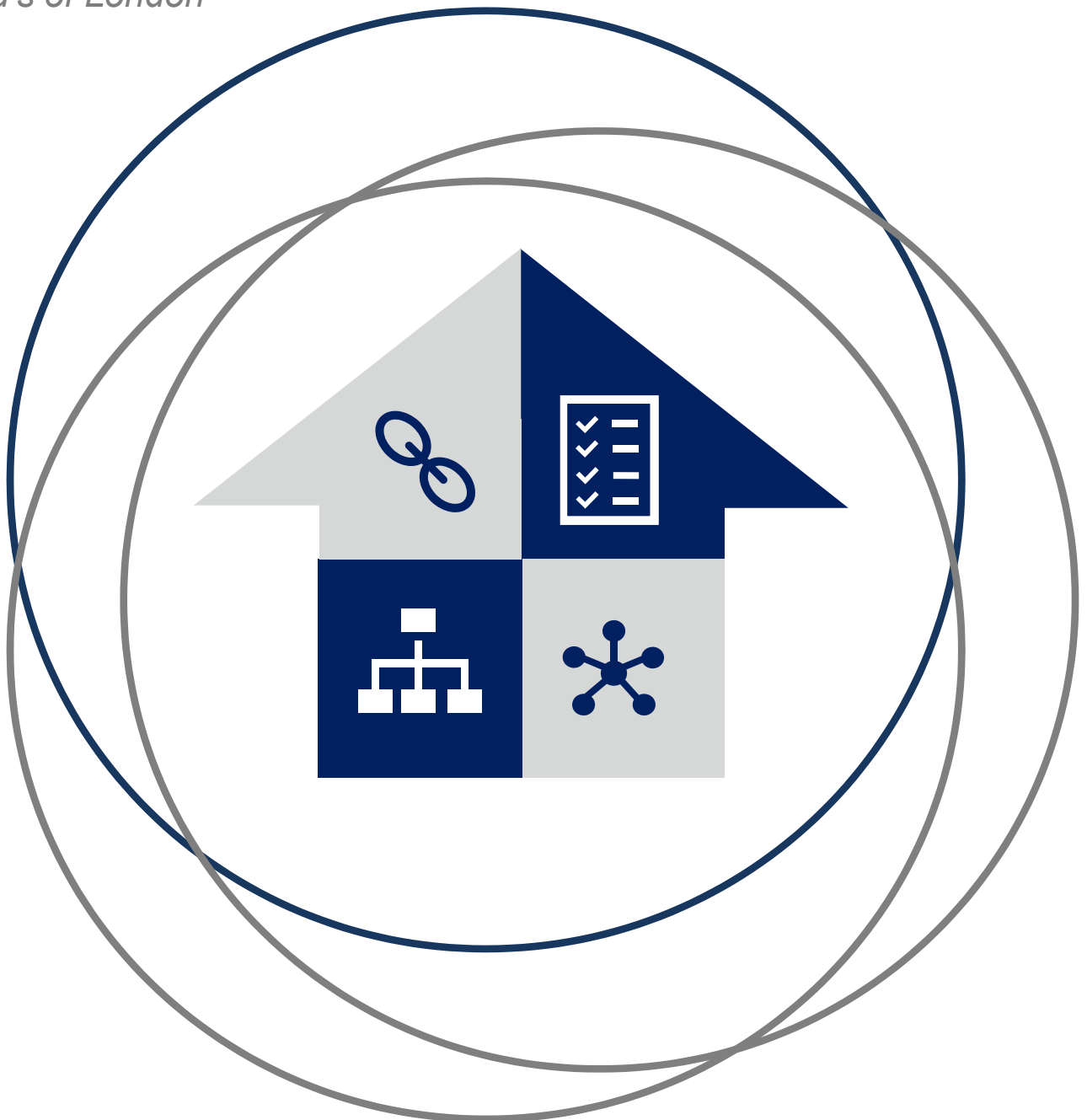


Innovative finance for resilient infrastructure

Preliminary findings

*Centre for Global Disaster Protection
& Lloyd's of London*



The Centre for Global Disaster Protection, in partnership with Lloyd's of London, convened experts from across the financial services, development, humanitarian and engineering communities to catalyse new thinking on how innovative financial instruments can help respond to the global resilience challenge.

