Resilience of the built environment

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Part of the BRE Trust

Presentation

- BRE Centre for Resilience
- Resilience of the built environment
- BRE Trust research programme
  - Overheating
  - Flood resilience projects

BRE Centre for Resilience

- BRE Centre for Resilience is a research hub that will deliver research and innovation in partnership with government, the construction industry and the insurance sector
- Working together to provide a platform for all of BRE and partners resilience related expertise
- National and global resource for government, local authorities, environment agencies, industry and the public

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BRE CENTRE FOR RESILIENCE

Centre - strategy

- Build on our existing expertise and capabilities:
  - Fire engineering, wind engineering, weathertightness, ground engineering (long term)
  - BREEAM Infrastructure, nuclear industry (recent innovation)
- Engagement with Government (national, local, agencies) and industry (construction, insurance)
  - e.g. APPG Inquiry on flooding
- Over 140 organisations signed up to be a Friend of the Centre
  - (www.bre.co.uk/resilience)
- Policy making / driven – white papers
  - Future Flood Resilient Built Environment (launched at Resilience14)
  - Further white papers

Resilience - definition

Cabinet Office - ‘the ability of assets, networks and systems to anticipate, absorb, adapt and / or rapidly recover from a disruptive event *(and longer term change)*”

– Refers to sudden shocks

– But - recognise long term changes that impact on resilience

– Emphasise systems and networks – built environment, infrastructure, etc

Resilience – definition

- Shocks
  - Extreme weather
  - Natural and manmade disasters
  - Fire
  - Terrorism, crime including cyber crime

- Stresses
  - Climate change
  - Population growth and urbanisation
  - Energy security and resources

Resilience – the challenges

– Inefficient free market responses lead to market failures
– Organisational failures and community incoherence
– Complex interdependencies
– Knowledge gaps
– Unproven responses and technologies
– Lack of standards
– Sudden shocks and long term changes

Extreme Weather (Innovate-UK: 2014)

Year	Event	Year	Event	Year	Event
2005	Flooding	2009	Flooding	2013	Hot weather
2006	Drought	2009	Snow and ice	2013	Storms
2006	Heat wave	2010	Flooding	2013	Flooding
2007	Flooding	2010	Snow and ice	2014	Flooding
2008	Flooding	2012	Drought	2014	Wettest Jan and driest Sept on record in UK
2008	Snow and ice	2012	Flooding		

Rethinking built environment resilience?

- ICE paper: Tye, Holland and Done – USA
- "Catastrophic failures in the built and natural environment resulting from climate extremes such as flooding have become all too familiar. Limit state design under changing climate conditions may no longer be appropriate and may lead to more frequent and unplanned failures. Developing optimal design responses by rethinking the target 'failure rate' to reduce our increasing vulnerability to extremes is essential. Addressing this requires strong communication links between the civil engineering community and climate scientists. These communication links, however, have often lacked the essential component of an on-going two-way interaction promoting clear communication of the core issues"

