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Introducing: Nexus Shocks Network

We agreed on a broad narrative on how these shocks are low probability, high impact events that span energy, water and food systems

In early 2015 the Economic and Social Research Council (ESRC) Nexus Network issued a call which would fund a set of pilot stakeholder engagement projects. The Nexus Shocks Network, chaired by Dr Candice Howarth and Dr Aled Jones of the Global Sustainability Institute (GSI) at Anglia Ruskin University, was one of those projects.

The Nexus Shocks Network brings together interdisciplinary and cross-sectorial expertise to engage in constructive dialogue, identify opportunities to address challenges, and explore opportunities to better inform decision making in response to nexus shocks. The Nexus Shocks Network now comprises of over 300 stakeholders from academia, businesses, government and not-for-profit organisations.

We set up the Nexus Shocks Network to facilitate intelligent and constructive conversations on how to build meaningful inter-disciplinary research and establish connections with relevant stakeholders to co-design ideas on nexus topics. As part of this, in June 2015 we convened an initial advisory group drawn from the Network to help frame our definition and the focus for the Network's activities. We adopted a co-design process as a critical component to ensure impactful and useful outputs. This meant that throughout the pilot phase no assumptions were made on the definition of nexus shocks, the process of decision making or how best to construct a research programme to address issues associated with nexus shocks. Following our initial advisory group meeting, we co-produced the aims of the Nexus Shocks Network:

- 1. To overcome obstacles and build on opportunities in responses to nexus challenges
- 2. To innovatively assess the complexity of societal responses to nexus shocks
- 3. To better inform business and policy responses

As part of this we assessed how to define nexus shocks and rather than a clear definition, we agreed on a broad narrative on how these shocks are low probability, high impact events that span energy, water and food systems. They impact multiple actors and scales making them complex to understand and difficult to address,

and importantly they represent systemic and cascading risks in both physical and social systems. These types of events are likely to become more frequent given physical trends such as climate change and economic trends including increased globalisation, which in itself builds both robustness and fragility.

Initial work by the Nexus Shocks Network

In autumn 2015, we facilitated five workshops exploring specific themes to critically assess how different stakeholders across sectors can contribute to the creation of better decision making processes around shocks to the nexus:

- 1. Predicting shocks and hazards (hosted by the Met Office)
- 2. Transmission and mitigation of nexus risks through infrastructure (hosted by Atkins)
- 3. Insurance and finance for resilience (hosted by Lloyds of London & Willis RE)
- 4. Local business responses to shocks (hosted by Climate UK, Cambridge Cleantech and LDA Design)
- 5. Governance, governments and shocks (hosted by Chatham House)

Each workshop built on a case study of a particular decision making process around a nexus shock provided by the hosts and delegates then explored barriers and opportunities associated with wider nexus shocks.

The workshops identified a number of critical issues and themes that require further exploration. Many of those issues and themes are outlined in this booklet.

On the 30 November 2015 a symposium was held in London, UK which drew together the lessons from each of these workshops and explored common themes, barriers and approaches to decision making around nexus shocks.

Each workshop built on a case study of decision making around a nexus shock

Working with a trans-disciplinary focus

The transdisciplinary nature of nexus shock decision making is central to the work of the Nexus Shocks Network as a group of committed stakeholders. We believe that developing physical science models to better predict endogenous nexus shocks, while vital, will not contribute to a more resilient society without the equivalent effort in capturing lessons from social sciences as well as engaging those actually involved in decision making from business, government and not-for-profit organisations right at the start.

A number of challenges from communication to ownership of impacts were identified during the discussions but so were a host of potential solutions. The challenges associated for example with different languages and lexicons used to communicate impacts and responses to nexus shocks across different stakeholders and sectors required flexibility, time and sustained engagement in the design of our work, the facilitation of workshops and reporting back to our funders and with members of the Network.

The Nexus Shocks Network will continue to act as a bridge between academics, experts and decision maker in the public and private sectors. It will explore ways to assess methods for capturing relevant data, taking into account the priorities of the stakeholder groups and aims to help construct what 'good' decision making in response to nexus shocks looks like.

Who owns the impacts from nexus shocks? Who pays for resilience? How can judgment based decision makers be better informed by evidence from both physical and social sciences? How do we judge a good decision?