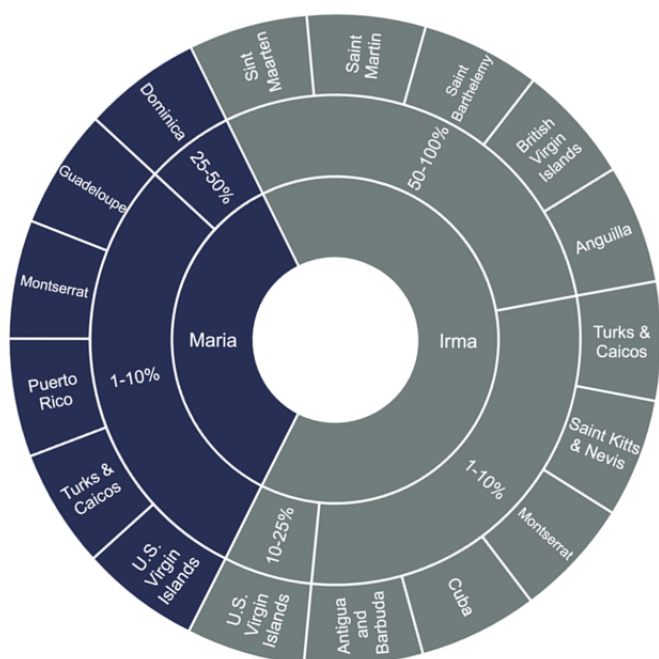
The importance of meeting this challenge was once again highlighted during the 2017 hurricane season which vividly illustrated the tremendous human and economic cost of natural disasters.

Globally, more than 11,000 lost their lives as a result of disasters (Swiss Re, 2018) and preliminary estimates suggest total economic losses could be \$300-330bn (Swiss Re, 2018 and Munich Re, 2018).

The North Atlantic hurricane season was notably active. Hurricanes Irma and Maria demonstrated the devastating impacts that extreme weather can cause on the lives and livelihoods of vulnerable people, and the disruption it can cause to critical economic and social sectors. Maria, for instance, resulted in damages and losses equivalent to 226% of Dominica's annual GDP, and large parts of the country remained without power several months on (Government of the Commonwealth of Dominica, 2017).

The magnitude and extent of impact across the Caribbean was vast, with some islands experiencing near total damage (see Figure 1, below). Risk Management Solutions (RMS) modelled estimates suggest that total direct economic losses in the Caribbean from hurricanes Irma and Maria were between \$55 and 105 billion (RMS, 2018). Indirect impacts, including disruption of critical services and business, further amplify the scale of disaster.

Figure 1: Total damage percentages (economic loss/total exposure) by country for hurricanes Irma and Maria (RMS)



The economic and societal impacts of disasters are growing.

The average annual cost of damages has increased almost 10 times since the 1970s (Swiss Re, 2018). This growth is driven primarily by development in high risk areas and, for some events, further exacerbated by the impacts of climate change.

Looking forward, climate change is expected to increase the frequency and severity of severe weather events (IPCC, 2014; IPCC, 2012). Rising sea levels further amplify the risk in low-lying coastal areas.

Small Island Developing States in the Caribbean and Pacific are particularly vulnerable to these changes.

More can be done to strengthen resilience and speed-up recovery from disasters.

- **Poorly constructed & maintained infrastructure, including schools, hospitals, housing, roads and power infrastructure are particularly vulnerable to disasters.** Analysis by RMS suggests that Caribbean damage costs from hurricanes Irma and Maria could have been of the order of \$16.5 billion less had impacted buildings across all islands been constructed according to 2018 design codes (\$1.7 billion reduction for subset of countries specified in Figure 2, see overleaf).

Making infrastructure, and the services it provides, more resilient, would mean less damage, lower repair costs, reduced injury and loss of life, less downtime, and, ultimately, better served communities. It would get children back to school, people in their jobs, and keep critical services like power and water online. With the right design, it can deliver a host of co-benefits. This allows economies to reduce the impact of disaster and to recover more quickly.