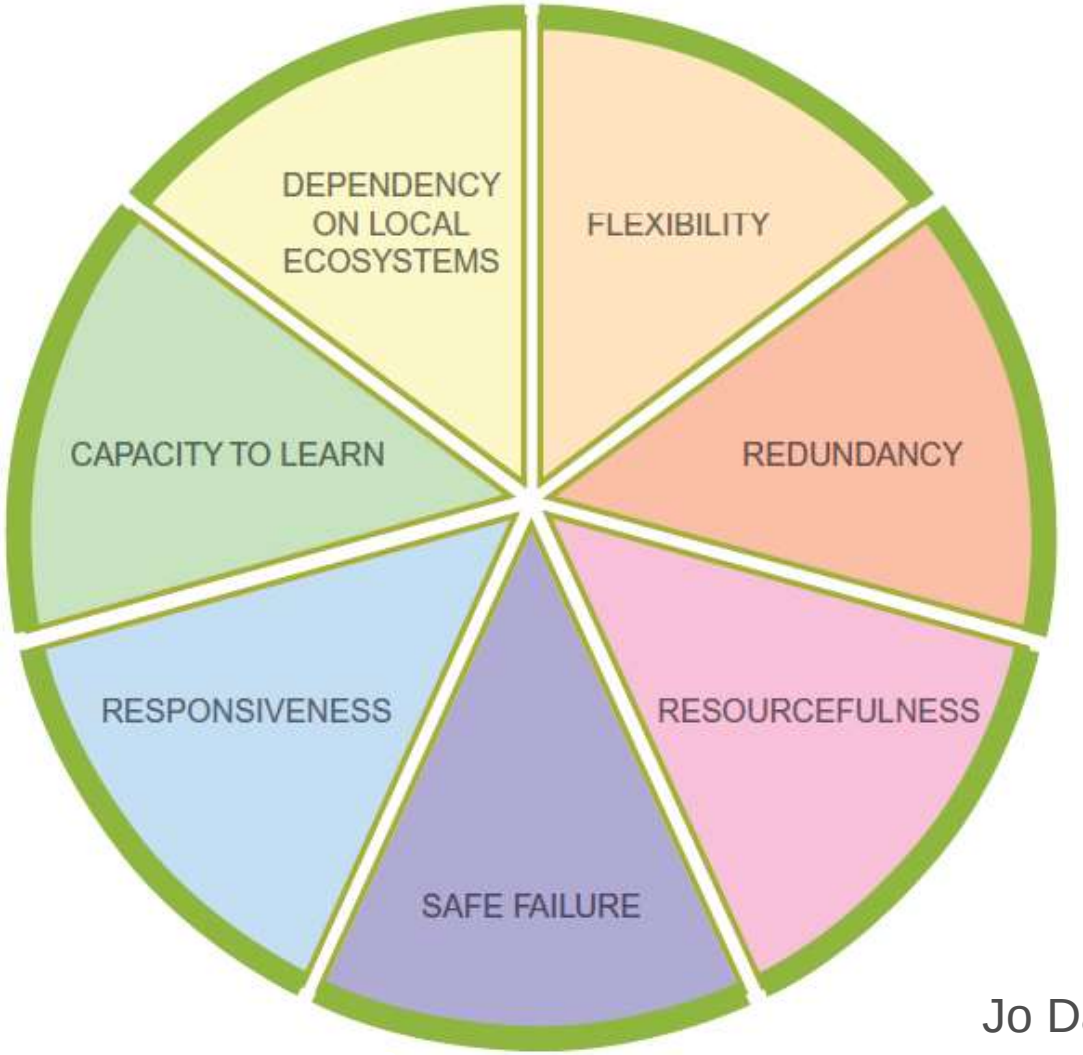
- A limit state is a condition of a structure beyond which it no longer fulfils the relevant design criteria

Resilient urban systems

- Increasing probability of extreme events
  - Flooding, overheating, extreme cold
- Increasing exposure
  - Number of people living within 5 m elevation from mean sea level: will double over 21st century to 400million
- Requires fully integrated approach to design
  - Solutions benefit from the involvement of all sectors – scientists, engineers, policy makers, end users and the public…..
- Accept a level of uncertainty about the magnitude of the impact … embed redundancy …fail-safe options -

- Redundancy .. duplication of components or functions to increase reliability, usually in the form of a backup or fail-safe.

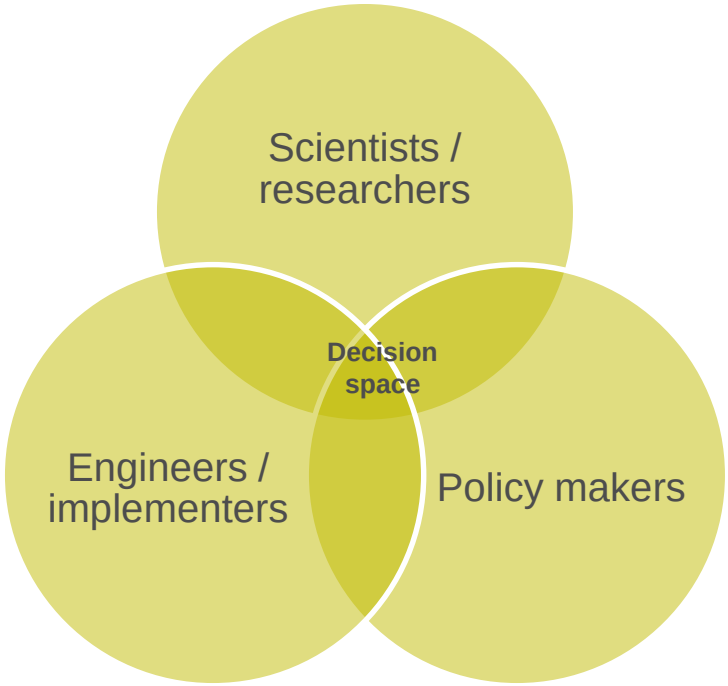
Characteristics of resilient urban systems



