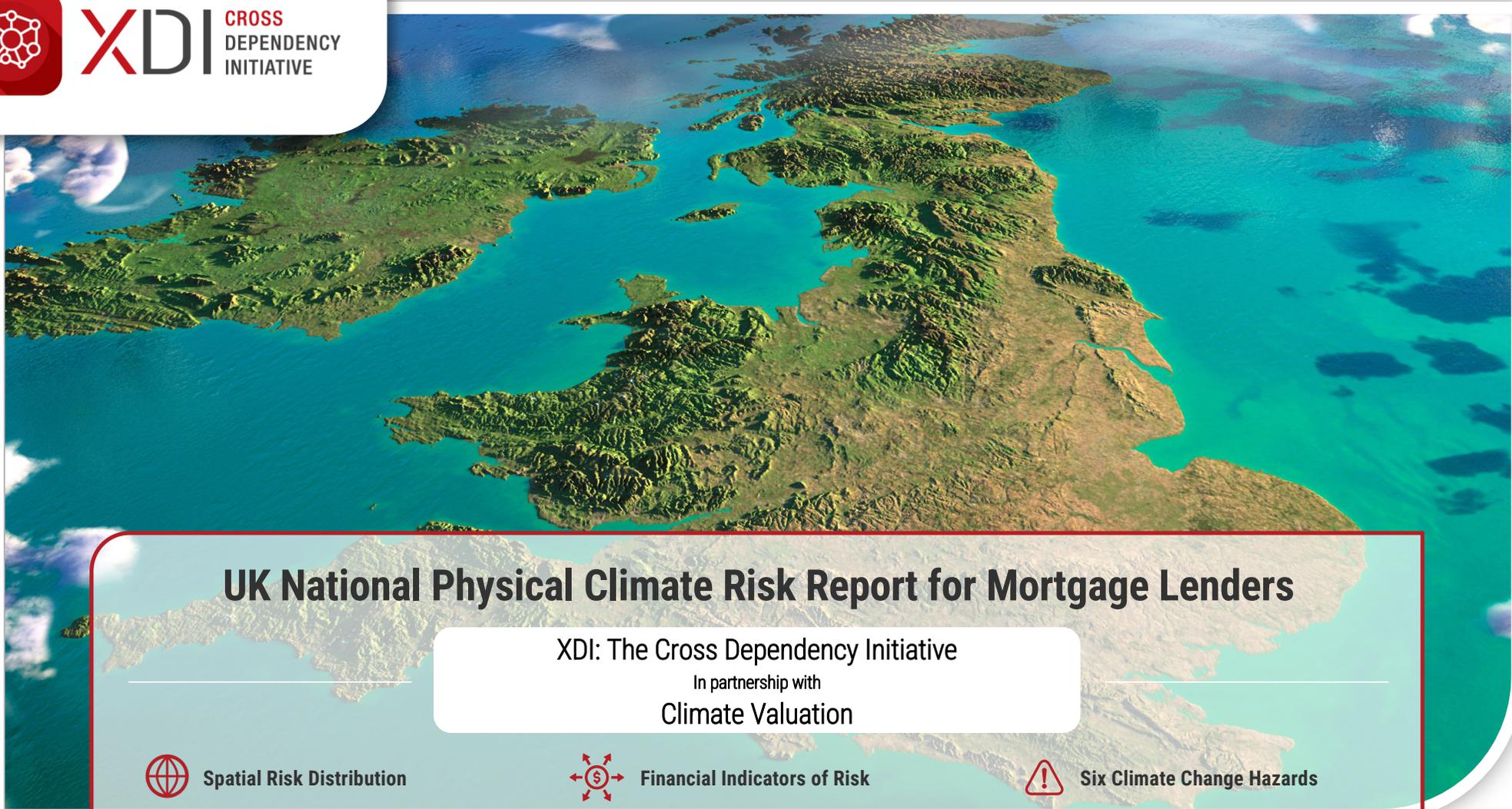




XDI CROSS
DEPENDENCY
INITIATIVE



UK National Physical Climate Risk Report for Mortgage Lenders

XDI: The Cross Dependency Initiative

In partnership with

Climate Valuation



Spatial Risk Distribution



Financial Indicators of Risk



Six Climate Change Hazards

November 4TH, 2021

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The Earth could be just 10 years from heating by more than 1.5 degrees Celsius – a threshold beyond which even more serious and frequent fires, droughts, floods and cyclones are expected to wreak havoc on humanity.