Collectively, these economic benefits from resilient investments provide a long-term 'resilience dividend' which may exceed the additional costs of resilience by a ratio of at least 4:1 (OECD, 2015; UK Government Office for Science, 2012; FEMA, 2011).

For some poor countries, there may be sound economic reasons for underinvestment in resilient infrastructure; for example, high discount rates or scarce resources required elsewhere.

But there can also be other barriers such as: a lack of finance to meet resilience demands; uncertainties as to how valuable the investment will be; difficulties in implementing and enforcing building codes; or political economy constraints.

- **Delays in recovery and reconstruction, mean that the short-term impacts of a disaster can have persistent long-term consequences.** Such delays can result from a lack of timely finance, materials, preparedness, regulatory and contractual issues, or capacity constraints.

For example, more than half a million homes were badly damaged or destroyed by the 2015 earthquakes in Nepal, but most people whose houses were severely damaged continued to live in temporary and improvised shelters more than 18 months later. Reconstruction was hampered by a number of local factors (Kumar, 2016).

If the benefits of building resilient infrastructure could be quantified and captured, this could help to finance the additional costs and boost investments in resilience.

Resilience investments generate a quantifiable resilience dividend. If some of this dividend could be captured using innovative financial instruments, it would help finance the costs of more resilient construction and building back smarter.

Resilience investments often need to be complemented by risk transfer solutions.

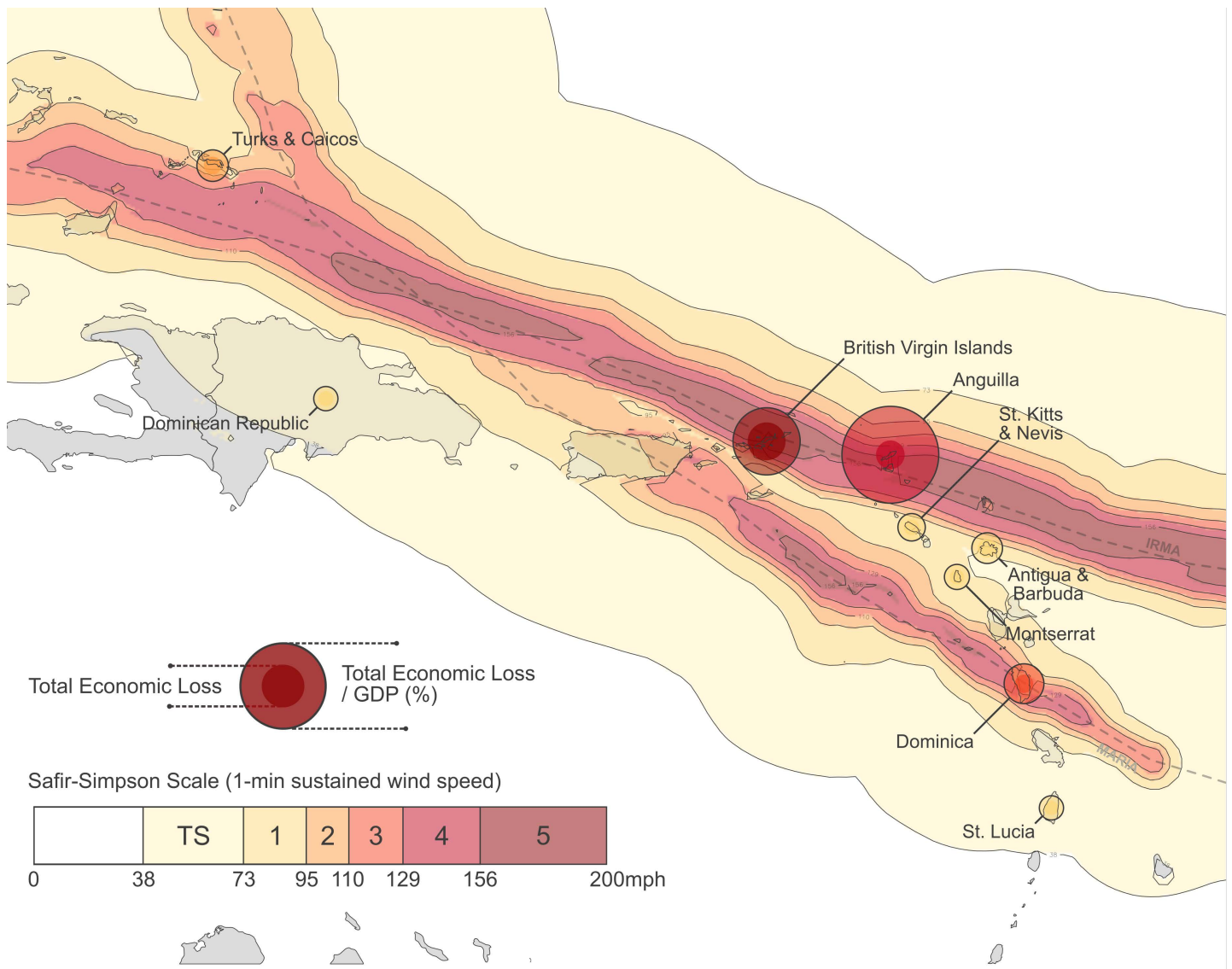
Resilient construction can play a crucial role in limiting the damages from smaller, more frequent events.