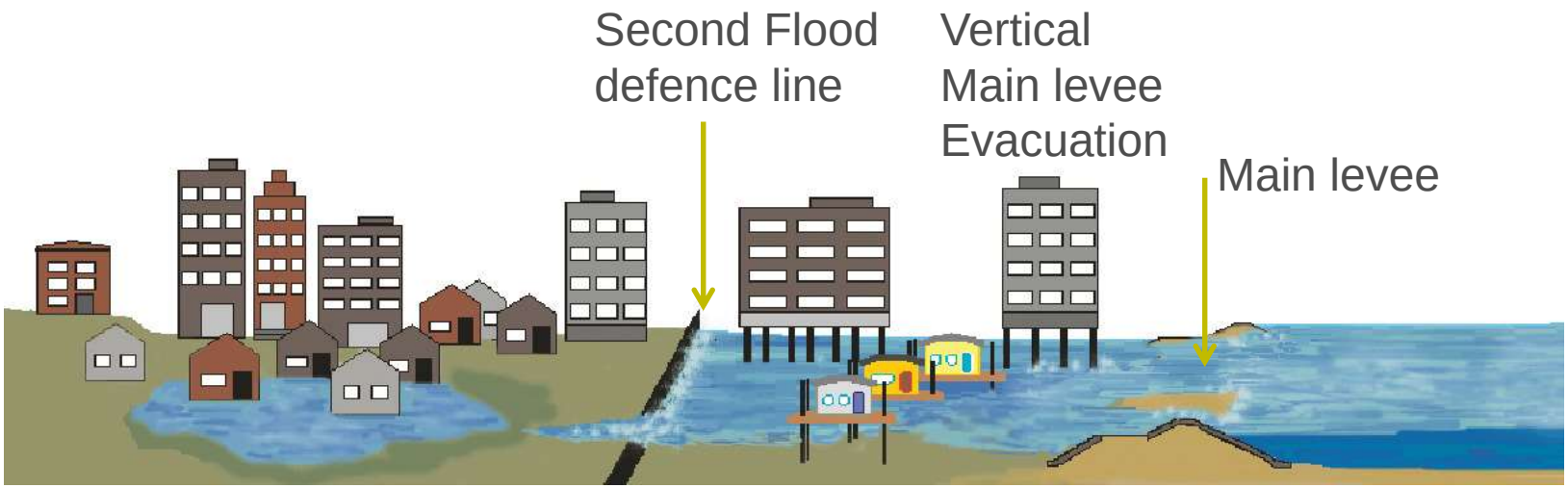
Jo DaSilva, Arup

Resilient urban systems

- Uncertainty is part of the approach – climate change
- Don't focus on a single engineered solution
  - e.g. multiple types of flood risk, may require flood defence, SUDS, resilient property design, emergency response, etc….
- Stakeholder involvement……



