Today’s Webcast starts at 1:00 p.m. Eastern.

You will not hear audio until the Webcast begins

Today's Moderator

Ed Sullivan

Editor

building OPERATING management

Today's Presenter

Cole Roberts, PE, LEED AP

Associate Principal

ARUP

- Co-authored "Two Degrees – Our Built Environment and the Changing Climate" with a focus on resilience, adaptation, and decision-making.
- Energy and sustainability business leader in San Francisco
- Design, assessment and consultation in the built environment
- Keynote speaker at numerous conferences
- Published in peer reviewed conferences and journals.
- Guest lecturer at Stanford University and the University of California at Berkeley.
- Arup is a 12,000 person employee owned design engineering and consulting firm with over 90 offices globally.

Learning Objectives:

- Review the role of resilience and resistance in an overall building-readiness strategy.
- Analyze the reasons that resilience is an increasingly urgent topic — and why that urgency will continue to rise.
- Learn how specific building systems — including the building automation system, the HVAC system, and the mass notification/emergency communication system — can make a building more resilient.
- Understand why effective operations and maintenance is an essential first step to resilience.

To ask questions:

Please use the question and answer panel on the right-hand side of the screen, and send to all panelists.

Presentation Handouts

All participants will receive an e-mail by the end of the day with a link to download a PDF copy of today's presentation slides.

CEU Information

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SIEMENS

Every building is different, we make them safe.

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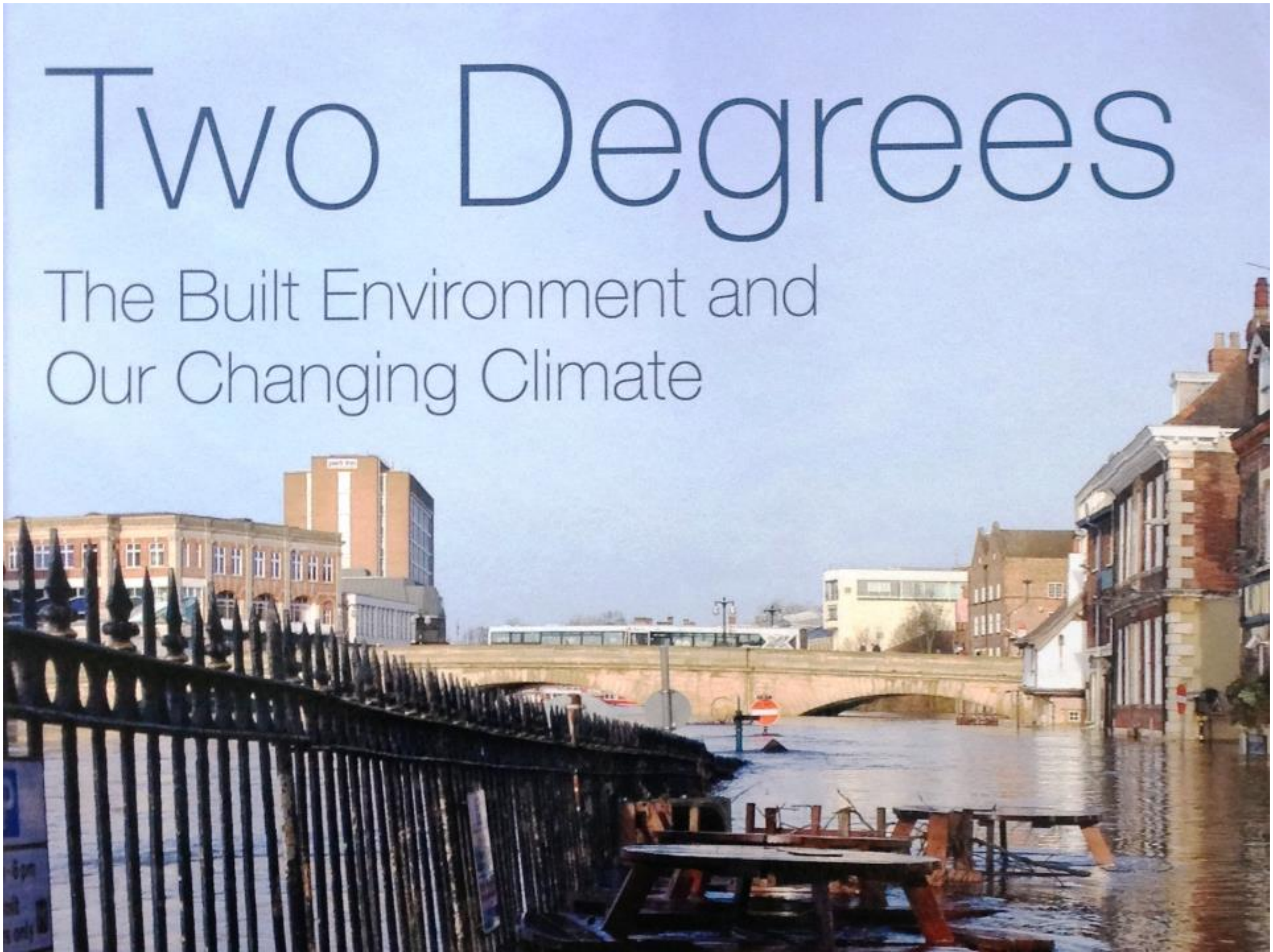
From simple to sophisticated, Siemens has the fire and life safety technology to meet a building’s unique needs.


Two Degrees
The Built Environment and Our Changing Climate

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+ Learning Obj: Resilience Value

- Marketing (e.g., REDI Rating System)
- Market Retention
- Loss Avoidance
- Business Continuity
- Reduced Insurance Premiums
- Co-beneficial Outcomes: e.g., better O&M, shared systems, better comfort control, etc.

Summary Overview

If a disaster strikes, how will your buildings respond? That's a question that more and more organizations are asking facility managers. Whether the risk comes from a flood or hurricane, an earthquake or a fire, facility managers increasingly need to develop strategies to ensure that buildings are resilient. What makes that task especially challenging is that there is no single template that can be used to make all buildings more resilient.

This webcast will examine key concepts and concrete steps that facility managers can take advantage of as they develop a resilience strategy for their own buildings. The webcast will take a close look at the important role that building systems can play in improving resilience. The speaker will help facility managers understand why some risks are on the rise, delve into overlooked factors like accumulated risk, and present examples of successes and failures.

Changing Climate

Frequency of Occurrence		Flooding Events	Drought	Heat Wave	Wind events (Nor'easter, Hurricane)
	Past (1970-2000)	• 1 in 100 years	• 1 in 100 years	• 2 per year	• 1 storm per 3 years
	Projected Future	• 1 in 15 years	• Unclear	• 8 per year	• More frequent

Source: NYC Panel on Climate Change, 2009; ClimAID, NYSERDA, 2012.

…Combined with:

Aging infrastructure

Increasing population

Limited Resources

HEALTH FACILITIES MANAGEMENT

Planning for Disaster | Survey Results

July 2014 | Vol 27 Issue 7

Credits: Rebecca Vesely, Suzanna Hoppszallern

87%

Percentage of organizations with one or more events in the last 5 years that required implementation of the **EMERGENCY PREPAREDNESS PLAN (EPP)**

58%

Percentage of organizations/facilities went on **EMERGENCY POWER** because of a disaster in the last 5 years

CAUSE OF EPP IMPLEMENTATION

52%	Winter storm
48%	Power outages and other system failures
20%	Tornado
17%	Flood
17%	Hurricane
15%	Hazardous spill/hazardous material incident
13%	Mass casualty incident
12%	Fire
12%	Emerging infectious diseases (excluding H1N1)
8%	Bomb threat
6%	Earthquake
5%	Evacuation
4%	Active shooter incident
2%	Mass transit strike or disruption
13%	No threats of events

HEALTH FACILITIES MANAGEMENT

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EMERGENCY MANAGEMENT COMMITTEE INITIATIVES

80%	Participated in emergency preparedness planning with city, county, and state agencies
68%	Participated in the development of community wide emergency preparedness plan
67%	Participated in emergency preparedness planning with local and state hospital associations
60%	Established mutual aid agreements with other hospitals and health care organizations in the community
51%	Applied for and received grant funding from the Health Resources and Services Administration
44%	Pursued collaborative activities to bridge gap between medical care and public health systems
41%	Identified at risk populations*
31%	Defined point-in-time and longitudinal surge capacity at the community level

* Identified at-risk populations who may need additional assistance, including those who have disabilities, live in institutionalized settings, are from diverse cultures, have limited English proficiency or are non-English speaking, lack transportation, have chronic medical disorders or have pharmacological dependency

SUPPLY CHAIN REQUIREMENTS DURING A DISASTER/PUBLIC HEALTH EMERGENCY

18%	Required emergency water supplies for patients and staff
13%	Caused shortage of local medicine supplies
10%	Caused shortage of local vaccines
7%	Required emergency foor supplies for patients and staff
5%	Required use of Strategic National Stockpile*
3%	Caused shotage or difficulty accesing oxygen and medical gasses
2%	Caused shortage of local medical counter-measures

* A national repository of medical counter-measures, vaccines, and other medical supplies in strategic locations around the nations

HEALTH FACILITIES MANAGEMENT

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TOP 5 MAJOR CHALLENGES TO EMERGENCY PREPAREDNESS

1 Unfunded mandates for emergency preparedness response

2 Time limitations

3 Competing resources/spending priorities

4 Governmental processes/compliance issues

5 Staff training in response skills

TOP 10 FEATURES INCORPORATED INTO FACILITIES TO ADDRESS DISASTERS & TERRORISM

45%	Additional fuel and emergency supply storage
42%	Flexible incident-command locations
38%	Additional generator capacity
37%	Advanced security/lockdown systems
32%	Expanded emergency communication systems
29%	Extra space for decontamination/mass casualties
27%	Remote data center
23%	Prevent access to outdoor air intakes
22%	Additional uninterruptible power supply capacity
19%	Enhanced air pressure control isolation capabilities

building OPERATING management

In Case of Emergency: How Building Systems Make Facilities More Resilient

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HEALTH FACILITIES MANAGEMENT