However, the most extreme events still risk acute damage and disruption to service. For instance, RMS analysis indicates that wind speeds from hurricanes Irma and Maria were so ferocious that direct economic losses across all islands would still have been ~80% of what was experienced, even if damaged buildings had been constructed to 2018 building codes.

In such cases, the imperative is to design infrastructure and critical services that can bounce back quickly, prepare in advance and put in place capabilities and systems that are able to deliver rapid finance to kick-start recovery and reconstruction.

In these cases, risk transfer solutions have a proven track record: payouts from such schemes can happen in days or weeks. This compares to the 4-9 months sometimes needed for multilateral financing or humanitarian aid for reconstruction and recovery (World Bank, 2017). Furthermore, setting out *ex ante* plans on how payouts will be spent can help ensure these predictable payouts are put to best use.

Figure 2: Hurricanes Irma and Maria, RMS HWind 1-min sustained wind speed footprints, with modeled direct economic loss estimates, and loss as a function of GDP proportionally displayed as circles for a subset of Caribbean countries



Modeled Economic Loss 2017

RMS has calculated modeled direct economic loss estimates for hurricanes Irma and Maria (results shown are for 9 areas listed to right). The underlying economic exposure database represents the RMS view of the existing building exposure at risk within the Caribbean. This database includes insured and non-insured residential, industrial, and commercial lines, but excludes certain public owned infrastructure. Building vulnerabilities are representative of the variable construction methods and implementation of building codes between islands.

The modeled wind footprints used in the analysis are single representations of each event, which exist within a range of uncertainty. As such modeled estimates are expected to vary from actual loss experience.

\$21.9 billion

Anguilla, Antigua & Barbuda, British Virgin Islands, Dominica, Dominican Republic, Montserrat, St Kitts & Nevis, St Lucia, Turks & Caicos

Build Back Better Counterfactual Analysis

A counterfactual analysis has been completed to quantify the reduction in total loss that would have resulted if housing and infrastructure was built to modern day building standards and codes (2018 vintage).

Modeled estimates of loss reduction show that structures built according to current building codes result in greater proportional savings at lower wind speeds. Irma and Maria generated wind speeds in excess of 150mph, even structures with modern building codes would have experienced damage. As a result, the proportional estimated savings for countries which experienced extreme wind speeds such as Anguilla, the British Virgin Islands, and Dominica, are less than for countries which saw less direct impact.

Additional resilience measures including roof anchors and opening protection can further increase structural resilience at higher wind speeds.