IPCC 2021

IMPORTANT INFORMATION

WHAT THIS ANALYSIS DOES AND DOES NOT DO

The analysis represented in this report uses the Climate Risk Engines operated by Climate Risk P/L that process information and return results. Generally, the analysis is conducted on Representative Assets which are synthetic representations of a real or hypothetical asset which may include real estate properties, infrastructure or other physical objects. Information about this Representative Asset is processed together with other relevant information such as location, age or value. The Climate Risk Engines integrate the information sent to it with information from a large number of national and international datasets from government institutions, universities and private companies to provide a generalised model of how climate change may affect a number of physical risks to the Representative Asset, all else being equal. However, the Climate Risk Engines do not provide a forecast, prediction or projection based on any real or planned asset.

The analysis does not purport to 'cover the field' of all potential risks associated with climate change nor to address coincidence or correlation between such risks. For example, extremes of precipitation and flooding may be coincident with extreme windstorms which can weaken a building making it more vulnerable to damage. The Climate Risk Engines do not necessarily take into account the impact of any actual built infrastructure, modifications, adaptations or resilience-building measures (public or private) that have been, or may be, applied that reduce (or exacerbate) the relevant hazard. No representation is made in relation to the availability or coverage of insurance to a real or planned asset.

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SCIENTIFIC LIMITATIONS

The information presented has been generated using an expert selection of the scientific methods and computational modelling techniques available at the time of creation. However, at any time there are known limitations of which you should make yourself aware. These are constantly refined and updated and are clearly specified on the Xdi.systems and EasyXDI website.

SCOPE OF MODELLING AND SCENARIOS

Science is not able to definitively predict the exact range or rate of future global warming; or the scale and rate of change of atmospheric and oceanic processes that may be hazardous, including temperatures, precipitation, wind and the rise in sea levels that result from this warming. Many variables will determine society's continuing rate of emission of 'greenhouse gases' (including political, regulatory, technological and behavioural factors), and how the Earth's natural systems respond. However, we can estimate a range of potential impacts across what mainstream science considers to be a plausible set of scenarios for future ocean and atmospheric behaviour. The scenarios used for this analysis are specified in the relevant Scenarios sections of this report.

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CAVEATS AND LIMITATIONS

Excluded Hazards: The analysis only includes hazards specified – it does not include hurricane/cyclone, landslip, erosion, lightening or any other hazards apart from those specifically identified.

Non-Accessible Assets: The analysis is based on synthetic representations of assets with identifiable address such as free standing dwellings, shops, offices, branches, factories, commercial buildings, apartments and duplexes. The analysis does not include movable dwellings without postal addresses such as caravans, annexes or tents.

Prepared by:

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EXECUTIVE SUMMARY

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INTRODUCTION

XDI undertakes asset level climate change physical risk analysis to the built environment all over the world. At any one time, about 100 people are EasyXDI.com to check physical risk to individual infrastructure and property assets. But in some circumstances a deep dive into a whole-of-country property data set is really beneficial. It can provide a national baseline of risks from hazards such as flooding, coastal inundation and subsidence to help stakeholders understand what lies ahead for the nation - along the lines of a report on the performance of a client portfolio. It also allows for a nuanced geographical breakdown so that we can see where and when problems are emerging and therefore support policy interventions by the public and private sectors to protect vulnerable communities.

The aim of this report is to provide quantified insights into the scale, severity and concentration of current and future extreme weather and climate change risk to the UK's national property address base. This information will be of relevance to government, regulators, and financial institutions working with commercial and residential assets.

This report contains results from analysis on the entire address base of 34 million residential and commercial addresses in the UK and Northern Ireland. The address base has been stress tested under RCP 8.5.

This data set creates the opportunity for all lenders, large and small, to have the information they need to avoid financial instability due to climate impacts.