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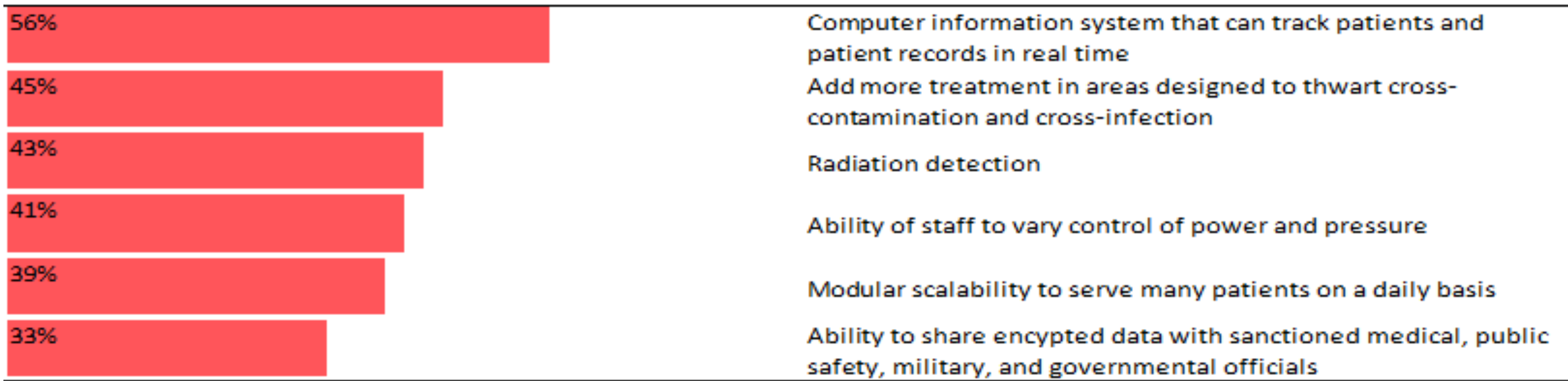
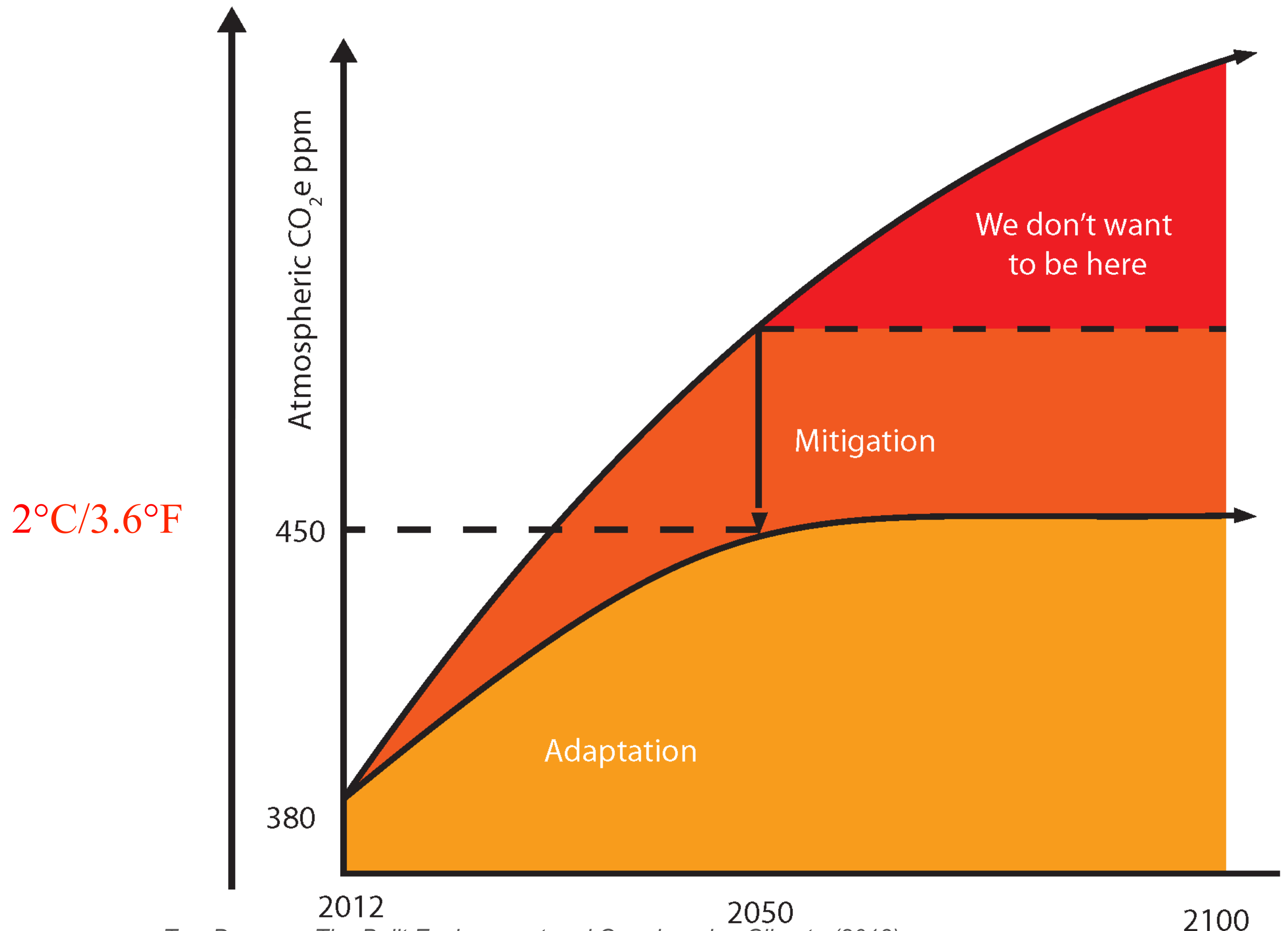
TOP 6 FEATURES INCORPORATED INTO EMERGENCY DEPARTMENT DESIGN



COMMUNICATION EQUIPMENT AND SERVICES USED BY STAFF IN AN EMERGENCY



Two Degrees: The Built Environment and Our changing Climate (2013)

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"We **never** have 100% certainty.

If you wait until you have 100% certainty,
something bad is going to happen
on the battlefield.

That's something we know."

— GEN Sullivan

Recognize a problem

Choose to act to remedy or avoid the problem

Act effectively

Adapted from Collapse *– How Societies Choose to Fail or Succeed, Jared Diamond*

How High Will the Sea Rise?

The marker in front of you shows several scenarios for sea level rise above the current Mean High Water mark.

- **6 m (19 feet, 8 inches):** sea level if Greenland Ice Cap melts (if the ice at both poles melted, the ocean would reach the road deck of the Golden Gate Bridge)
- **2.9 m (9 feet, 6 inches):** 100-year flood level with a 1.4 m rise in sea level and a storm surge
- **1.4 m (4 feet, 7 inches):** high end of predicted sea level rise by 2100
- **1.0 m (3 feet, 3 inches):** moderate estimate of predicted sea level rise by 2100 (approximately today's 100-year flood level)
- **0.5 m (1 foot, 8 inches):** low end of predicted sea level rise by 2100

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building OPERATING management

In Case of Emergency:
How Building Systems Make Facilities More Resilient

Image: Heidi Nutters

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building OPERATING management

In Case of Emergency:
How Building Systems Make Facilities More Resilient

Image: Sergio Ruiz

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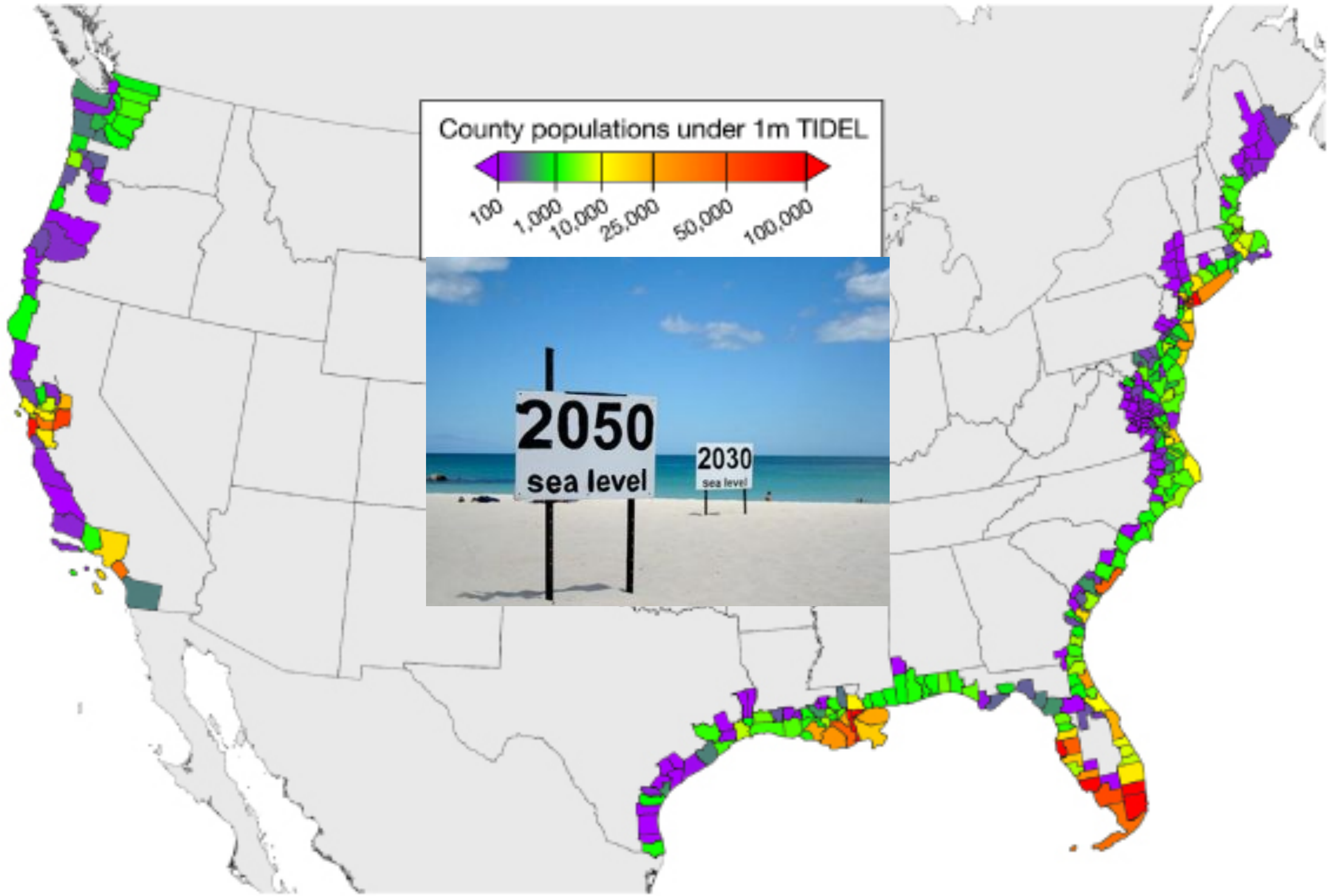
County populations under 1m TIDEL
100
1,000
10,000
25,000
50,000
100,000
2050
sea level
2030
sea level