Implementation of 2018 building codes reduces damage & loss

8%

Reduced Direct Economic Loss Estimate (\$1.7 billion reduction)

\$20.2 billion

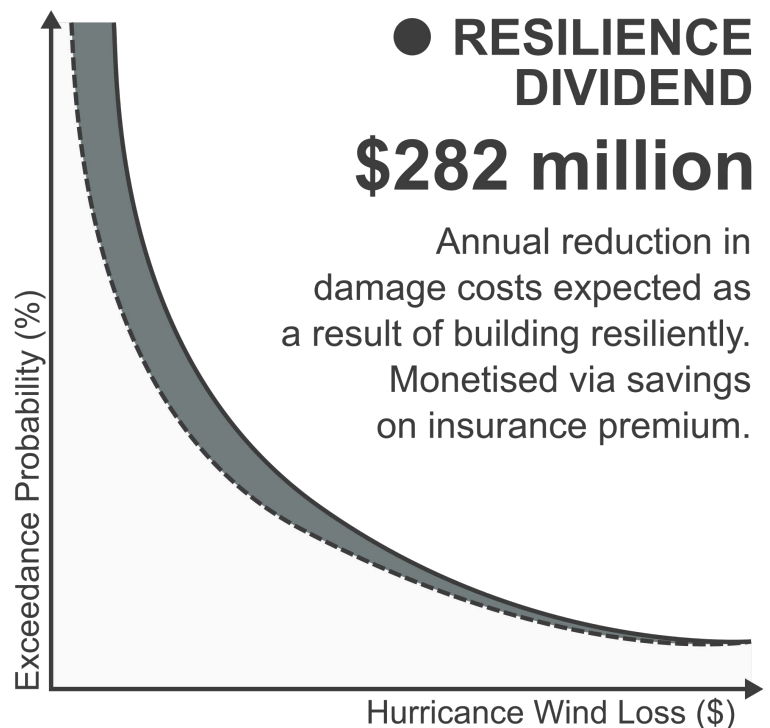
Probabilistic Risk Analysis

If damaged structures are rebuilt resiliently, hurricane losses will be reduced across the full spectrum of possible future storms.

Expected losses will be reduced for high-frequency low-severity events, as well as less frequent catastrophic events like Irma and Maria.

Using innovative financial mechanisms, this risk reduction has the potential to be monetised through savings on the annual risk cost and used to help finance the additional cost of rebuilding resiliently.

The excess risk for catastrophic events can be managed using a combination of risk reduction and risk transfer mechanisms.



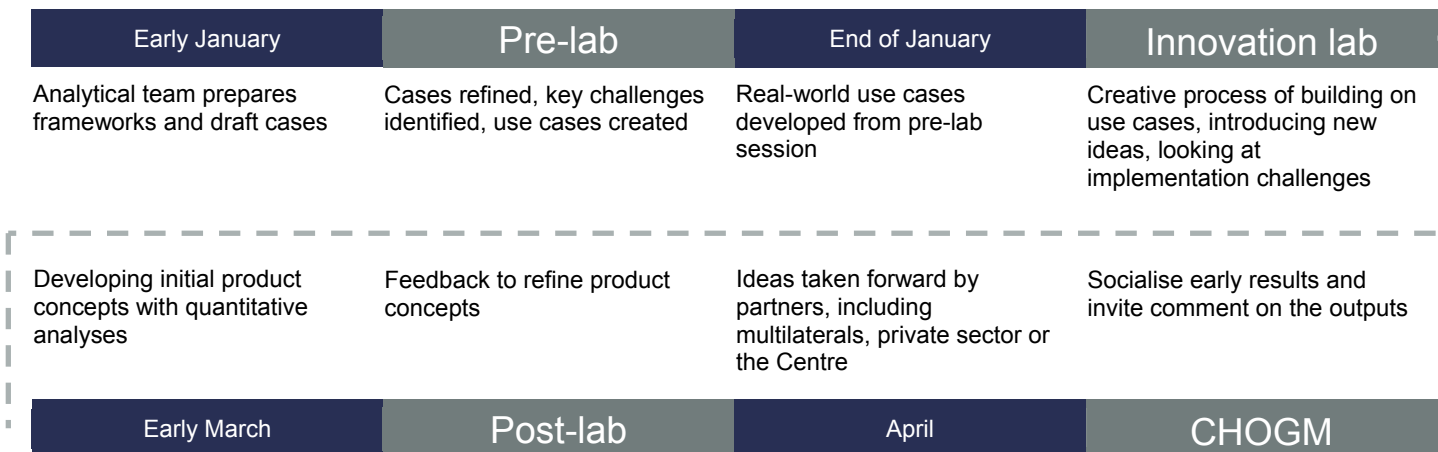
What role for innovative finance?