ANALYSIS PARAMETERS

Emissions Scenario: The impacts of the high-emission scenario RCP8.5 is presented here which is consistent with current trends. Emission pathways RCP4.5 and RCP2.6 are computed, but not presented herein.

Aggregation: Risks have been aggregated into 406 government areas.

Metrics

- **MVAR** Max-to-Date Value at Risk
- **HRP#** Number of High-Risk Properties per county
- **HRP%** The percentage of High Risk Properties per area
- **CAV%** Climate Adjusted Value percentage of value of building stock

Time frame: Risks computed annually from 1990 to 2100, reported at

- current position,
- end of mortgage terms (2050), and the
- end of the modelling horizons and building life (2100).

Hazards: Six hazards have been considered in detail

- Riverine flooding; surface water flooding; coastal inundation; extreme wind storms; and soil subsidence.
- Forest fire, freeze-thaw and hurricanes will be of less relevance in the UK.
- Heat waves have been analysed but are not covered in this data-report.

Archetype: Addresses are analysed according to the construction and engineering properties of a moderately resilient asset, no sensitivity testing is included in this report,

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INSURANCE AND DEFAULT RISK

5-fold increase in insurance costs. Premium corrections likely.

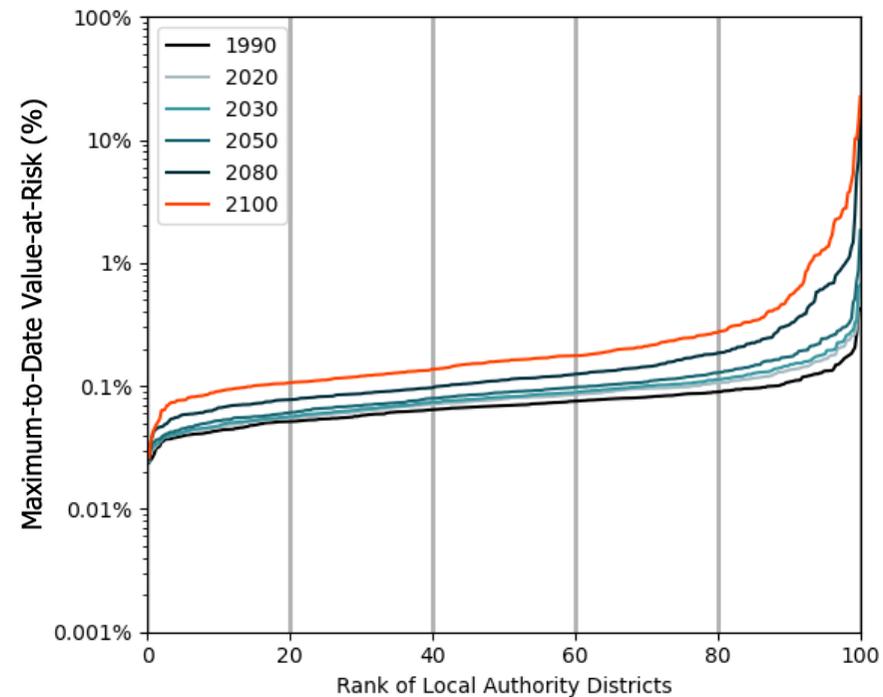
- Its estimated that the annualised of costs damage-based losses has increased by 18% since 1990 due to climate change.
- Insurance premiums have likely not kept up with this underlying risk and a correction is therefore expected.
- Looking forward, insurance costs for extreme weather can be expected to increase a further 28% between 2021 and 2050 and 5.4 fold by the end of the century.

Half a million properties at risk of losing affordable insurance, increasing to 1.9 million

Of most importance to mortgage lenders are high-risk properties which are vulnerable to a loss of affordable insurance and therefore at severe default risk in case of an extreme weather event as well as negative equity as property values adjust.

- Currently, **555,250** properties (or 1.6% of addresses) have been classified as high-risk.
- This is projected increase to **742,000** (2.18%) by 2050 and then to **1,860,000** (5.45%) by 2100.
- These properties are at high risk of mortgage default if they are uninsured when an extreme weather event occurs.
- The long-term impacts will largely be locked-in by existing building codes and planning regimes.
- Possible mitigation through future emission reductions, property adaptation, municipal protective works or relocation of high risk-communities.