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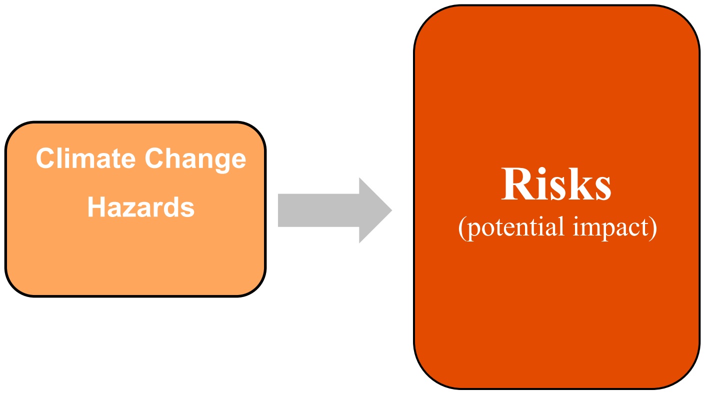

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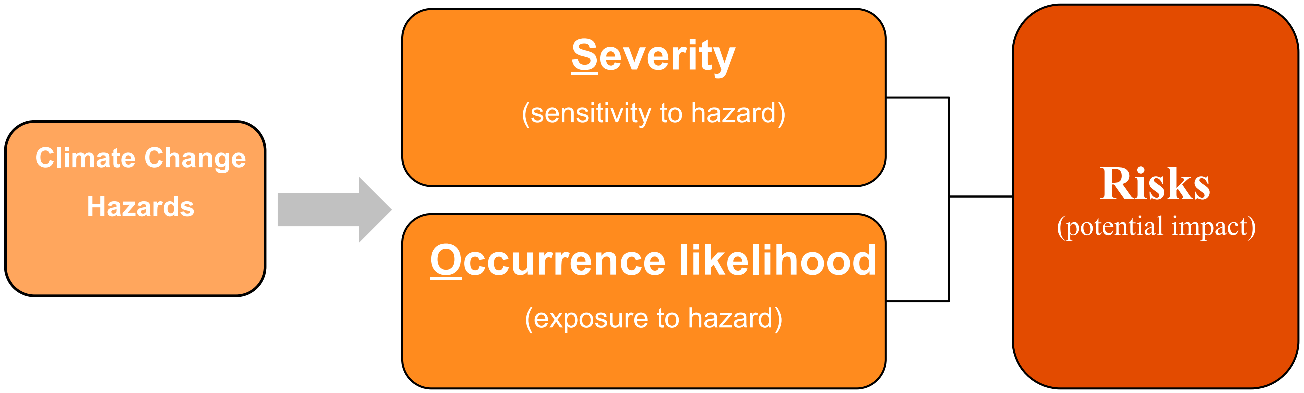

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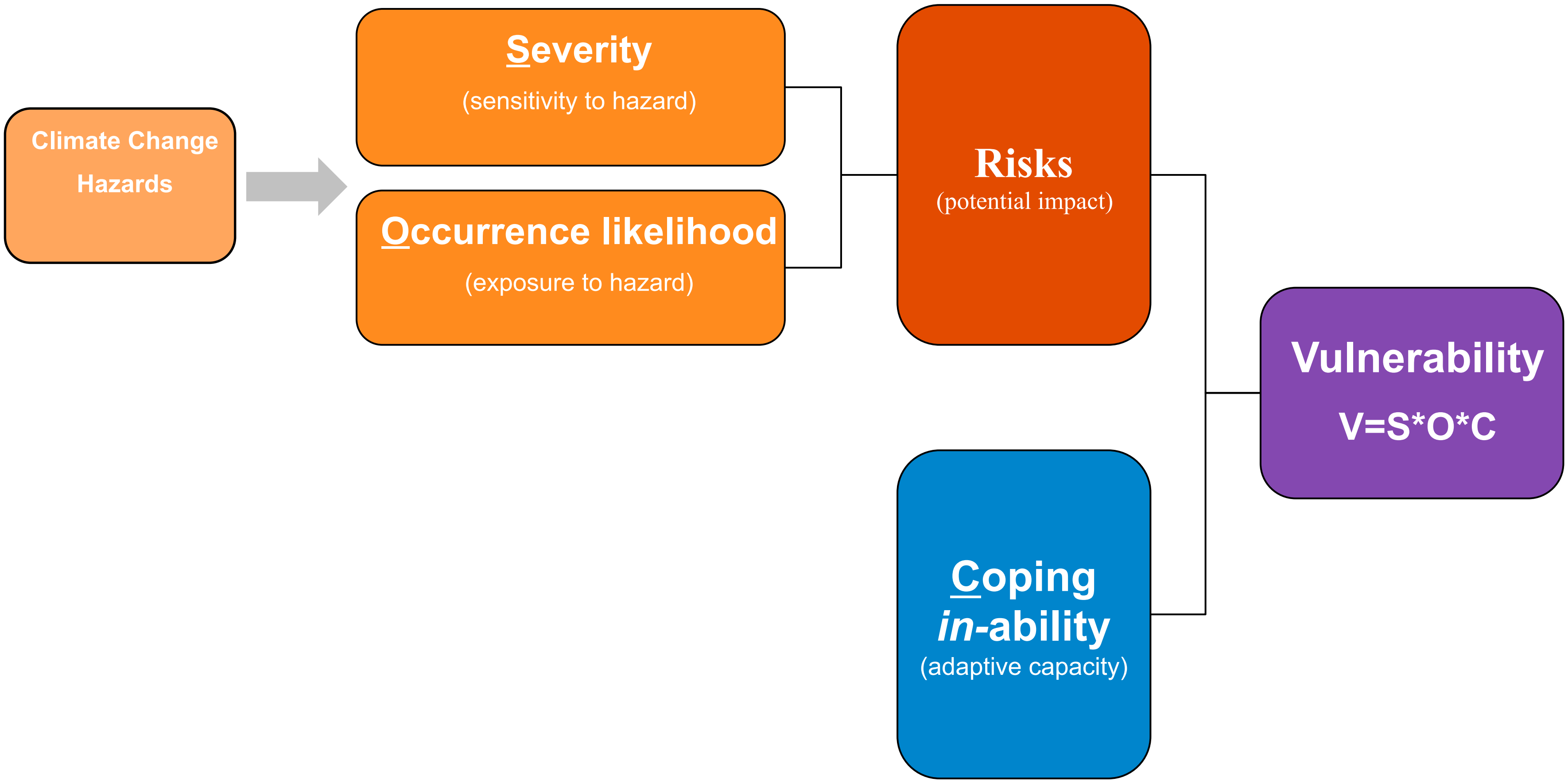

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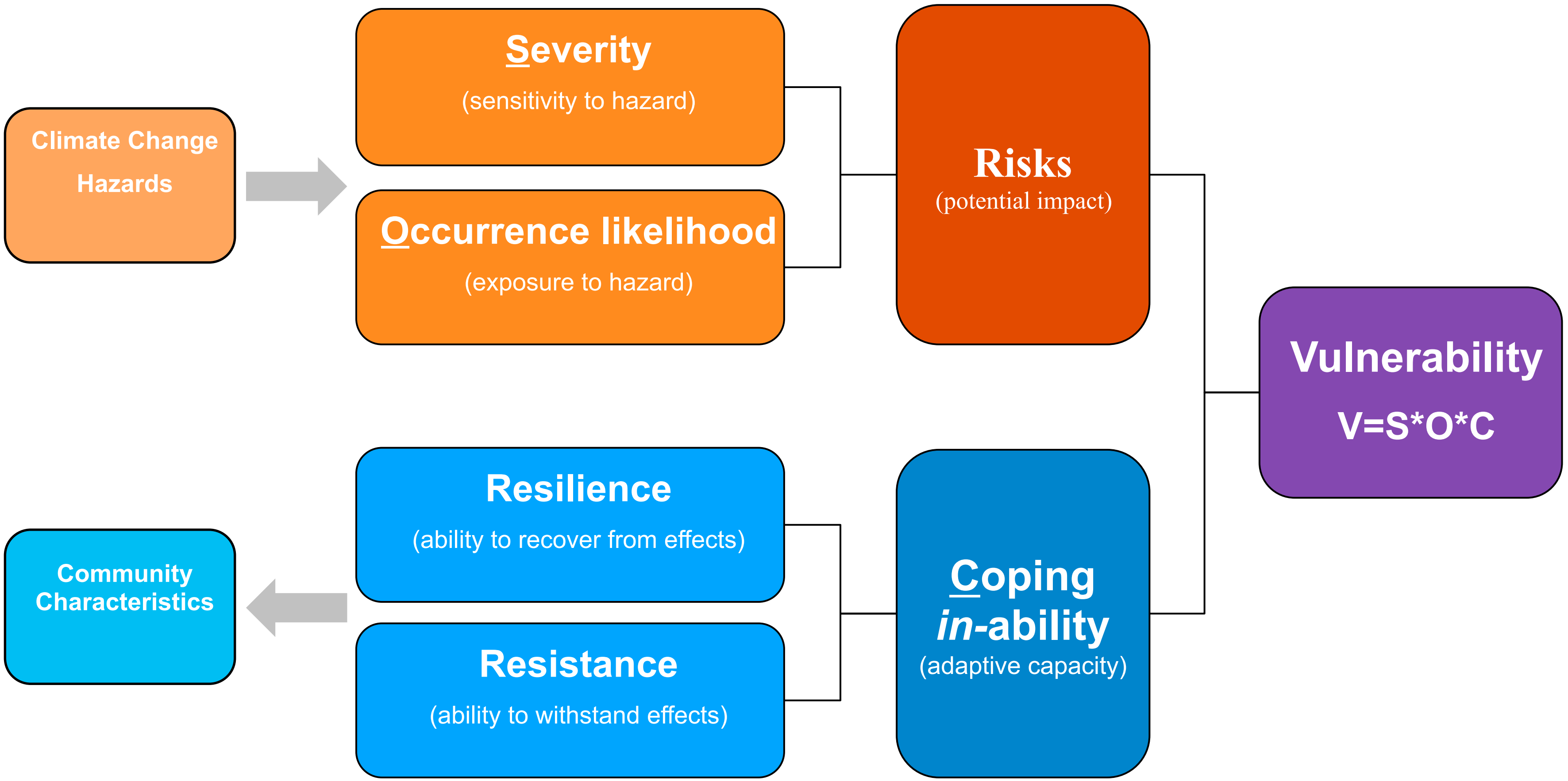