Cascading flood compartments with adaptive response

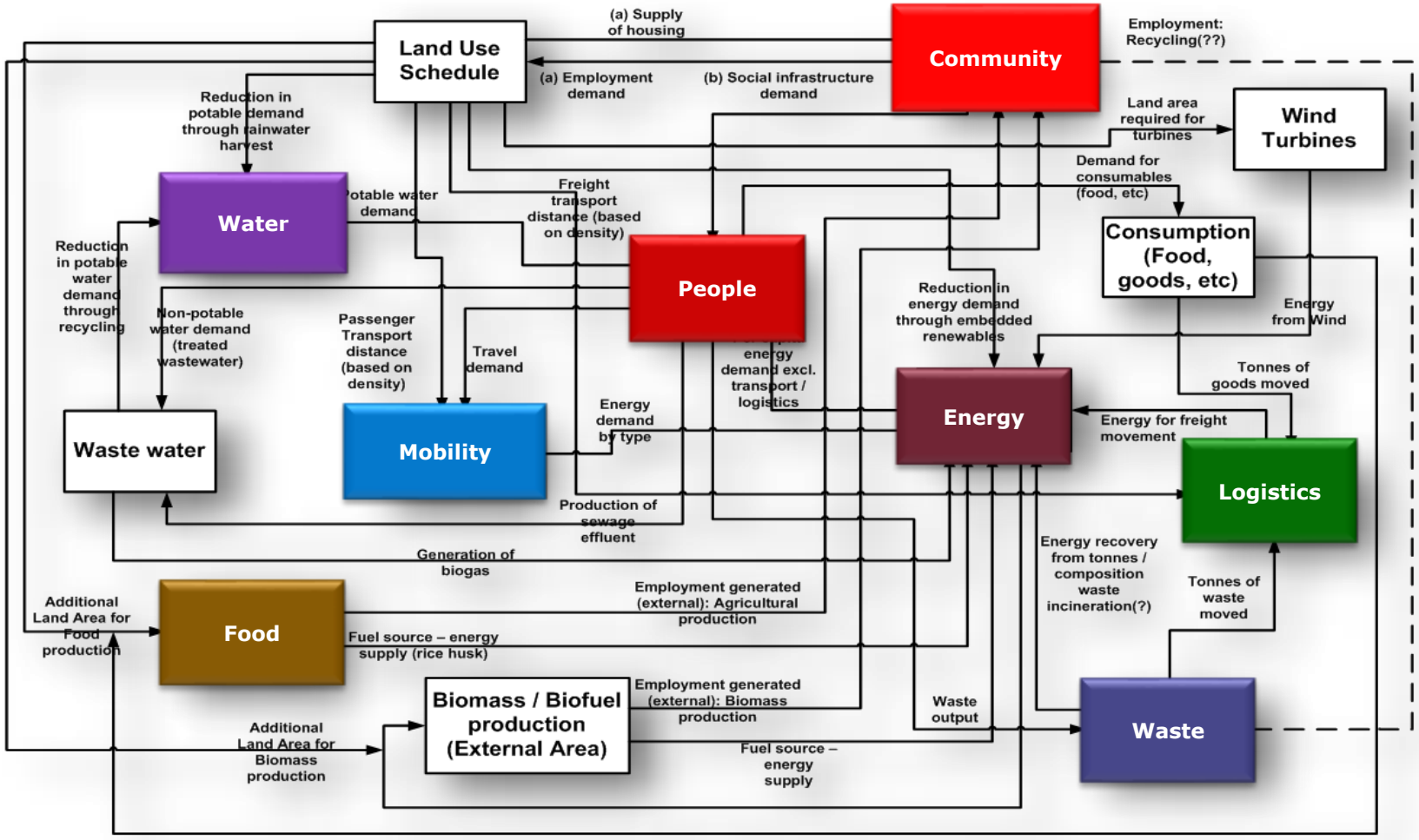


Adaptation to flooding dry and wet-proofing

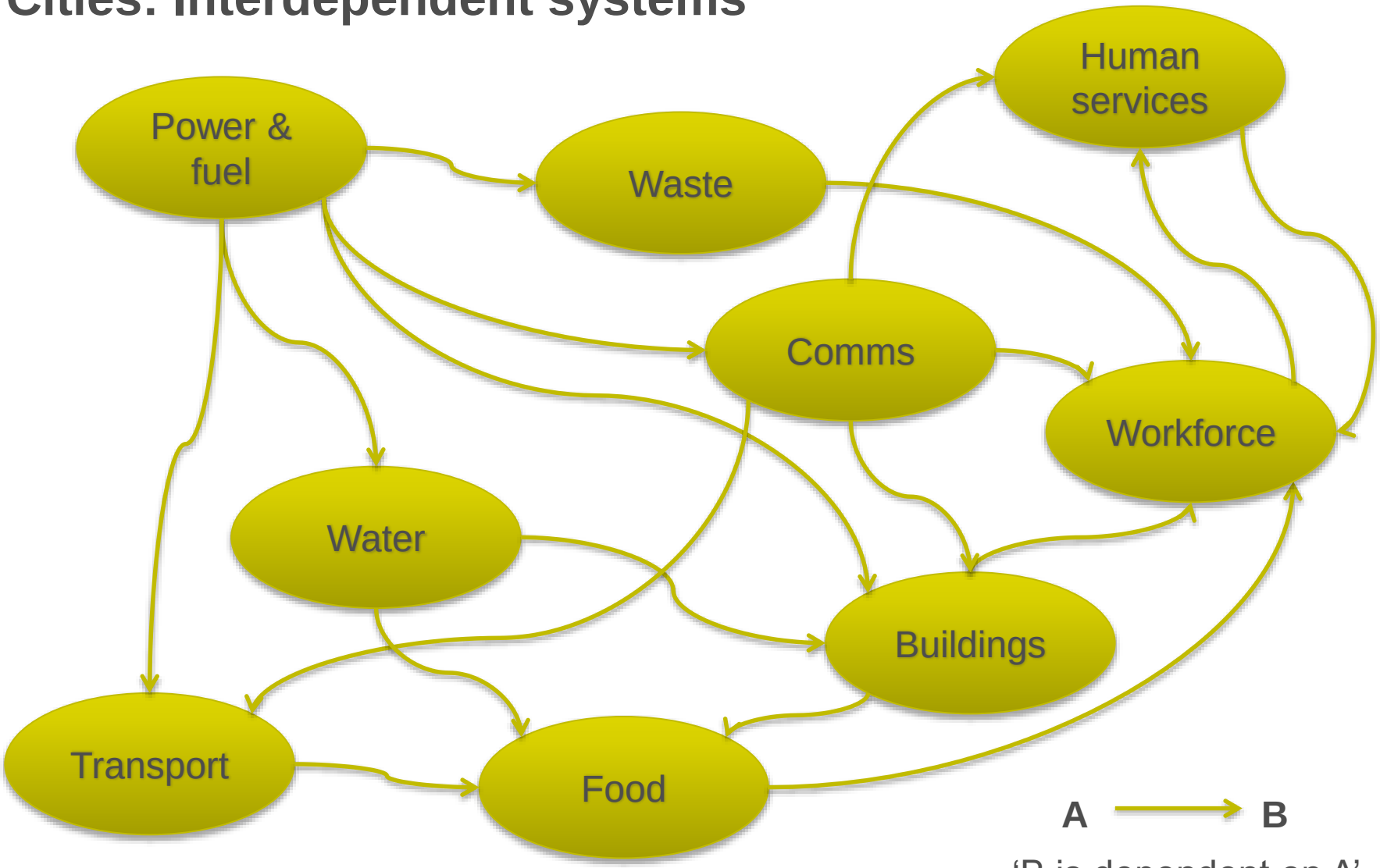
Adaptation by floating and amphibious homes, homes on piles

REF: Flood Mitigation Using Cascading Dike System Nehlsen, E., Wilke, M., Goltermann, D., Pasche, E.