The first Innovation Lab of the Centre in partnership with Lloyd’s, focussed on developing new financial instruments that combine incentives for resilience with risk transfer. The Centre for Global Disaster Protection is a partnership between the UK Government and World Bank and works with governments and humanitarian agencies to strengthen pre-disaster planning, catalyse innovative finance for resilience and use risk financing tools like insurance to protect people and speed-up response and recovery. Lloyd’s continues to support this topic, and sees the Lab as a pathway to building developing countries’ understanding of and access to the insurance products, in alignment with the InsuResilience and Insurance Development Forum goals. As part of these efforts a group of businesses at Lloyd’s have launched a Disaster Risk Facility, which pools \$400m capacity along with the expertise to develop reinsurance solutions for natural catastrophe risks in emerging economies.

The Innovation Lab brought together experts from the public and private sector, in an open format, to generate and incubate new solutions to meet identified problems. The first Lab of the Centre was held in January 2018 to investigate financial products and structures that incentivize risk reduction and resilient rebuilding by bringing together elements of project financing and risk transfer.

The Lab was a dynamic working session with more than 50 participants working together from across the insurance, investor, engineering, humanitarian and development communities. Participants worked from real-world use cases prepared in a pre-lab session, identifying, developing and stress testing possible solutions. It was supported by a team of experts from Risk Management Solutions, Vivid Economics and re:focus partners, providing technical analyses.

Figure 3: The Innovation Lab process



Innovation Lab Products

Four broad ideas emerged from the Innovation Lab. These range from ideas that have already been developed but which can be re-purposed for these challenges which could be brought to market relatively quickly, through to ideas that, although further from current practice, hold significant potential, as shown in the graphic on the next page.

Figure 4: Product concepts





Insurance-linked Loan Packages

Concessional loans with integrated resilience conditions

This approach, requiring only small modifications from current practice, would explicitly integrate risk transfer solutions into the (concessional) loans provided by international financial institutions. It would specify that the loans should only be spent on infrastructure where resilience has been explicitly considered and built into the design. Resilience would be further incentivised by reduced upfront costs of insurance and/or offering more favourable lending terms (or equivalently, a grant element) upon demonstration that identified measures had been delivered. Continued availability of those terms would be conditional on evidence of adequate maintenance.

- **Resilience Incentive:** Prior actions in lending agreements, upfront saving on insurance premiums reinvested in resilience and/or more favourable lending terms offered once resilience actions have been completed
- **Insurance Element:** Earmarking portion of the loan for insurance or making insurance provision a loan condition. Insurance element could contain a multiyear commitment. Pricing would assume the resilience measures are in place but with options to review efficacy of resilience measures over time. With resilience, the premium would be lower, providing an upfront dividend that can at least partially offset any cost of implementing resilience
- **Potential Use Case:** Suitable for financing large critical infrastructure such as roads, bridges, power, water and wastewater facilities, where ongoing maintenance and resilience to disaster are crucial



Resilience Impact Bond

A bond with outcome-based repayments that are focused on resilience and social goals

The RIB concept would explicitly transfer the risk of providing resilient services to private investors. Investors would provide upfront financing to ensure that critical services requiring infrastructure (e.g. education, health, power) are more resilient. Returns would come through payments made by the donor (or 'outcomes funder'), but with returns varying according to either the ongoing provision of resilient services, or other conditions stipulated by the funder that aim to proxy this. One such condition might include adequate natural catastrophe risk insurance coverage. This idea builds on the emerging practice of development impact bonds (DIBs) which DfID is already exploring as an innovative way to leverage private sector investment and delivery expertise in pursuit of development goals.