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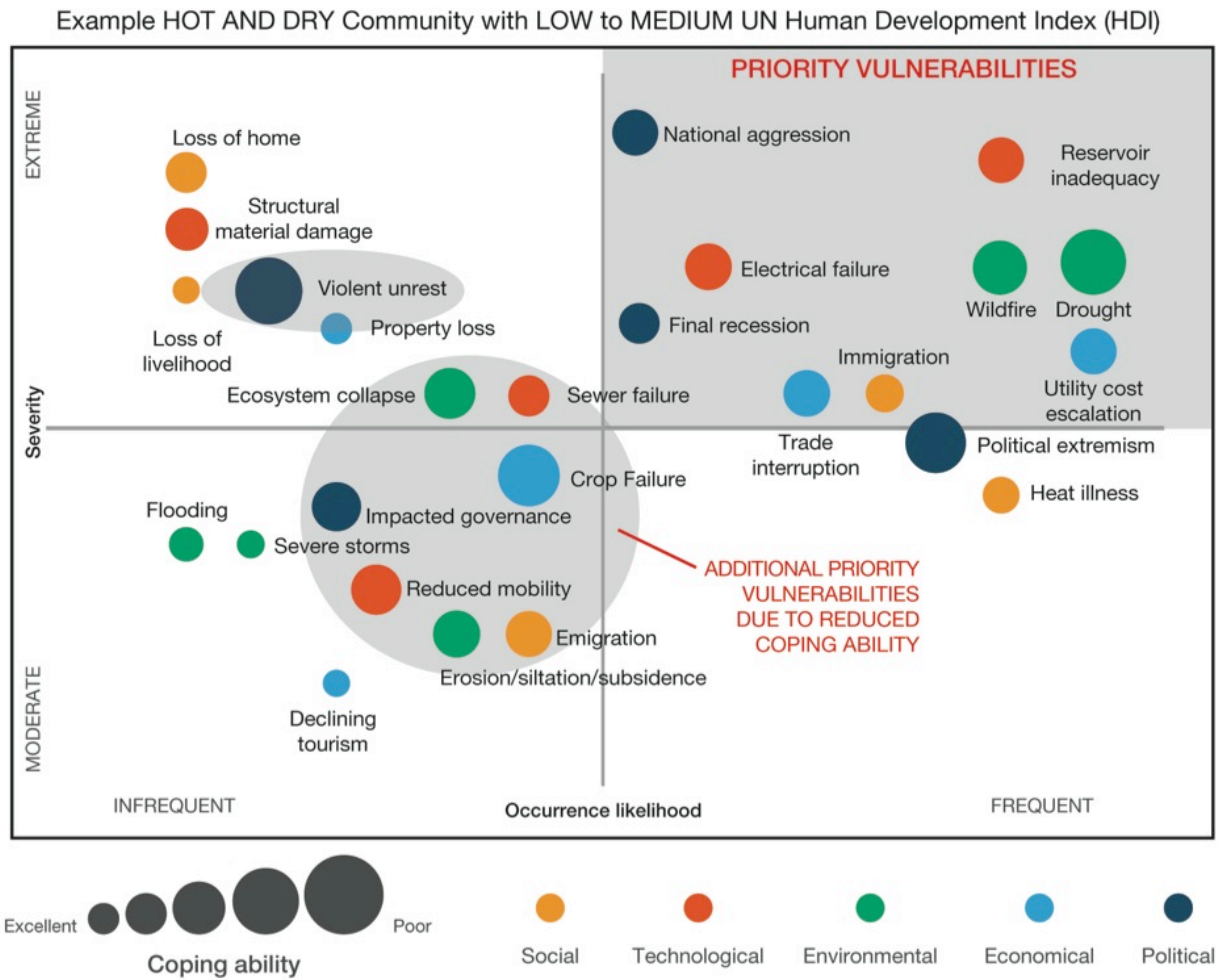
New Hartford, Iowa



Example HOT AND DRY Community with LOW to MEDIUM UN Human Development Index (HDI)
PRIORITY VULNERABILITIES
EXTREME
MODERATE
Severity
Loss of home
Structural material damage
Violent unrest
Property loss
Loss of livelihood
National aggression
Reservoir inadequacy
Electrical failure
Wildfire
Drought
Final recession
Immigration
Utility cost escalation
Ecosystem collapse
Sewer failure
Trade interruption
Political extremism
Crop Failure
Heat illness
Flooding
Impacted governance
Severe storms
Reduced mobility
Emigration
Erosion/siltation/subsidence
Declining tourism
ADDITIONAL PRIORITY VULNERABILITIES DUE TO REDUCED COPING ABILITY
INFREQUENT
Occurrence likelihood
FREQUENT
Excellent
Poor
Coping ability
Social
Technological
Environmental
Economical
Political

Risk Accumulation?

Risk Accumulation

- Bay Area: Elevated Seas + Earthquake+ Levee Breach+ Failed Infrastructure Systems
  ➔ Economic & Health System Failures
- Los Angeles: High Temperatures+Water Scarcity+Non-resilient Urban Form,
  ➔ Economic & Health System Failures
- Honolulu: Energy, Water, and Food Import Dependence,
  ➔ Economic & Health System Failures
- Minneapolis: Retreating Freeze Lines, Monocrops, Wooden Structures,
  ➔ Economic System Failures

Risk Accumulation

- **Japan**
- **Louisiana**
- **New York City**
- **<u>Inland Europe</u>: Heat Index+ Non-Resilient Buildings +Cultural Norms**

  ➔ 50k dead in 2003

The Case Against "Predict and Prevent"

- **"Design Conditions" and "Likely Scenarios" are based on past conditions**
- **Single System Planning and "mal-adaptation"**
- **Emphasis on constructed interventions**

Principles of Resistance and Resilience

Robust systems are able to withstand the impacts of hazard events without significant damage or loss of function.

Redundant systems have spare or latent capacity (or the ability to manage loads), which can absorb sudden surges in demand or partial loss of supply.

Diverse & Flexible systems provide service via a number of pathways, using distributed resources and multifunctional equipment. If one pathway fails, another can be used to achieve service.

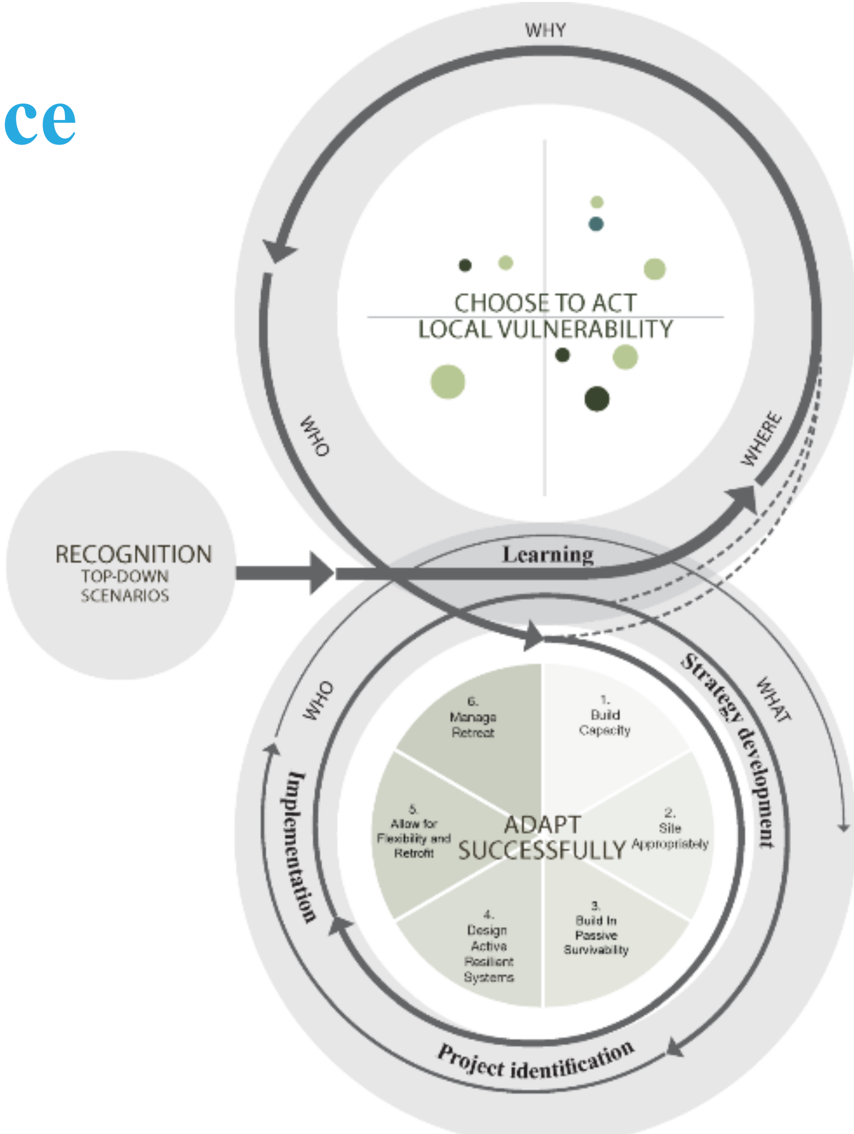
Safe Failure systems absorb shocks and the cumulative effects of slow-onset challenges in ways that avoid catastrophic failure if thresholds are exceeded.

Responsive systems incorporate automated monitoring, short feedback loops and controls at multiple points, enabling transparency of performance and timely adjustment to maintain functionality.

Coordination between systems means that knowledge is shared, planning is collaborative and strategic, and responses are integrated for mutual benefit.