All these are questions we continue to explore whilst allowing space and time for reflection and flexibility in our approach and in the context within which nexus shocks occur.

Dr Candice Howarth and Dr Aled Jones
Global Sustainability Institute



Workshop hosts

Atkins

As one of the world’s largest design, engineering and project management consultancies, Atkins is a key stakeholder in infrastructure development from the local to the global level.

Atkins’ work on resilience means it is inherently interested in nexus shocks which fed into the design of the Nexus Shocks’ *Infrastructure* workshop. Decision making associated with infrastructure occurs throughout its lifecycle and must have a response to these types of shocks embedded within them, minimising the risk to infrastructure itself and the services it provides.

Involvement in the Nexus Shocks Network empowered Atkins’ Geoff Darch and his colleagues to discuss what they see as the major vulnerabilities to the sector and ensure that these feed into our research agenda. These include:

- Inherent vulnerability relating to the exceeding of design standards and the difficulty in estimating such standards given the change in the likelihood of extreme weather events as a result of climate change
- Systemic risks which can occur when a shock travels from one asset or infrastructure system to others; having a knock-on effect through supply chains
- Slow shocks when no individual event is severe but the cumulative impact of ‘mini shocks’ leads to a tipping-point whereby overall impact is significant
- National shocks that impact the whole country, meaning any response is thinly spread over a wider area, hindering the effectiveness of recovery
- Continental shocks occur in an ever connected and globalised world where a shock on one area cascades across the nexus and beyond national boundaries
- ‘Tele-connected’ shocks where a shock in one part of the world can be connected to a shock in another resulting in additional vulnerability
- Communication shocks which come from an over reliance on communication technologies across the nexus, such Global Navigation Satellite Systems e.g. GPS.

Dr Geoff Darch, Head of Climate Risks and Adaptation: “Decision-making within strategic planning for infrastructure has to consider significant long-term uncertainties in supply and demand, for example: population growth, efficiency savings, regulation, and climate change. The Nexus Shocks Network is facilitating discussion on the risks presented by nexus shocks, and how these can be managed, recognising the particular nature of connections within and across sectors.”

Cambridge Cleantech is a stakeholder in the local economy, supporting its 300+ members by exploring global opportunities for technology innovation and linking these with companies in the sector.

Cambridge Cleantech are interested in shocks to the nexus because of the opportunities they present for emerging technologies, especially in how they can provide some solutions to mitigate against shocks in terms of preparedness and how they can support recovery post-shock.

Involvement with the Nexus Shocks Network in the *Local Economy* workshop meant that Cambridge Cleantech could gather knowledge that would be relevant for its members as well as make valuable connections with stakeholders in local businesses in the region and local governments.

Martin Garratt, CEO: “The Nexus Shock Project has proved invaluable to Cambridge Cleantech as it has underlined the importance of business continuity in terms of planning for shocks, reminded businesses of the cost reduction in planning properly for shocks, and promoted the business opportunities in terms of developing product and service solutions for shocks.”

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Chatham House

Its Energy, Environment and Resources Department (EER) seeks to advance the international debate on energy, environment and resources policy and to influence and enable decision-makers and stakeholders to take well-informed decisions.

The Network Shocks Network events brought together a diverse pool of expertise, leading to varied and interesting discussions. We look forward to participating in future events of this kind

The Energy, Environment and Resources Department (EER) at Chatham House

works to enable decision-makers and stakeholders – governments, NGOs, business and media – to take well-informed decisions that contribute to both achieving sustainable development and mitigating potential future climate and resource-related insecurities.

Chatham House's EER department's interest in shocks to the nexus comes from the research it is currently undertaking on critical chokepoints in global food trade to develop sustainable, risk-based strategies for global food security. This requires an understanding of the vulnerability of global trade to disruptions of all kinds: the food system must be resilient not only to shocks within the food supply chain – such as harvest failures or import and export restrictions – but also to those resulting from broader trade, political, and environmental dynamics. The project will recommend strategies to build the resilience of the global food system to shocks and to strengthen the sustainability of trade and transport infrastructure.

Chatham House hosted the Nexus Shocks Network workshop on *Governance and Governments* to discuss their research and benefit from the feedback from expert delegates. The discussions led to a broad agreement that efforts to bridge the gaps between distinct spheres of expertise and experience, to achieve greater transparency of information, and to encourage a coordinated, holistic approach to risk mapping and mitigation at all levels will be critical to responding to the increasingly complex and systemic risks that threaten security of food supply and stability of food prices.