MAXIMUM-TO-DATE Value-at-Risk (MVAR%)



This graph shows the distribution of Maximum-to-Date Value-at-Risk across the UK national address base under the RCP8.5 scenario for the moderately resilient property archetype. The vertical axis is Maximum-to-Date Value-at-Risk % and the horizontal axis is the percentile of assets in that MVAR band.

The different coloured lines represent different time points between 1990 and 2100.

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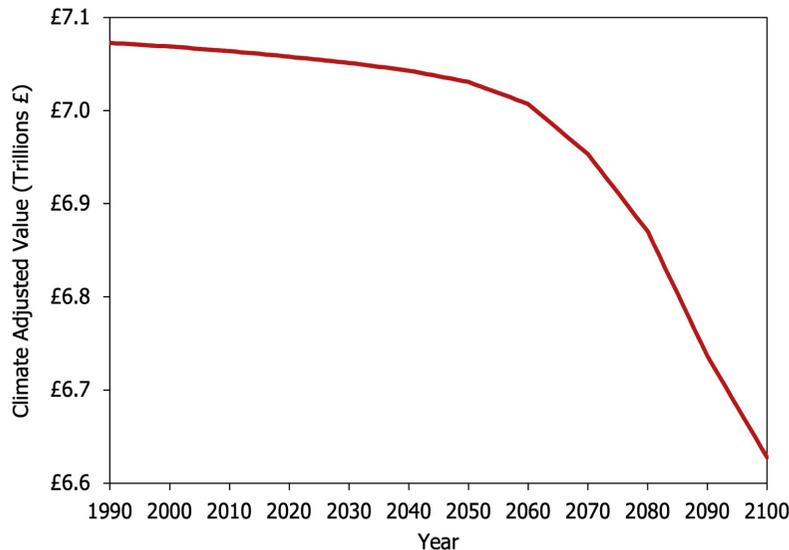
PROPERTY VALUE DECLINES

1.4% Property Value Corrections Overdue, 7.5% of climate correction projected

As both commercial and residential property buyers start to consider climate change and insurance costs in their purchasing decisions it is to be anticipated that properties highly exposed to extreme weather and climate change impacts will decrease in value relative to the market. In some cases, those declines may be severe enough to cause negative equity.

- The modelling suggests an overdue market correction of 1.4% due to climate change.
- Looking forward the decline will increase to 1.7% by 2050 and 7.5% by 2100.
- Value of the likely correction is over half a trillion pounds (~ £525bn) before 2100.

CLIMATE ADJUSTED VALUE (CAV)

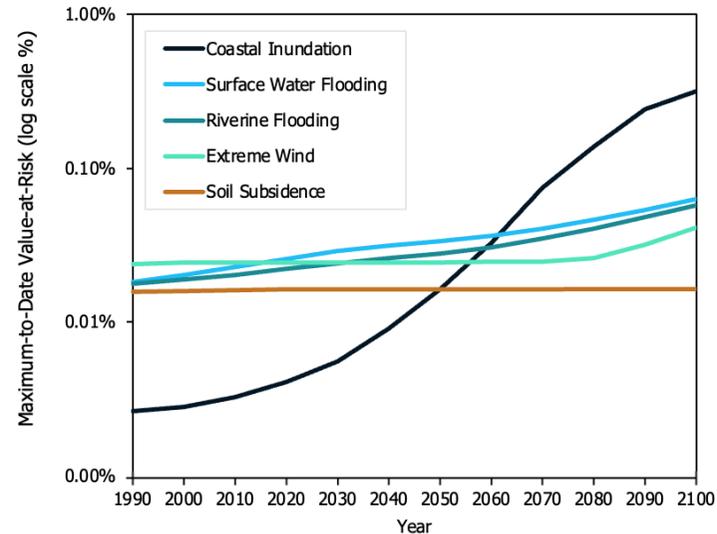


KEY HAZARDS DRIVING CLIMATE RISK IN THE UK

Inland flooding driving risk today, overtaken by coastal inundation as seas rise

- Currently and in the short term, riverine and surface water flooding will be the main drivers of extreme weather and climate change impacts to property.
- Eclipsed by coastal inundation driven by storm surge and sea level rise around 2060.
- To a lesser extent wind-storm events and soil subsidence during droughts represent lower level but widespread risk, which will be of less importance to lenders, but significant for insurers. The climate signal on these hazards is currently weak or uncertain.
- Percentage of properties flood exposed in 2100: 4% River, 7% surface, 6% coastal.