Toolkit for Resilient Cities; Arup, RPA, and Siemens (2014)

Urban Resilience Framework



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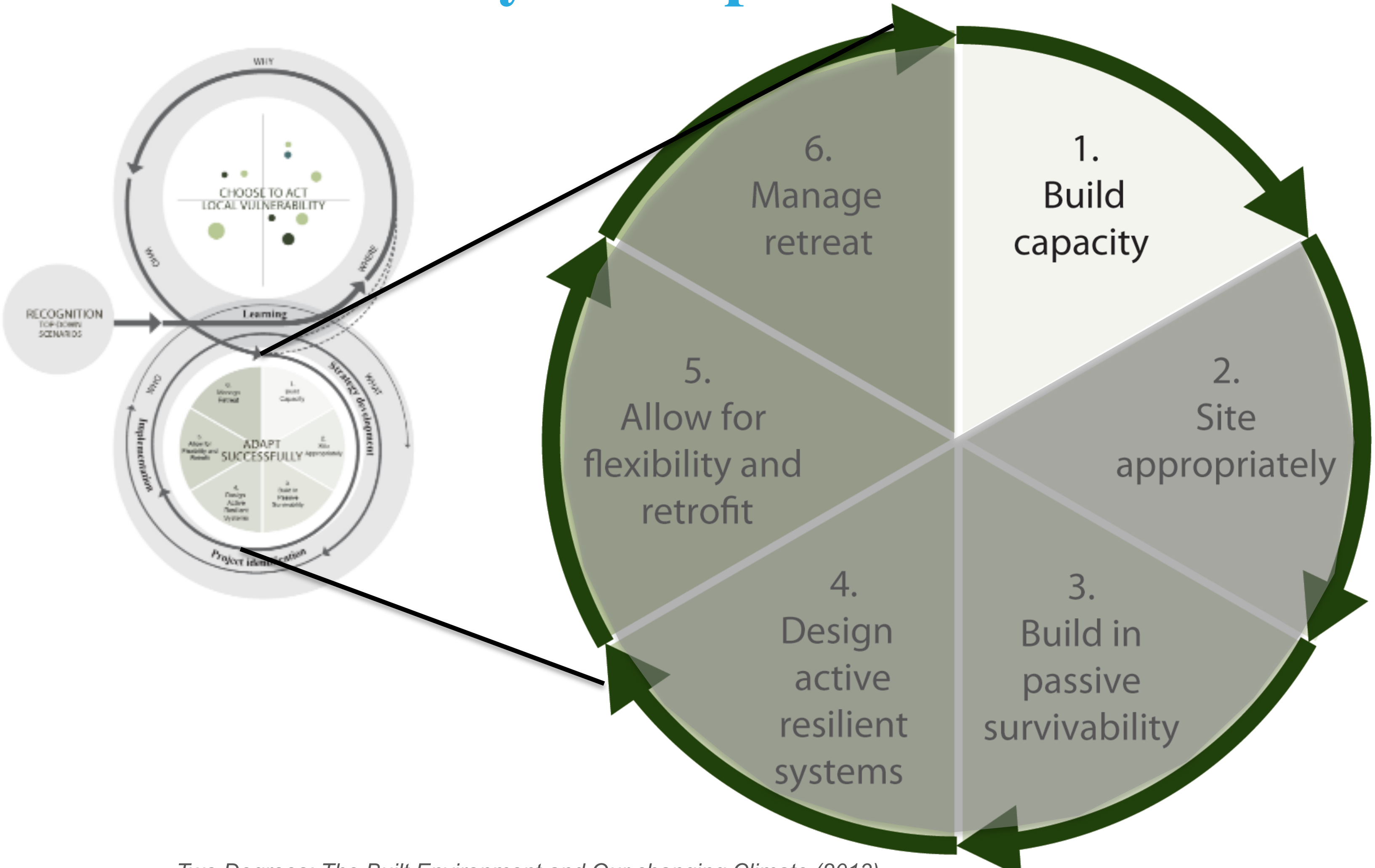
Act Successfully: Comprehensive + Time Based



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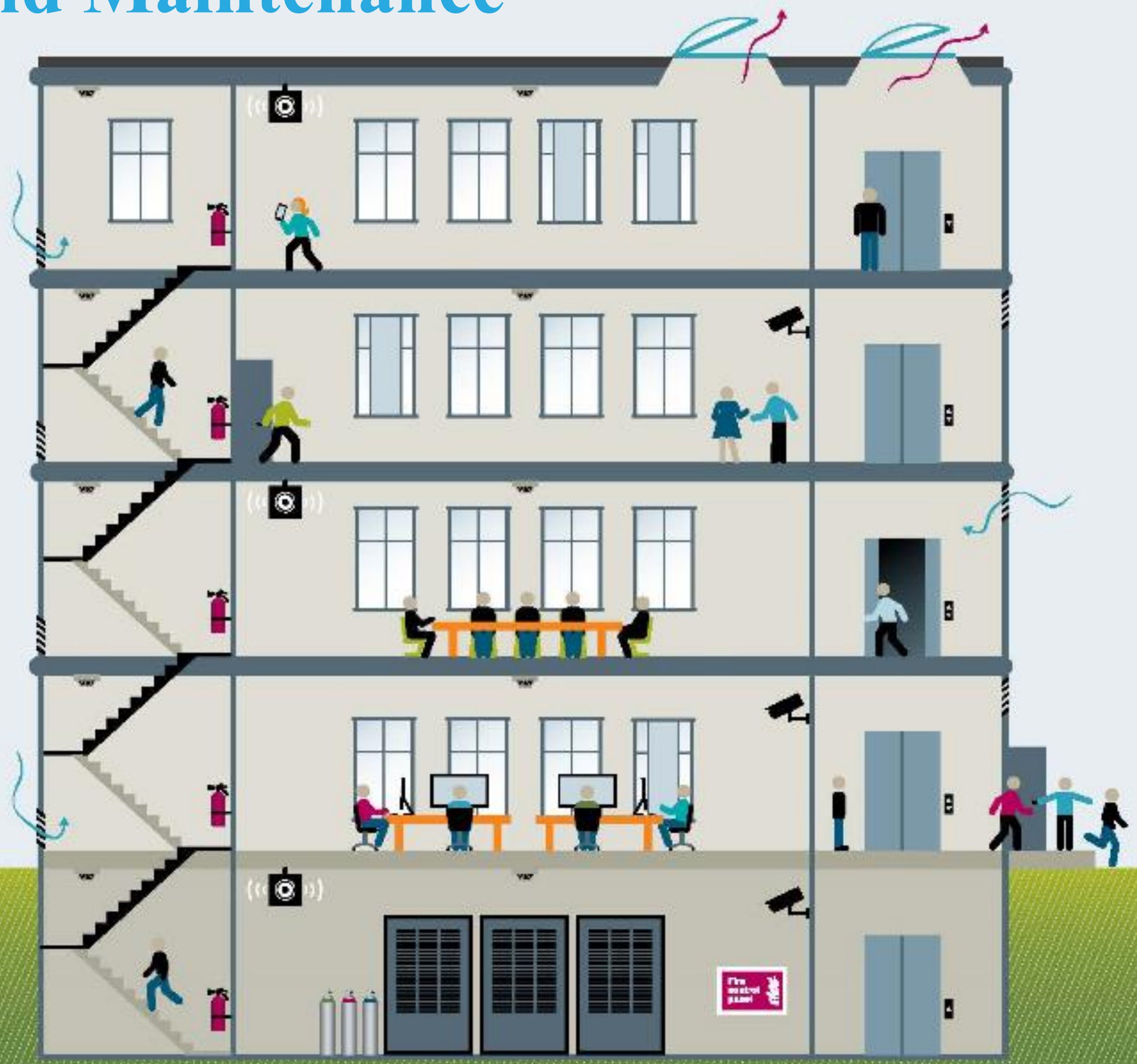
Katrina – Build Capacity

Operations and Maintenance

Building Systems

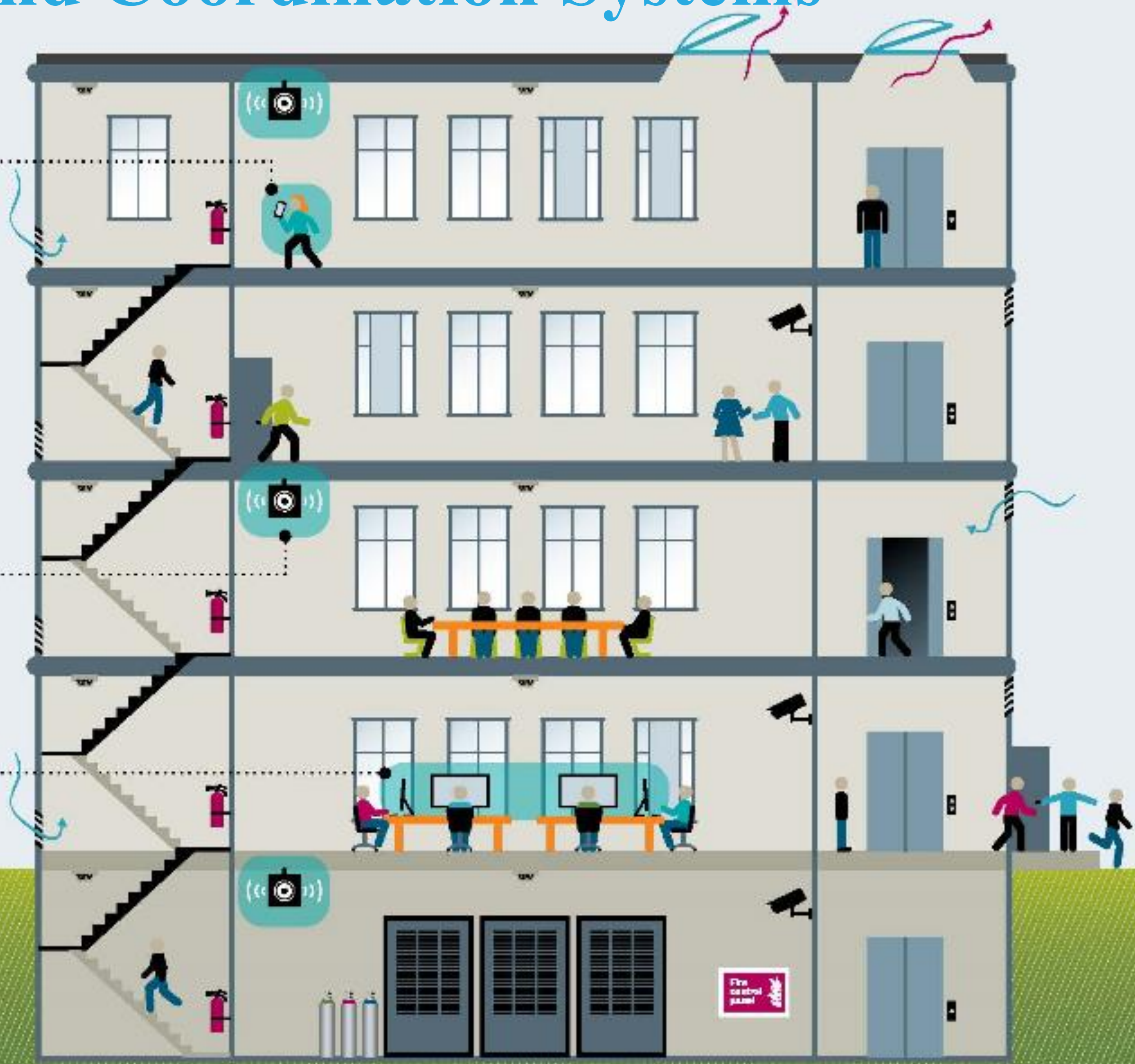


Toolkit for Resilient Cities; © Arup (2014)