Laura Wellesley, Research Associate: “The Network Shocks Network events brought together a diverse pool of expertise, leading to varied and interesting discussions. We look forward to participating in future events of this kind.”

LDA Design co-hosted the Nexus Shocks Network workshop on the Local Economy where Helen Pearce, a director at LDA, demonstrated that shocks to the nexus have the potential to affect us all, unless we take action to build resilience in the built environment, infrastructure and the landscape.

Helen presented the Futures research which LDA Design completed with the Global Sustainability Institute. The research explored the major economic, social and environmental drivers of change in the world and the challenges and opportunities they present, and set out practical solutions which can deliver results and add value for clients. The findings are now being applied across LDA Design's business and they are working with their clients to use the drivers of change to shape their business models, priorities, investment decisions, and projects.

LDA Futures builds on LDA Design's track record of delivering more sustainable development, from parks to property development to major infrastructure projects. For example, they have completed a strategic environmental investment plan to support economic growth and development in Oxfordshire, helped renewable energy developers to deliver low carbon, distributed energy generation across Britain including solar and wind farms, designed and planned multi-functional infrastructure and public realm projects such as Swansea Bay Tidal Lagoon, and worked with communities on urban regeneration and new development to meet local needs.

Reflecting on the workshop, Helen said: “It was illuminating in the extent of the impacts that a shock would entail and the lack of preparedness, for example the lack of local food and water stores for use in case of emergency. Going forward, we need to take an integrated, holistic approach to developing new communities, infrastructure and public realm, taking into account the range of future challenges and opportunities.”

LDA Design

LDA Design is an independent landscape, urban design, environment and planning consultancy with clients including developers, landowners, communities and local authorities.

It was illuminating in the extent of the impacts that a shock would entail and the lack of preparedness, for example the lack of local food and water stores for use in case of emergency

Lloyds of London

is the world's specialist insurance and reinsurance market, specialising in new, unusual and complex risks, which operates in more than 200 countries and territories worldwide.

The severity of these impacts is likely to rise with increasing global interconnectivity and mounting pressures on the world's infrastructure and ecosystems

Lloyds recognises that complex impacts arising from extreme events have the potential to significantly impact the insurance industry. Lloyd's has previously looked into nexus shocks, specifically considering a shock to the global food system in a report released earlier in 2015. This work used scenario analysis to better understand impacts of what *might* happen – as opposed to what *will* happen – in the case of an acute shock to world food supply.

While models are traditionally used by insurers to assess their ability to pay claims against extreme events, the scenario developed illustrates the potential for shocks to give rise to social and economic changes, which can themselves have complex, far-reaching financial and humanitarian consequences. This exercise highlighted that there can be cascading economic, political and social consequences of a food production shocks, alongside human costs.

Co-hosting a Nexus Shocks Network workshop on *Finance and Insurance* allowed Lloyd's to inform the aims and objectives of the Network, and to ensure that the network is as useful as possible to the stakeholder group. Lloyd's believes the Network should facilitate progress in the areas of focus by driving improvements in the knowledge underpinning composite modelling capabilities and supporting insurers to develop products that increase the resilience of communities, businesses and governments to sudden disruptions. The Network would make this possible by providing a platform for discussion and knowledge-sharing among experts on the different types of impacts on the various industries they affect. By doing this, it will inform decision makers about the interactions within the food-energy-water-environment nexus.

Commenting on the network's contribution, Trevor Maynard, Head of Exposure Management and Reinsurance, said: "The complexity and severity of these impacts is likely to rise with increasing global interconnectivity and the mounting pressures placed on the world's infrastructure and ecosystems. As such, one of the key steps that could better inform decision-making would be to place a greater emphasis on developing coupled models, capable of capturing not only the physical effects of extreme events but also their various economic and social impacts."

The Met Office is responsible for predicting extreme weather events and their impacts. Where a nexus shock is a heightened risk, the Met Office have a direct line to inform decision makers – from the household level to the Government – to advise them on their responses. Advisors at the Met Office will, for example, talk directly to the Cabinet Office, recovery units and the media during a crisis. At the workshop on *Predicting Shocks and Hazards*, Melanie Harrowsmith, Met Office Advisor to Head of Civil Contingencies, also explained that her team are especially interested in learning about linked and compounding risks that build up towards a tipping point, as seen in the sequence of storms that led to the 2013/14 winter floods.