Cities: systems of systems

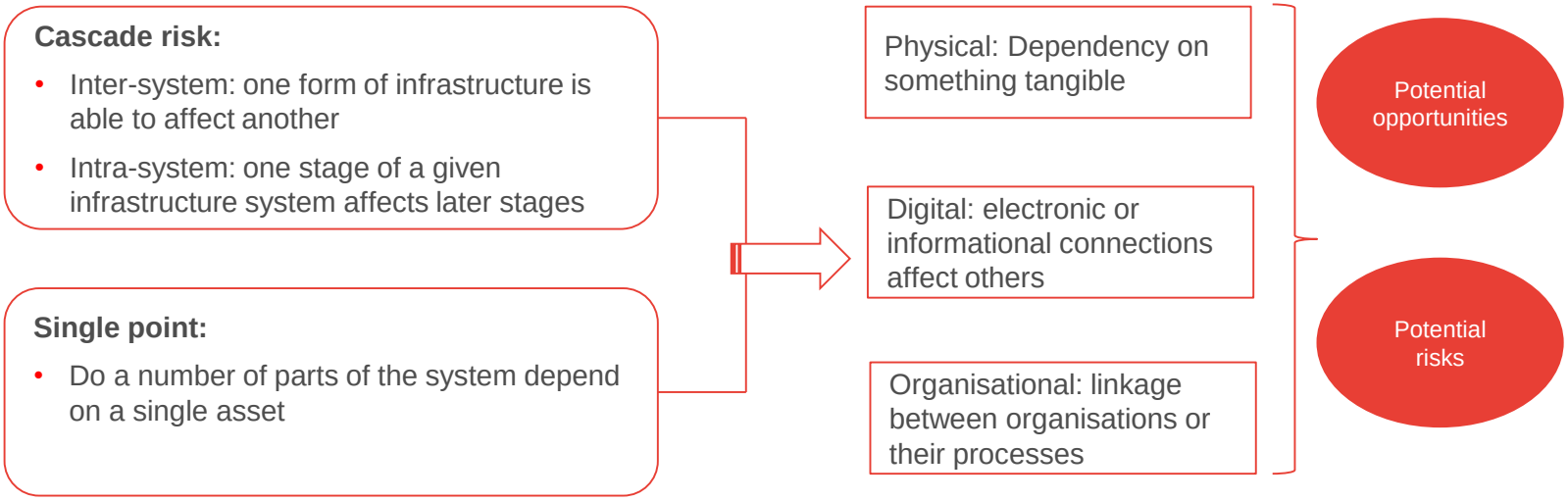


Cities: Interdependent systems



Why do interdependencies matter?

- Increased risks; increased impact of perturbations
- Opportunities for decreasing costs, increasing value, improving functionality/future flexibility



BRE Trust – Resilience Thematic Research Programme

- £1 million investment in collaborative research
- Support (welcomed) from industry, government, others
- 2 year programme
- Initial 5 projects start April 2015

- Developed after series of stakeholder workshops

Overview of stakeholder workshops

- Heavy focus on **climate resilience**: perception of increasing vulnerability, climate change, population and urbanism are challenges that the built environment must address
- **Flood resilience** identified as a priority by all groups, including planning, new build and retrofitting
- **Existing standards** well developed in some areas (wind loading, fire engineering, physical security), but not in others such as flooding and cyber security
- **Closing the gap** on performance, wind damage at below design wind speed
- **Fire resilience** focus around innovative materials and components

Overview of stakeholders workshops

- **Lack of tools** to assess or quantify the resilience of buildings, communities, etc; development of BREEAM, CfSH
- **Maintenance of resilience**, managing the long-term implications of SUDS
- **Overheating**, key areas are where vulnerable people live, care homes, hospitals
- **Cyber resilience**, need to understand and develop standards related to data and operational security in the built environment
- **Language of resilience**, need to reach common understanding
- **Sudden shocks and long term changes**, the different dimensions of resilience
- **Aesthetics of resilience**, acceptability of resilient solutions at building and community level

First tranche of projects

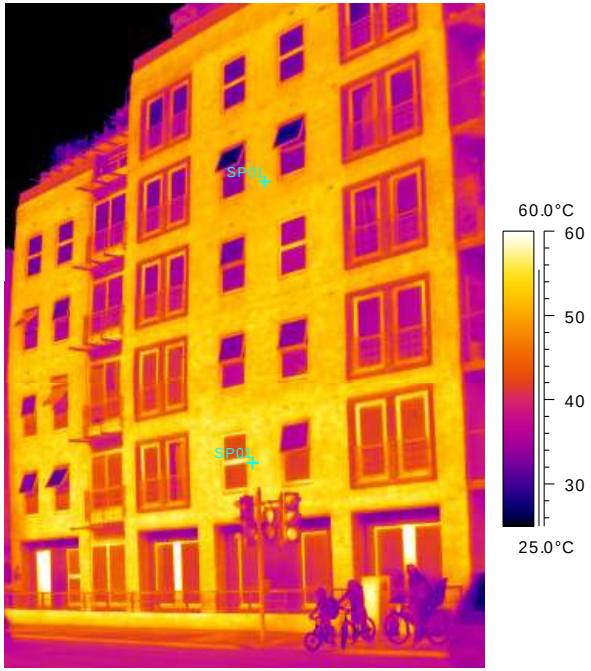
- Flood resilient repair
- Overheating in dwellings
- Wind gap!
- Community Resilience
- Disaster Resilience – developing QSAND