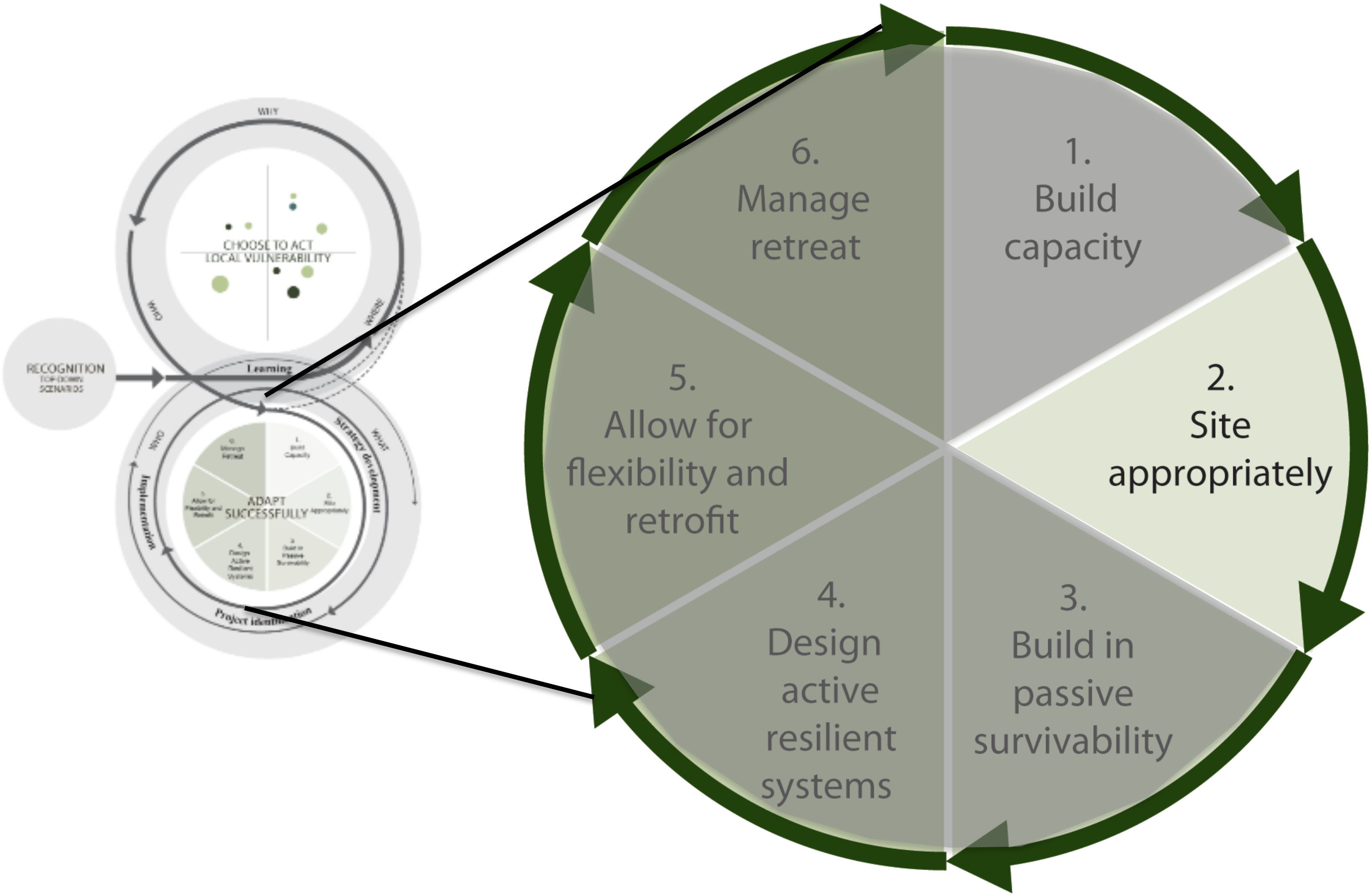
Notification and Coordination Systems

Building Mass Notification Systems coordinate human reactions to hazards

Mass Notification Systems (MNS) deliver targeted messages to advise building occupants during a crisis. Messages are disseminated through multiple redundant channels, including voice systems, LED signage and local area networks. The system can contact people en masse inside and outside of the building, and directly via personal devices such as cell phones. Systems inform occupants about what action they should take, therefore coordinating movement to facilitate safe and efficient response. At Medicine Hat College in Alberta, Canada, the MNS comprises 192 strategically zoned indoor speakers, together with four giant voice speakers outside. There are connections to response team cell phones, employee PCs, and two command-and-control centers. The system was designed around the College's existing Emergency Response Plan, and allows targeted alerts via a user friendly digital interface. Typical risk scenarios are pre recorded to allow easy activation and effective messaging during a crisis.



Toolkit for Resilient Cities; © Arup (2014)



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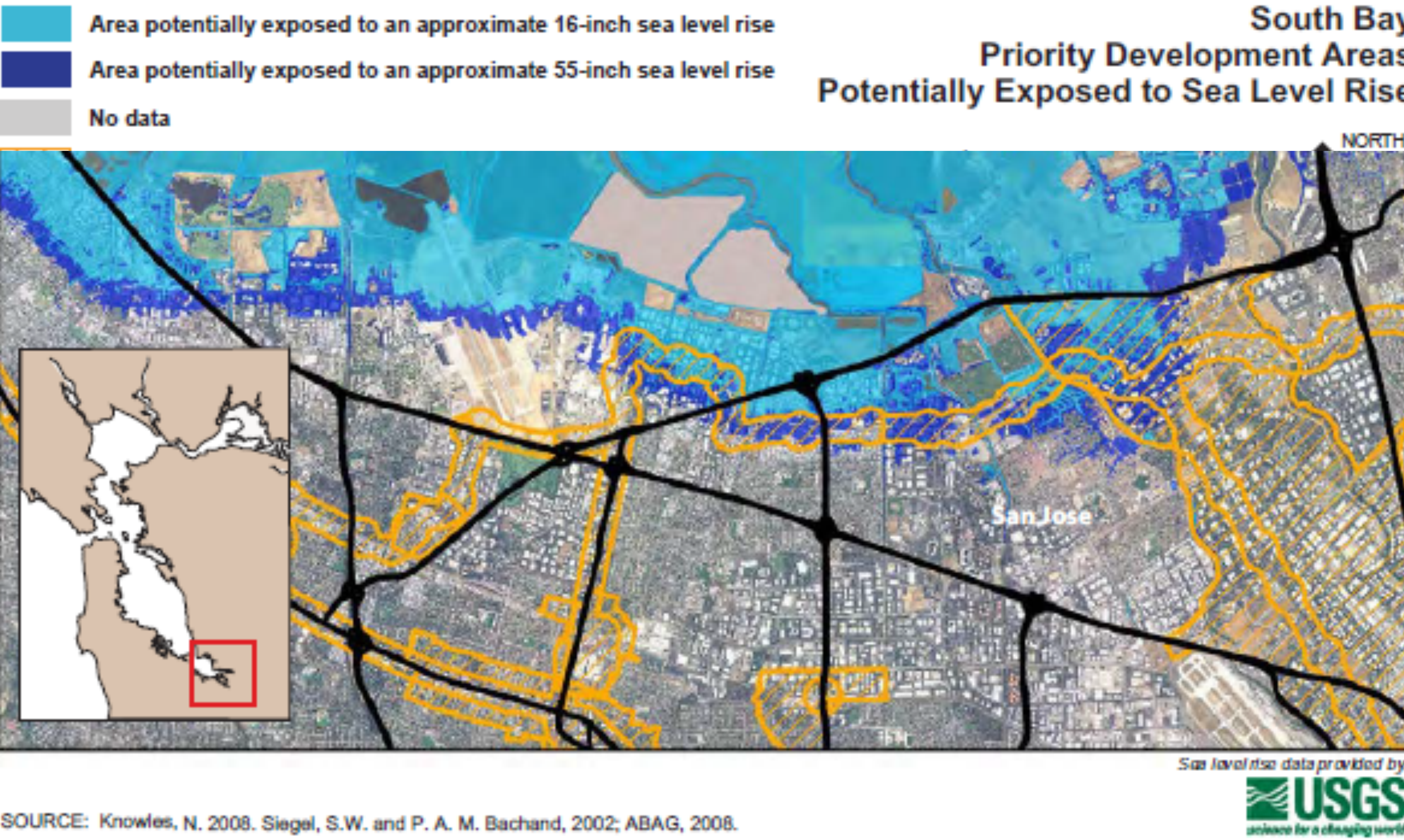
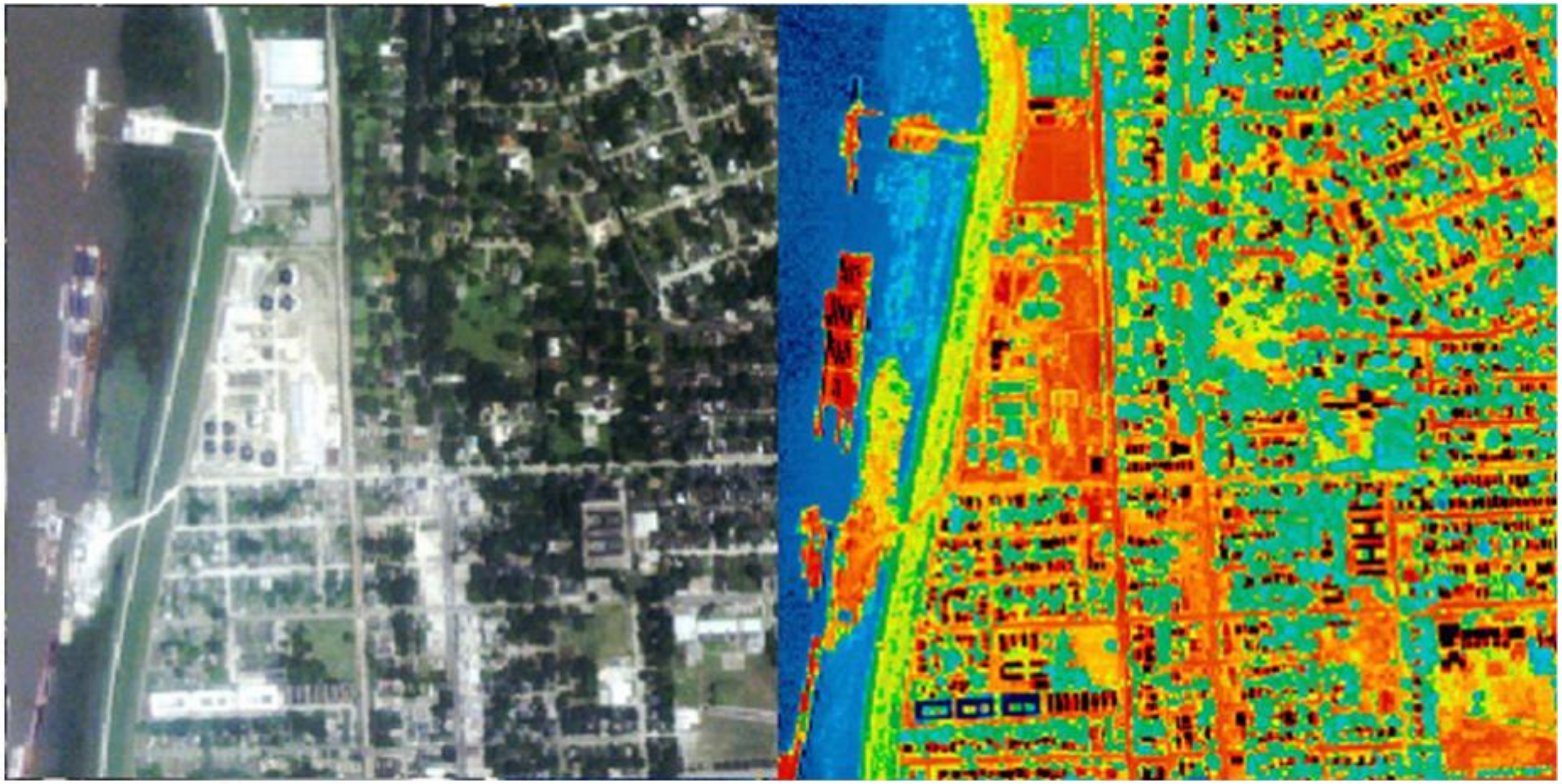
Site Appropriately – Priority Dev. Areas