Being involved with the Network provided the Met Office with the opportunity to share its lessons and experiences with other knowledge providers, as well as practitioners. It gave them the chance to explain how they go about addressing the complexity and uncertainty associated with shocks to the nexus, particularly in relation to their communications strategy. For instance, the Met Office has moved to a traffic light system when dealing with the media; highest impact being red, medium impact being amber, and minimal impact being green. By focusing on impact rather than the science, the information becomes relatable and degree of urgency become obvious.

Kirsty Lewis, Applied Climate Science Team Leader at the Met Office, explained that the workshop identified a clear knowledge gap: "Better awareness of how the social and physical systems are connected is needed, particularly in how they impact upon one another in the context of shocks to the nexus. This would help the Met Office and other providers of knowledge to communicate in a way that does not install a social response that exacerbates the shock but instead mitigates it."

Met Office

forecasts weather and models climate change for the UK and worldwide. It provides world leading weather services for the public, businesses, and government, making it a leading knowledge provider to decision makers.

Better awareness of how the social and physical systems are connected is needed... This would help the Met Office communicate in a way that does not install a social response that exacerbates the shock but instead mitigates it

Willis

is a multinational risk advisor, insurance brokerage and reinsurance brokerage company.

By recognising the role of insurance and applying leading edge research, the Nexus Shocks Network is helping to build a more resilient future

Willis is the world's fourth-largest insurance broker when measured by revenues, making it a major stakeholder in the finance and insurance market globally.

Shocks – or the risk of shocks – to the nexus exacerbate existing vulnerabilities caused by financial markets, regulatory change, political risk, resource stress, and technological and environmental change. Many of these current and future risks are unrecognised by owners and operators and continue to be uninsured. This causes a resilience deficit, for insurance is integral to smoothing the financial impacts of large losses caused by shocks. New tools and techniques have made the insurance industry resilient over the past 20 years and by expanding these techniques to the wider economy, risk becomes embedded into decisions on capital allocation.

Willis co-hosted the Nexus Shocks Network workshop on *Finance and Insurance* to highlight questions and feed into the agenda for this area. This highlighted how vital it is to bring together different stakeholders and act as a platform to inform the insurance industry so that Willis and other companies can understand the interconnections and feedback loops associated with shocks to the nexus. It is specifically important for the Nexus Shocks Network to consider how nexus shocks impact risk management decisions. Importantly it highlighted the need to better understand who owns a risk, who pays for the risk mitigation and who is impacted by that risk, as this is needed to better inform the role of insurance in nexus shock solutions.

Greg Lowe: “As an industry we understand the many hazards nexus shocks pose to society, but by raising awareness we can help ameliorate the impacts of nexus shocks. By recognising the role of insurance and applying leading edge research, the Nexus Shocks Network is helping to build a more resilient future.”

TRYING TO FIND CONSENSUS OVER A NEXUS AGENDA...



Summary of workshops

Predicting Shocks and Hazards

Met Office
28 September 2015

Shocks to the nexus impact knowledge providers most notably in how it effects their reputation – trust and credibility are key. However, in the context of uncertainty, it appears that decision makers often rely on the knowledge providers to hand them the *actual* decision. This means that on occasion knowledge providers can be treated as scape goats by the decision makers who are reluctant to justify their actions by citing a ‘gut feeling.’ This is underpinned in how the priorities of the Met Office are many and often conflicting. For example, they are relied on to gather and disseminate knowledge to various audiences, while also taking responsibility for the impact any communication may have (such as panic, market price reduction etc...). The Met Office are also working on simplifying their methods of communications such as changing to a traffic light warning system.

Key questions that need to be asked are ‘what is the knowledge providers’ role in decision making?’ and ‘what *should* it be if the decision making process is to be transparent and democratic?’

Infrastructure

Atkins
1 October 2015

A significant amount of infrastructure was never designed to be resilient to new emerging shocks but instead has evolved in response to changes in societal demands throughout history. Consequently, a key challenge is to design and adapt infrastructure with future societal demands and nexus shocks in mind. Infrastructure resilience also needs to better frame who is vulnerable and how social systems help support this resilience.