- **Resilience Incentive:** Investors provide upfront financing to be used for providing resilient services. Added incentive for investors as returns will be greater if the project delivers greater resilience against shocks
- **Insurance Element:** Risk management and insurance plans could be preconditions for outcome-based payment and/or would be encouraged by the prospect of higher returns if the services provided are demonstrably more resilient
- **Potential Use Case:** Suitable for financing resilience of critical services that include an infrastructure element, including education, healthcare, social, and emergency services



Resilience Bond

A catastrophe bond where bond coupon payments are reduced when resilience measures are implemented

A catastrophe bond (cat bond) which takes account of the impact of resilience measures. In the event of an eligible disaster, investors lose all or a portion of the capital value of the bond, which is transferred to the bond sponsors. Resilience Bonds also account for the impact of resilience measures through reducing bond interest payments once these measures are implemented. This reflects the lower risk bond investors bear. This idea has been identified in previous work (*re: focus*, 2017), but more work is required to bring the product concept to market.

- **Resilience Incentive:** The difference in bond coupon payments is captured as a "rebate", which can be used to support project implementation
- **Insurance Element:** Catastrophe bond features transfer risk to investors through insurance intermediaries
- **Potential Use Case:** Suitable for financing risk reduction initiatives, which provide a range of resilience dividends across various beneficiaries. For example, to finance storm surge defences at ports.



Resilience Service Company

An agent who pays for and implements resilience measures upfront in return for a share of future insurance premium savings

A ReSCO would pay for and implement resilience measures upfront, recouping its investment from the risk based insurance premiums by reducing volatility. Based on Energy Service Companies who design, finance and take the performance risk of energy efficiency investments, sharing the energy cost savings they generate between themselves and the asset owner. ReSCOs would overcome the unwillingness of asset owners to incur the upfront costs from resilience measures. In the first instance, proof of concept may need to be delivered by a development partner or a Public Private Partnership. Donor support would be required in scenarios where insurance uptake is very low. Further work is needed to develop and test this idea.

- **Resilience Incentive:** Future savings from resilience measures incentivise the ReSCO to pay for those measures upfront
- **Insurance Element:** Risk-based priced insurance is integral for resilience savings to exist
- **Potential Use Case:** Suitable for financing simple retrofit measures across multiple smaller structures. For example roof anchors and opening protection to increase resilience to hurricane wind damage

Recommendations

Policy makers

- Understand the risks and invest in good risk data. Risk information is the basis for planning and decision making in many areas of disaster risk management, including resilient infrastructure, pre-disaster planning and purchasing insurance.
- Prioritise resilience as a key part of development and economic growth. Build institutional capabilities and mainstream resilience into planning, policymaking and investments.
- Invest in strengthening preparedness and planning, particularly in critical economic and social sectors.
- Develop incentives, systems, practices and innovative financing instruments that encourage both resilient construction and, critically, ongoing maintenance
- Develop disaster risk financing strategies that are integrated with disaster preparedness plans and which use risk financing tools, including insurance, to finance more rapid and more cost-effective response and recovery from disasters.

Insurance industry

- Take part in resilience discussions with policymakers, offering expertise to help facilitate risk understanding including which insurance products are available and how they can be used to transfer risk off government balance sheets.
- Stand ready to assess the impact of resilience measures on risk levels and price this into insurance policies. Insurers have expertise in risk modelling and assessment that could be beneficial for policymakers.
- Make allowances for reduced risk levels in insurance premiums. This already takes place in the underwriting process, but further work is needed to capture resilience dividends.

Invitation to continue to the dialogue

These ideas will be developed further in the coming months and we welcome your engagement.

Lloyd's, the Centre for Global Disaster Protection and our partners will be refining these ideas, ahead of the publication of a final report in June 2018. We would value your scrutiny and feedback on these emerging ideas – what might work, what will not work and how they can be improved.

For more information on how to engage in the process, please contact:

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The Centre for Global Disaster Protection was launched by UK Prime Minister Theresa May in July 2017 with the goal of working with governments to strengthen pre-disaster planning, catalyse innovative finance for resilience and use risk financing tools like insurance to protect people and speed response and recovery. The Centre brings together partners including the UK Government, the World Bank, civil society and the private sector with the shared goal of enhancing the financial resilience of developing countries to climate and disasters. The Centre is funded by the UK Department for International Development (DfID).

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