the energy sector, the CCC were asked within the coalition's programme for Government to advise on renewables.

3.2 Lessons learnt since the introduction of the Act

- **Treatment of emissions from international aviation and shipping remains unclear.** Interim carbon budgets and the end goal are set factoring in the UK share of international aviation and shipping emissions, but these emissions fall out of the scope of current carbon budget accounting under the Act. While the Government has accepted that they must be covered by the UK's 2050 Net Zero target they have not yet formally set out how they will be included in UK climate targets. This highlights the need to agility in the process, to respond to issues as they arise between major updates of the CCRA.

- **Carbon budget accounting methodologies can be complex.** While the 2050 target is legislated as a percentage reduction on UK emissions in 1990, the interim carbon budgets are legislated as absolute emissions totals. This makes the level of ambition needed to achieve the carbon budgets sensitive to changes in estimates of the UK's emissions to reflect improved scientific understanding (for example better measures of emissions from peatlands). These changes can act to make carbon budgets artificially harder or easier to achieve depending on their specifics.

- **Other parts of the UK's contribution to climate change are not addressed.** The carbon budgets focus exclusively on the UK's emissions from domestic activity in accordance with international emissions accounting rules. Other parts of the UK's contribution to tackling global climate change, including its overseas carbon footprint and contributions to international climate finance, are not covered by the Act, although these are considered in the advice the CCC provides to Government.

3.3 Lessons learnt in conducting an effective CCRA

Key challenges that have emerged over three assessments so far:

- **Collating evidence from a disparate evidence base is difficult but not impossible.** The UK approach centres on an assessment of the level of risk or opportunity under different assumptions on the level of climate change, socioeconomic development and adaptation ambition. The CCRA's approach to scoring each risk or opportunity has evolved into a criteria-based framework based on urgency (as introduced earlier), rather than using a single quantitative assessment of magnitude based on climate projections. This approach allows for more evidence with different underlying assumptions to be included, as well as evidence with a range of uncertainties.
- **A CCRA relies upon a large programme and large numbers of experts must be well-managed:** A well-established governance framework is used to effectively manage the process, with clear decision-making structures – without this evidence and expert views can be difficult to bring together in a timely coherent fashion. The CCC acts as the central coordinating body for this work to make sure that it proceeds to plan. The CCC uses three independent review groups; technical peer reviewers, government reviewers, and other external experts, to ensure the Evidence Report outputs are robust.

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