Key issues include the challenge of building resilience into communications and IT infrastructure to support shock responses, as well as a requirement for careful consideration on how to maintain a sustainable nexus even when communications and IT have failed. In addition the cumulative impact of nexus shocks on infrastructure and the lasting damage this can have needs to be better understood.

Insurance and Finance

Lloyds of London
& Willis
2 October 2015

An emerging theme is one of the different actors involved in building resilience, the leverage points between them, and the various scales of response and the business case for action. A ‘good’ decision would be one that builds resilience across the different leverage points in the nexus. Insurers consider their role as limited to sending appropriate price signals associated with shocks and provide the risk sharing/smoothing capacity. Other participants felt insurers have the responsibility to help build resilience. Expectations of this role therefore need to be considered.

From this follows further questions about the value of resilience – what price is acceptable? A key issue is ‘who pays’ for resilience?

Local Economy

Cambridge Cleantech
& LDA Design
6 October 2015

A major theme that emerged is the salience of recurring challenges and how key actors in local economies (communities, businesses and local policy makers) prioritise resilience. There were thought to be tensions and conflicts between competing demands – in particular over business resilience for smaller enterprises. An important question therefore is at what point do shocks to the nexus become salient for decision makers at the local level, and how can they be better informed?

A focus on best practice and lessons learnt was suggested. How to structure collaboration to make sure that everyone’s priorities are taken into account and how this can aid communication inter- and intra-stakeholders, allowing for holistic approach to informing decision making was discussed.