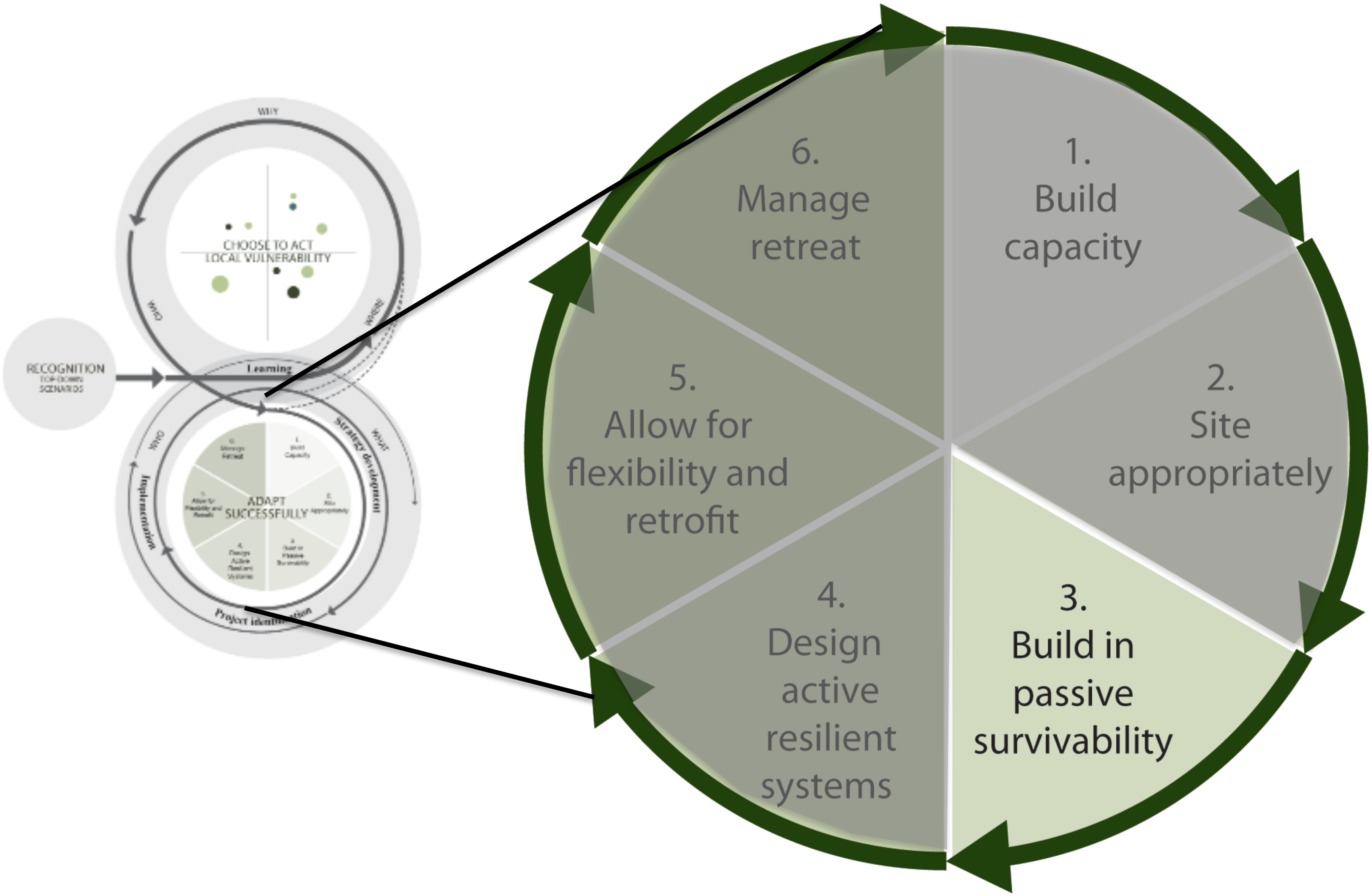
SOURCE: Knowles, N. 2008. Siegel, S.W. and P. A. M. Bachand, 2002; ABAG, 2008.

Synergies – Cheonggyecheon Stream

Synergies – Heat Island Reduction



Baton Rouge Urban heat Island
" The bright red areas in this image are about 65 deg. C (149 deg. F); dark green and blue areas are around 25 deg. C (77 deg. F). The solid blue swatch of color flowing down the left side is the Mississippi River.
http://science.nasa.gov/science-news/science-at-nasa/1998/essd20nov98_1/



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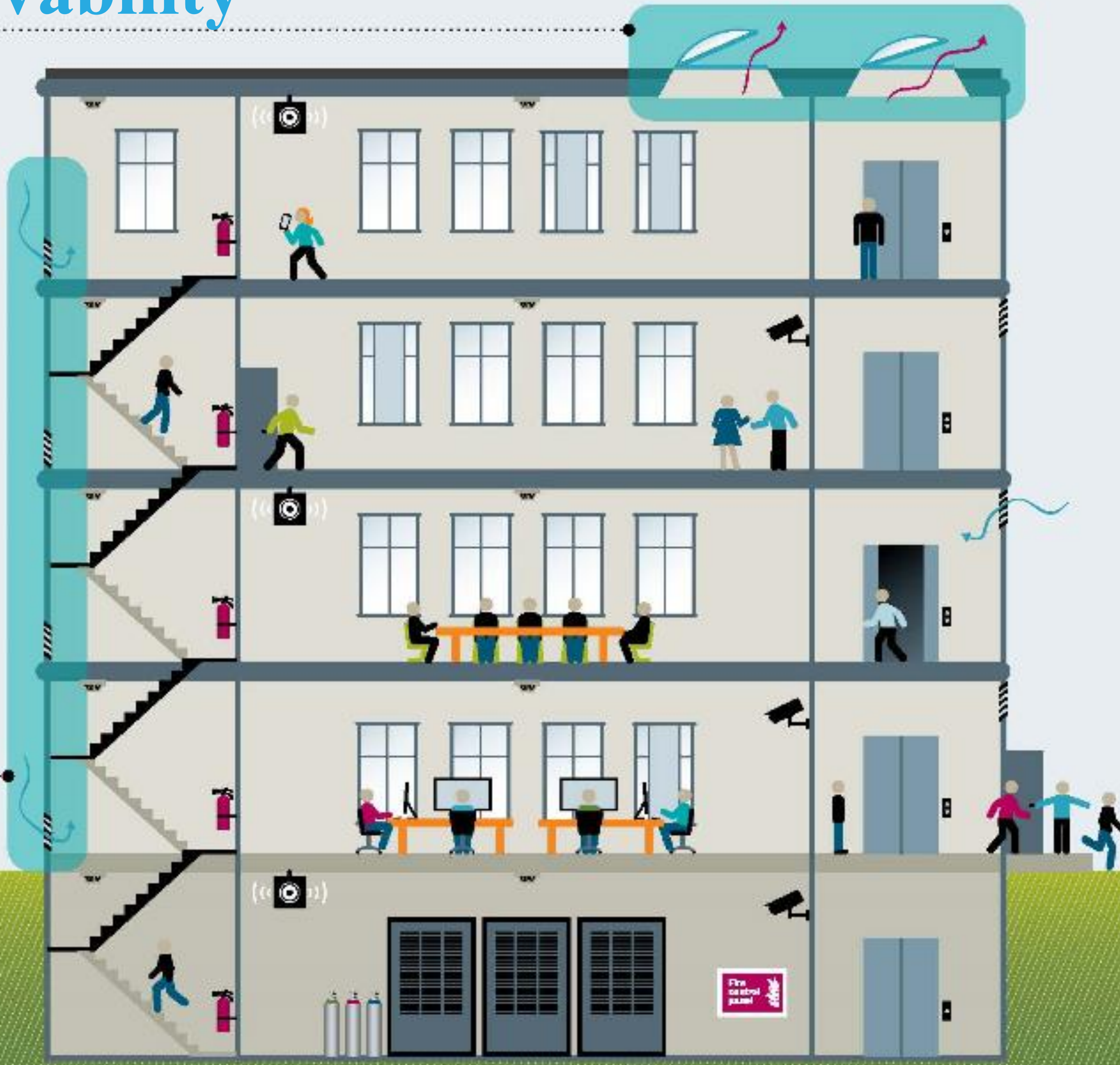
Passive Survivability