Overheating – some of the questions

- No accepted definition of overheating (dwellings and other buildings)
- National thresholds needed: upper temperatures
- Base thresholds on health or thermal comfort
- Building regulation role
- Role of design: aspect, solar gain, ventilation, internal heat gains

Background to the research

- Overheating is already happening in UK
- It will be exacerbated by urbanisation and climate change effects
- Increasingly overheating is being seen in new-build dwellings
- Ventilation is seen as a key factor
- Hence → 18-month BRE Trust project
- Main objective: to gather data from real dwellings (existing and new-build) and to investigate causes/extent of overheating
- Access to flats has been provided by the Peabody Trust (PT)
- Project will also involve PT's supply chain



Research tasks

- Assessment and monitoring of single-aspect flats in deep urban locations
- *Existing flats* – Bethnal Green
  - Monitoring
  - Engagement with residents
  - Review of design & build
- *New-build flats* - Clapham
  - Review designs
  - Assess construction practice & quality of finish
  - Embed monitors
  - Undertake full assessment of the risk of overheating
  - Inspect and assess building systems
  - Monitor internal conditions

Anticipated outcomes of the research

- Collect data for occupied flats and assess extent of overheating
- Investigate causes as far as possible
- Embed monitoring equipment in a new residential building to help study heat movement throughout the structure
- Monitor throughout construction and into occupation phase, including air flows in and out of dwelling
- Undertake detailed design review
- Establish the extent of overheating
- Strive to establish causes of overheating if it is occurring
- Look at what measures could have been taken to prevent/reduce overheating
- Contribute to the Resilience agenda by informing best practice

Research outcomes

- Develop guidance for design teams:
  - Why is overheating occurred within these flats?
  - What measures should be taken (as part of the design process) to avoid this happening in the future?
- Guidance will be tailored to the appropriate members of the design team, and also to the build team as a whole - to increase integrated understanding of decisions made
- BRE C4R and other established communication channels in order to disseminate project findings
- BRE Academy training and awareness courses

Flood resilience

- Planning
- UK – presumption against building in flood prone areas
- Not to develop, unless other sites are not available
- Would the development be insurable

- Building regulation
- Health & safety, energy efficiency, accessibility
- Flood resilience (Scotland a requirement, if there is a flood risk; elsewhere not!)

Water ingress

Flood resilient repair: aims and objectives

- The aim of the research will be to enable the greater uptake of flood resilient repair approaches by homeowners, assisted by appropriate standards and contractors with the skills to deliver cost-effective measures

- 10,000s properties flood in recent years
- Urbanisation and climate change is increasing the risk
- Many properties are repeatedly flooded

- Resilience as opposed to resistance measures

Objectives / Tasks

- To establish the state of the art in flood resilient repair for existing homes through a combination of literature review and site inspection of properties.
- To use develop a range of performance measures that can form the basis of a flood resilient repair standard for existing homes; to set a performance standard for flood resilience.
- To develop the standard by creating technical guidance, this will provide a range of options that specifiers and builders could take to reducing damage from flooding; the guidance will include both materials and design details as examples.

Objectives / Tasks

- To carry out a demonstration of flood resilience measures using the Innovation Park at Garston.
- To produce a publication that can be used for wider dissemination and wide replication on he subject of flood resilient repair that can be used by a wide range of industry professionals and be supported by insurers. The publication will be supported by a dissemination strategy through the Centre for Resilience.