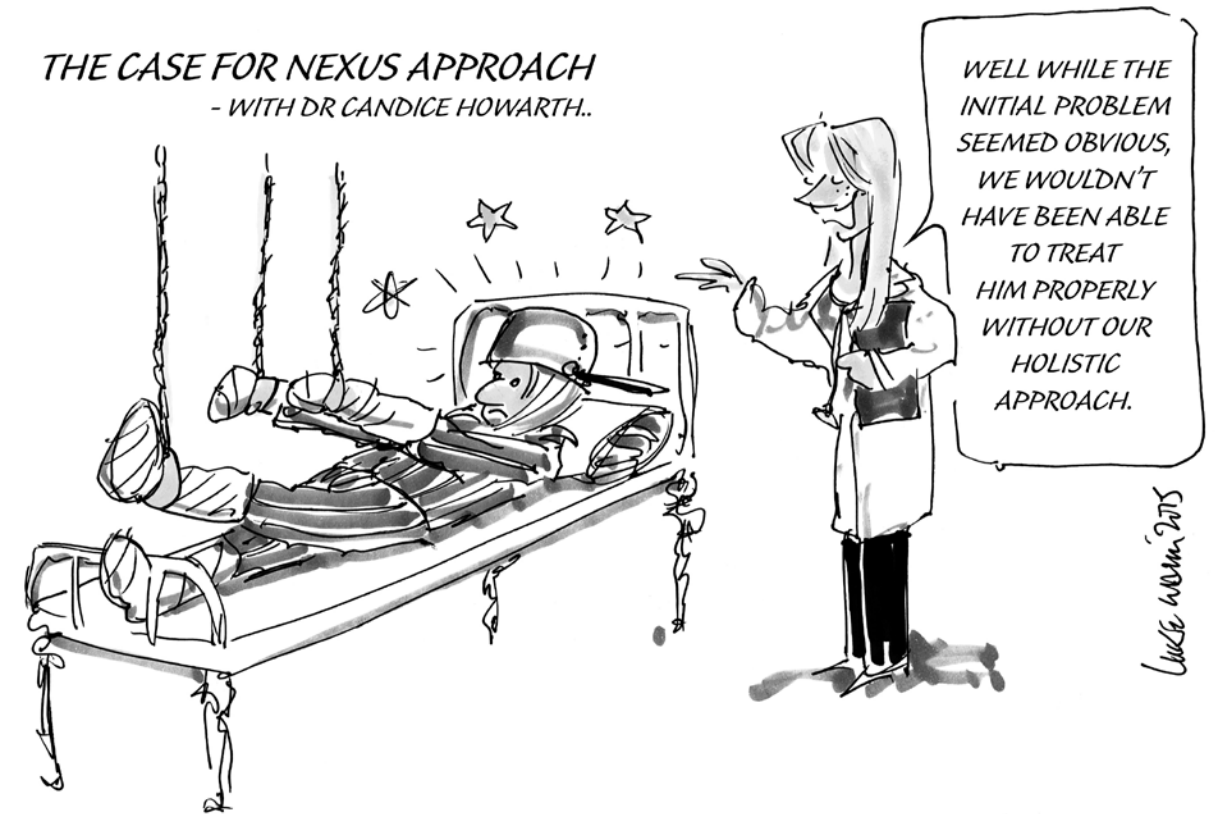
Governance and Governments

Chatham House
9 October 2015

One of the main points that came out of this workshop is the need for collaboration between researchers in different disciplines and stakeholders. In particular there is a need for better incorporation of judgement-based decisions. In addition, 'time', specifically the difference between long termism and short termism, emerged as an important theme to consider. Due to the temporary nature of elected governments decision making at the national level often adopts a short term approach making it difficult to influence decision making in the context of long term priorities. However, political parties are forced to defend their policies at least every 5 years to the whole electorate which creates opportunities for influence, as well as providing a chance for policy makers to communicate important issues to the whole electorate.

Therefore, while governments may not always prioritise long term issues their lack of action in the area is also down to a failure to influence elected officials and engage with the electorate to convince them of the salience of resilience, rather than simply being about the design of the electoral calendar.

THE CASE FOR NEXUS APPROACH - WITH DR CANDICE HOWARTH..



Barriers to decision making

Predicting shocks and hazards

Communication and Collaboration	<ul style="list-style-type: none">• Timing and accessibility of information• Miscommunication or distortion• Cross-sectorial issues
Decision Making Processes	<ul style="list-style-type: none">• Reactive rather than proactive response• The solution may lie outside the owner of the asset• The benefit received may lie outside the owner of the action
Social Dimension and Culture	<ul style="list-style-type: none">• Practice of not sharing data• Different responses from different stakeholders
Response to Shocks	<ul style="list-style-type: none">• Location-specific nature of shocks in terms of impacts and causes• Limits of forecasting

Infrastructure

Communication and Collaboration	<ul style="list-style-type: none">• Uncertainty, inefficiency and complexity of shocks• Characteristics of infrastructure resilience• Lack of experience of shocks
Decision Making Processes	<ul style="list-style-type: none">• Lack of acceptance that infrastructure is a shared asset• Numerous resilient assets does not equate to a resilient system• Conflicting timescales of research and activity
Social Dimension and Culture	<ul style="list-style-type: none">• Lack of social contract with infrastructure• Resilience in nexus systems often require demand side responses• Lack awareness of what infrastructure provides until it fails
Response to Shocks	<ul style="list-style-type: none">• Challenges in costing the benefits of resilience• Financial structures for investment returns on infrastructure too short

Local economy

Communication and Collaboration	<ul style="list-style-type: none">• Lack of trust in decision makers and those informing them• Lack of community understanding of risk
Decision Making Processes	<ul style="list-style-type: none">• Lack of clarity over who owns the problem• Possible passive, panic and irrational responses if not prepared• Lack of clarity over who owns responsibility for action
Social Dimension and Culture	<ul style="list-style-type: none">• Some resources are valued higher than others• Cultural differences between organisations (e.g. urban vs rural)• Difficulties with scaling from local to global
Response to Shocks	<ul style="list-style-type: none">• Strict requirements from local authorities• Lack of available resources to deal with the shocks

Finance and insurance

Communication and Collaboration	<ul style="list-style-type: none">• Markets can act in unexpected manor to regulatory change• Confidentiality issues - private companies may be reluctant to share their data
Decision Making Processes	<ul style="list-style-type: none">• Assessing who pays the cost• Blame political community; little consideration for roles of others• Framing risk: language, time, geography impact collaboration
Response to Shocks	<ul style="list-style-type: none">• Interdependencies between assets: cascading effects• Risk capacity and ability to adapt is different at all scales• Lack of insurance penetration in vulnerable communities