EVOLVING CONTRIBUTION OF EACH HAZARD



This log scale graph shows the steady growth of riverine and surface water flooding, and the exponential growth of coastal inundation.

Extreme weather and subsidence risk have a large contribution due to the large number of exposed properties to low level impacts.

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GEOGRAPHICAL DISTRIBUTION OF RISK

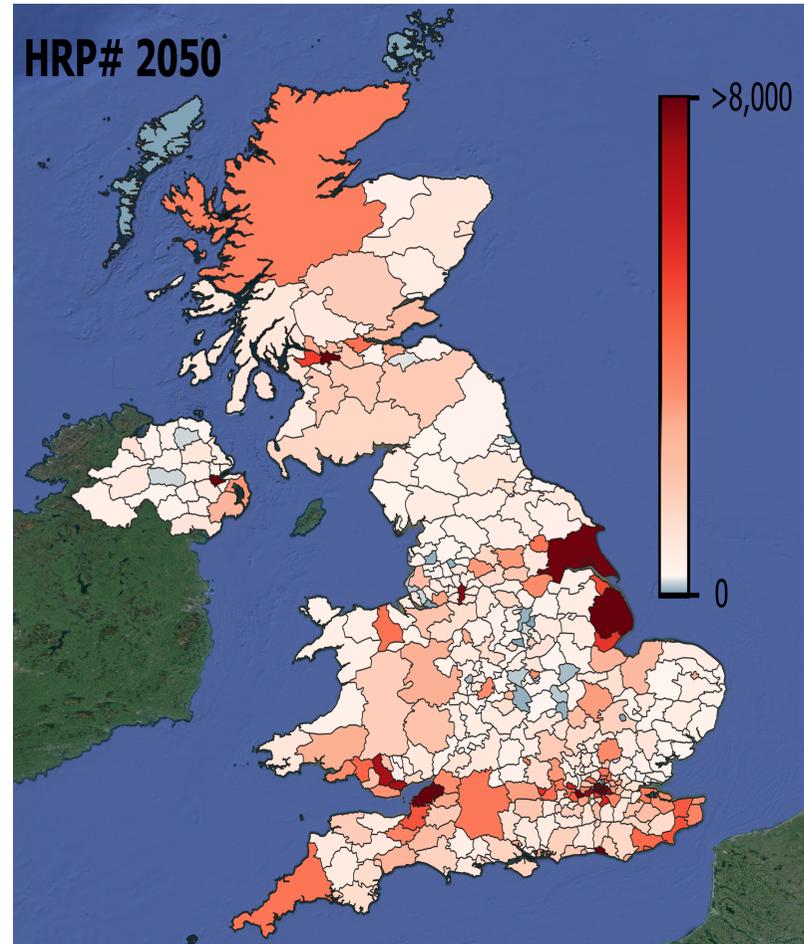
High geographical concentrations. Some properties at risk of being unable to obtain mortgages.

Across all 406 administrative areas within the UK, 81 (20%) areas with the highest counts of high-risk properties contribute to 70% of all high-risk properties in the year 2050.

- In suburbs with high percentages of high-risk properties, some values are projected to collapse as properties become un-mortgageable.
- The 10 areas with the highest percentage of high-risk properties in 2050 have been identified for each UK country.

RANKING OF AREAS HRP# (HIGHEST TO LOWEST)

	England	Scotland	Northern Ireland	Wales
1	Kingston upon Hull	Glasgow	Belfast	Denbighshire
2	Spelthorne	Renfrewshire	Ards	Rhondda Cynon, Taff
3	East Lindsey	West Dunbartonshire	Down	Neath Port Talbot
4	North Somerset	Falkirk	Larne	Merthyr Tydfil
5	Boston	East Dunbartonshire	Omagh	Vale of Glamorgan
6	Runnymede	East Ayrshire	Ballymena	Cardiff
7	Lambeth	Highland	Banbridge	Bridgend
8	Reading	Scottish Borders	Newry and Mourne	Swansea
9	Slough	Perthshire and Kinross	Derry	Carmarthenshire
10	Hastings	Clackmannanshire	Magherafelt	Powys



The more severe impacts of extreme weather and climate change - those sufficient to cause default or negative equity - are highly clustered.