Outcomes and making the most of results

- Standard for flood resilient repair
- Demonstration of flood resilient repair

- Change behaviour amongst insurers, recovery industry and contractors
- Awareness raising, leading to training for insurers, loss adjusters, specifiers and builders

- Certification of the repair process
- Certification of repair products

Insurance: Property Flood Resilience Database PFR-d

PFR-d project

Overall aim is to bring together sources of flood data that can be used to increase the resilience of buildings to flooding

Objective 1:

- To produce data that can be used by government in order to target investment in PLP / FRe

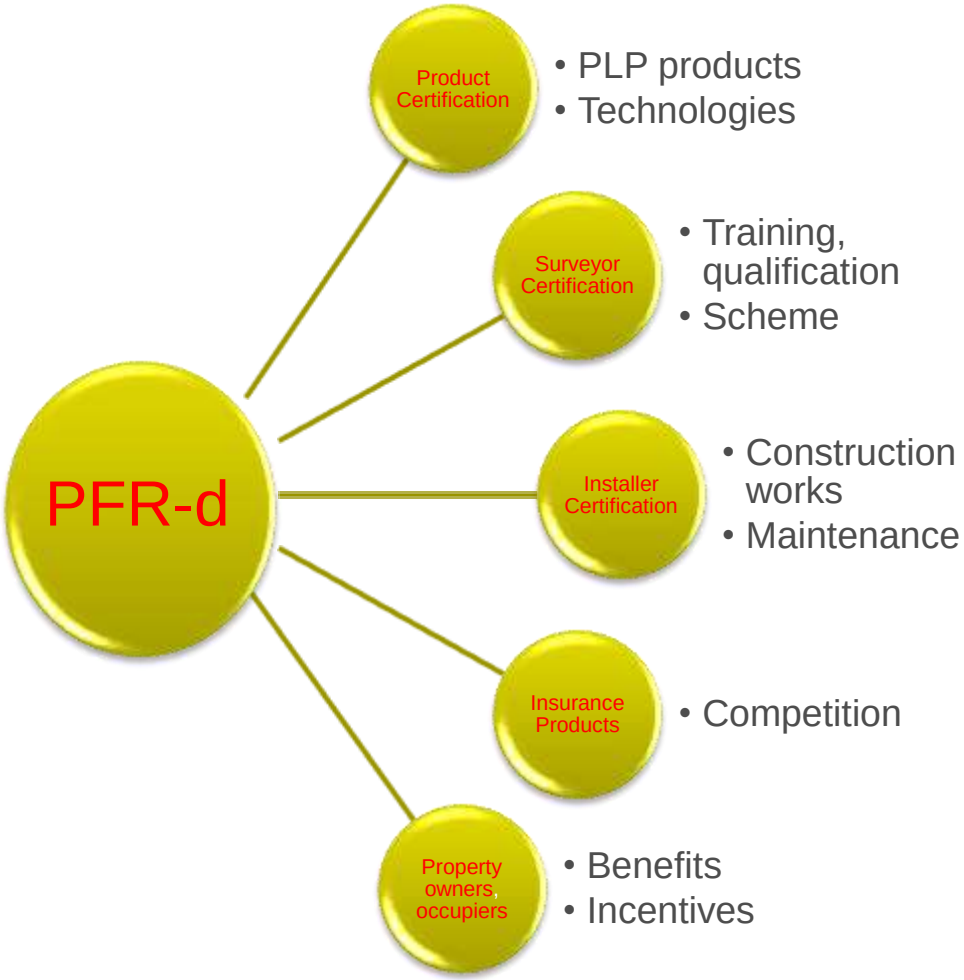
Objective 2:

- Improve insurance databases of improved properties so that the market can adjust the products offered to clients

PFR-d ‘the missing piece’

- Insurance companies use maps (geocode) – to accurately assess flood risk to property (to within one metre)
- Geocodes use datasets such as elevation, land use, rainfall, river geometry, river flow rates, tidal data … to predict flood depths for particular events (1 in 75 …)
- This data is used to assess risk and determine premiums
- Improved previous situation, but still needs further data to address use of flood resilience technology
- Emergence of Flood Re! – not the silver bullet

PFR-d connections



Thoughts

- Research: address the big picture through projects at different scales
- Research: component research is needed, but understand where it fits in resilience systems – a challenge
- Building (design, construction, operation, maintenance, end-of-life) cycle – how can we embed resilience at each stage
- Do we need a Resilience of the Built Environment Report! – ‘Lathom, Egan, Pitt… type’?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