Exacerbation and mitigation

Governance and Governments

Communication and Collaboration	<ul style="list-style-type: none">• New media makes it difficult to manage response• Complications around government communication of decisions• Lack of confidence in judgement based data
Decision Making Processes	<ul style="list-style-type: none">• Lack of understanding of whose responsibility to respond• Lessons learnt internationally are not incorporated domestically• Failure to translate lessons across sectors
Social Dimension and Culture	<ul style="list-style-type: none">• Preoccupation with legacy and ego• Have to consider different interests and values of all stakeholders
Response to Shocks	<ul style="list-style-type: none">• Challenges of having discussion at a local level and global scale• Time frames are very different for government• Justify ownership of risk may be long term, distant and costly

At all workshops, delegates were asked about the exacerbating and mitigating factors for their respective stakeholder group.

Exacerbate

- Timing of response
- Competing demands
- Impact of technology on increasing vulnerability
- Lack of collaboration
- Allocating responsibility
- Strategic responses
- Risks to credibility
- Cultural understanding knowledge production and use

Mitigating

- Clarifying distinction between cost and value
- Identifying opportunities from nexus shocks
- Leadership
- Communication
- Collaboration across sectors
- Better alignment of timescales



Informing decision making

Thinking ahead

Predicting Shocks and Hazards	<ul style="list-style-type: none">• ‘Humanising’ the shock by giving it an identity• Lessons: Focus on managing risks rather than mitigation of risk
Infrastructure	<ul style="list-style-type: none">• Consider physical and societal pathways through which shocks cascade through the system• Considering the bigger picture to take into account vulnerability and knock on effects
Governance and Governments	<ul style="list-style-type: none">• Government need to be more visionary• Moving from evidence to judgement based decision making• Increase understanding of risks to increase resilience
Finance and Insurance	<ul style="list-style-type: none">• Governments need to give regulators a mandate to act
Local Economy	<ul style="list-style-type: none">• Shared responsibilities, decentralisation of decision making with stronger connections between centres where decisions are made• Ownership of response by taking bottom up approach stage

Collaboration

Predicting Shocks and Hazards	<ul style="list-style-type: none">• Coordination between actors and agencies on the ground• Engage with decision makers throughout the process, rehearse scenarios and build a rapport with all the stakeholders involved
Infrastructure	<ul style="list-style-type: none">• Develop a joint vision with all stakeholders involved• Encourage better alignment of timescales: speed up research that is policy relevant
Finance and Insurance	<ul style="list-style-type: none">• Establish new partnerships to identify challenges and propose new solutions e.g. Public-Private Partnerships programmes• Finance sector to speak with a more unified voice

Societal context

Predicting Shocks and Hazards	<ul style="list-style-type: none">• Anticipate social responses• Decision making process need to be credible and logical taking into account capacity as well as social responses
Infrastructure	<ul style="list-style-type: none">• Establishing a vision of what type of society we want in the context of nexus shocks and how infrastructure can support this• Assessing cumulative impacts of small societal changes
Governance and Governments	<ul style="list-style-type: none">• Cultural changes needed to combine short and long term thinking to build better cultural understanding and acceptance• Increase democratic participation and communicate lessons learnt
Local Economy	<ul style="list-style-type: none">• Understanding psychosocial responses to warnings and risk• Shared economy of skills and knowledge

Process

Predicting Shocks and Hazards	<ul style="list-style-type: none">• Having a mandate to advise on specific issue• Increase scientific advisors understanding of challenges faced by decision makers
Infrastructure	<ul style="list-style-type: none">• Resilience league tables for companies
Governance and Governments	<ul style="list-style-type: none">• Resilience and efficiency to be considered in decisions to enable complimentary and flexible mechanisms• Relinquish control to enable national voices to actively participate
Finance and Insurance	<ul style="list-style-type: none">• Diversity of products and services available for finance• Engage with international context for investment and insurance
Local Economy	<ul style="list-style-type: none">• Flexibility in planning and procedures• Assess available and value of local resources

Knowledge and communication

Predicting Shocks and Hazards	<ul style="list-style-type: none">• Providing decision makers with pertinent information and be selective in choice of scenarios• Investigate barriers to communication
Infrastructure	<ul style="list-style-type: none">• Join up efforts underway that are looking to overcome barriers• Better framing narrative on shocks to enable proactive approach
Governance and Governments	<ul style="list-style-type: none">• Manage evidence: Sectorial level transfer of learning• Utilising new media (whilst being conscious of potential miscommunication) to facilitate rapid communication
Finance and Insurance	<ul style="list-style-type: none">• Dialogue between insurers and policy makers• Focus on opportunities and business solutions to overcome communication issues
Local Economy	<ul style="list-style-type: none">• Engage virtual community• Share lessons learnt and celebrate success• Developing 'what-if' scenarios to help resilience in the system