EXECUTIVE SUMMARY 5 OF 6. RECOMMENDATIONS

1. Assess risks to individual Mortgage Portfolios

It is important for each lender to understand the extreme weather and climate change physical risks to their individual portfolio. At a minimum this must cover the hazards to which each property is exposed, and how these hazards are projected to evolve over time. This should include the specific vulnerability of each property or the range of possible vulnerability if design and construction details are not available. Borrowers may need support due to the risk of unaffordable insurance cover, default and negative equity.

2. Require comprehensive insurance coverage for High-Risk properties

The immediate risk to the lender is that a property that is damaged or destroyed by an extreme weather event does not have adequate insurance to cover the cost of the rebuild or repair. Therefore,

- a) Establish actual vulnerability with on-site survey to determine the design and construction attributes.
- b) Establish the hazards and quantum of property insurance coverage in zones of high hazard exposure.
- c) Require that each borrower with a high-risk property provide the bank with certificate of currency of the policy with the identified cover and inclusions.

3. Screen Incoming Mortgages as the Point of Sale

The simplest way to reduce physical climate risks within the lending portfolio is to avoid writing new mortgages on high-risk properties unless resilience works are undertaken. It is therefore highly recommended that lenders implement Point-Of-Sale screening systems. Lenders should ensure the design standards for properties being considered for mortgages are appropriate for the present and future location-specific hazards. Where properties fall short either (a) more information may be needed to verify resilience or (b) adaptation strategies to ensure the building becomes fit for purpose

4. Be proactive with building resilience in the portfolio rather than relying on insurers or government.

Every year insurers are able to change their position with regard to included hazards, premiums and geographical coverage, so there is no long-term commitment over the life of a mortgage as there is for a mortgage lender. Government insurance schemes and commitments of building protective infrastructure like river levies and sea-walls fall prey to political winds. As a result, mortgage lenders cannot presume to rely on insurers or governments to implement development or financial mechanisms to drive adaptations, or to prevent risky properties from being built or sold. It is therefore imperative that lenders acknowledge they are more exposed than other financial sector actors and be prepared to protect their own position and drive adaptation with their customers.

EXECUTIVE SUMMARY 6 OF 6. RECOMMENDATIONS

5. Develop climate-ready products and policies

To safely write new mortgages for an incoming high-risk property means finding a way to make that property low risk. In many situations actions can be taken at a property level to make the property resilient to the location-specific hazards. While these actions will have associated costs, these costs could be met via 'mortgage-extension' products provided by the lender. These should be seen as necessary investment that will immediately increase the value of the property, ensure the property is insurable at low cost for the life of the mortgage and therefore protect the bank against climate driven serviceability pressures, default risk and negative equity. Lenders might also wish to establish public policy recommendations that promote government grants and relocation programs to drive local adaptation and support homeowners in high-risk locations.

6. Test Adaptation Strategies

The impact of different internal and external (e.g.: planning) policies can be tested to see their effect on the climate risk position of the lender over time. This can be informed by churn rates, point-of-sale screening rules and geographical distributions. In general, this information will be useful for investors to understand not just the lenders current position with regard to climate change risks, but if and how the lender intends to achieve a target risk posture for climate change impacts.

7. Prepare for Shareholder and RMBS Scrutiny under TCFD

Investors themselves are being asked by the market to disclose their climate risk exposure and this means they will need to understand the risk profile of their shareholdings and products like Residential Mortgage Backed Securities (RMBS). As such lenders must expect to have this analysis to hand or expect the investors to make their own assessments using national or regional data (such as this report). Therefore, lenders would be wise to be proactive about risk disclosure and forward-looking risk mitigation and management, as ignorance of an issue is perceived as a higher risk than inaction.