Organisations represented in the

Nexus Shocks Network

Attended the workshops and symposium

- Agulhas Applied Knowledge
- Atkins
- Business Emergency Recovery Group (BERG)
- Cabinet office
- Callund Consulting
- Cambridge Chamber of Commerce
- Cambridge Cleantech
- Centre for Energy and Environment, University of Exeter
- Chatham House
- Cambridge Institute for Sustainability Leadership
- City of London's Security and Contingency Planning Group
- ClimateUK
- Complex Systems Research Centre (CSRC)
- Cranfield University
- Department of Energy and Climate Change
- Department Environment, Food and Rural Affairs
- Department for International Development
- Devon & Somerset Fire & Rescue
- Engineering and Physical Sciences Research Council (EPSRC)
- E3G Third Generation Environmentalism
- Earth Security Group
- East of England Local Government Association
- Empowering Responsible Investment (EIRIS)
- Environment Agency (EA)
- Economic Social Research Council (ESRC)
- Fighting Poverty with Financial Inclusion
- Future Business Centre
- The Greater Cambridge Greater Peterborough Enterprise Partnership
- Glasgow University
- Global Food Security
- Global Sustainability Institute
- Grantham Research Institute on Climate Change and the Environment
- HIS
- ICAEW
- Imperial College London
- Innovate UK
- International Centre for Infrastructure Futures (ICIF)
- ISR
- Kingfisher
- LDA Design
- Lloyds of London
- London School of Economics
- Met Office
- Newcastle University
- The Nexus Network
- Opportunity Peterborough
- Parliamentary Office of Science and Technology
- Peterborough Environment City Trust (PECT)
- Peterborough City Council
- Rescient Ltd
- Risk solutions
- Risk Management Solutions
- Severn Trent
- Standard and Poor's
- Stockholm Environment Institute
- Suffolk County Council

- Synchronicity Earth
- The Dawe Foundation
- The Institute of Actuaries
- The Royal Society
- The University of Leeds
- The University of York
- The Water Cluster
- University College London
- UK Data Archive
- United Nations Environment Programme
- University of Exeter
- University of Hertfordshire
- University of Surrey
- University of Sussex
- Vivid Economics
- Welsh Government
- Willis RE

Those who expressed an interest but were unable to attend

- Agritech East
- Association of Train Operating Companies
- Aviva
- BUILD: Infrastructure Business models, valuation and Innovation for Local Delivery
- C40
- CBI
- DCLG
- DfT
- EA Climate Ready
- Energy Research Partnership
- Food Standards Agency
- GCGP
- Grantham Institute LSE
- Groundwork Suffolk
- IIGCC
- Infrastructure Operators Adaptation Forum
- Institute for Global Prosperity
- King's College London
- LSE
- National Grid
- Natural England
- Network Rail
- Nottingham University
- Oxford
- POST
- RMS
- Suffolk Chambers of Commerce
- Suffolk Climate Change Partnership
- Tellus Matter
- The University of Aberdeen
- The University of Manchester
- UN
- UNEP
- University of Sheffield
- University of Southampton
- University Of Wisconsin
- World Bank

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We would like to thank the ESRC Nexus Network who funded the establishment of the Nexus Shocks Network and provided valuable feedback throughout the project.

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Cartoons by Luke Warm

Mark Nesbitt is an award winning Irish cartoonist and caricaturist who has worked under the pen name of 'Luke Warm' since 1990. His work has been published regularly in many national newspapers in the UK and Ireland including the *Financial Times*, *The Irish Times* and *The Times Higher Education Supplement*. He has illustrated more than ten books and been syndicated by the Press Association. His Conference Cartoons, drawn on the spot during plenary sessions and workshops, are now extremely popular. Please see further details at CartoonsbyLukeWarm.co.uk or call him on 01237 441 559. The cartoons in this booklet are copyright and may only be reproduced with written permission from Luke Warm.

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