Responsive building management systems maintain occupant health and comfort

Building Management Systems can be calibrated to work in response to local microclimates and maintain occupant comfort. The California Academy of Sciences in San Francisco takes advantage of natural air currents in the surrounding Golden Gate Park to regulate the indoor temperature. Windows and skylights are designed to open and close automatically, controlled by an automated ventilation system. As heat rises through the building during the day, the skylights will open to allow hot air out from the top of the building, while louvers below draw in cool air at the lower floors. This provides an energy efficient and cooling flow of air during hot weather that can operate independently without the need for conventional energy intensive air conditioning systems and chemical coolants.



Toolkit for Resilient Cities; © Arup (2014)

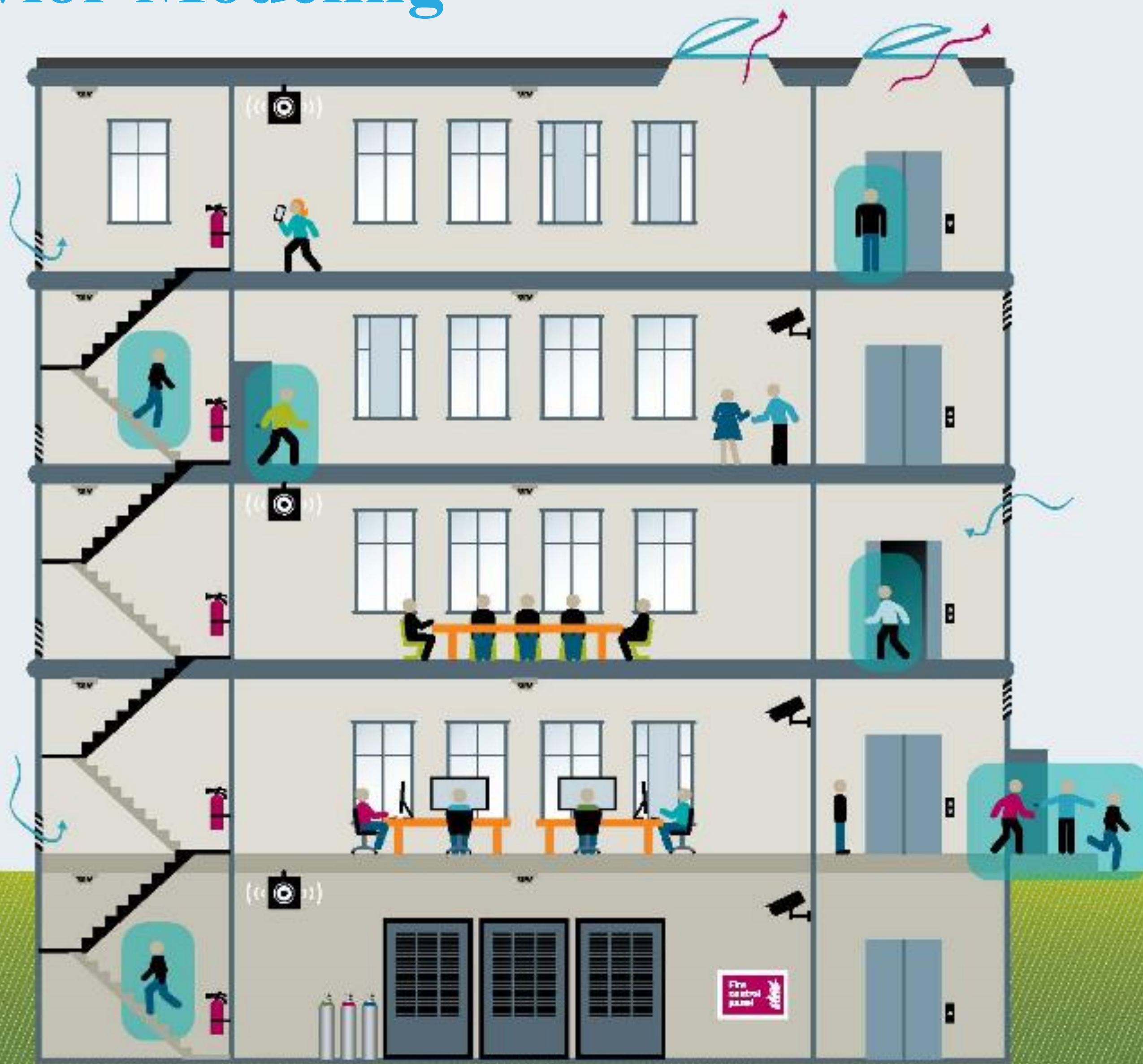
Y2E2 Building – Passive Survivability

ARUP

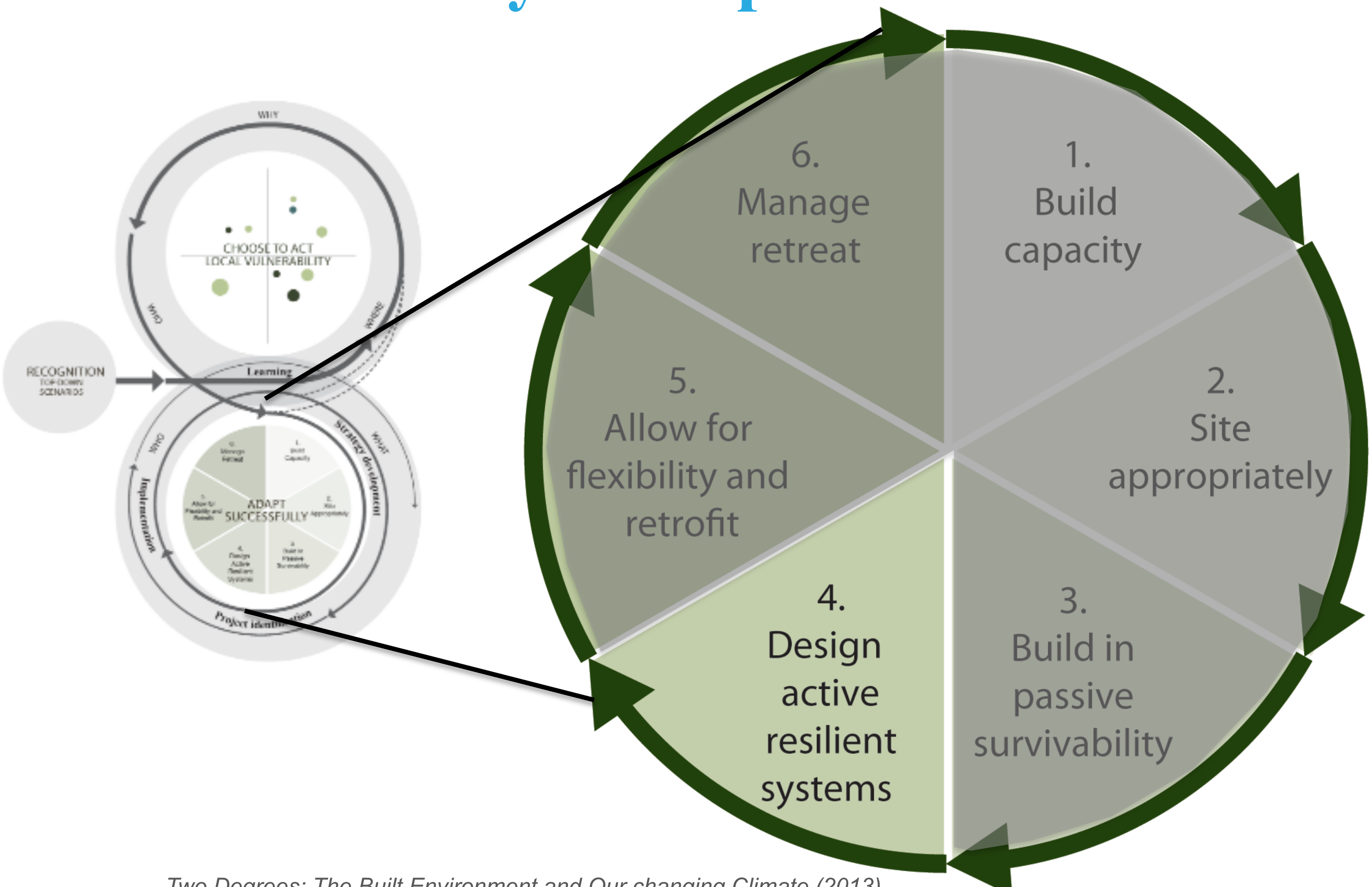
Human Behavior Modeling

3D simulation of human behavior enables advanced evacuation planning

The behavior of building occupants during an emergency can be modeled prior to an event, using advanced 3D simulation software. The software enables movement through a building or space to be forecast up to ten times faster than real time with relative accuracy, including places where blockages may occur. Using this information, evacuation strategies may be planned and communicated to building users to ensure a rapid flow of people to safety. This tool improves human preparedness, coordination and response. With a faster than real time reaction, this technology also helps to gain valuable time in a situation where every second counts. The approach has been implemented with a number of high rise buildings, including 1 Canada Square at Canary Wharf, which until 2012 was the tallest building in London. The software can even model people flows at the city block level, thereby assisting evacuation far beyond the walls of a single building.



Act Successfully: Comprehensive + Time Based



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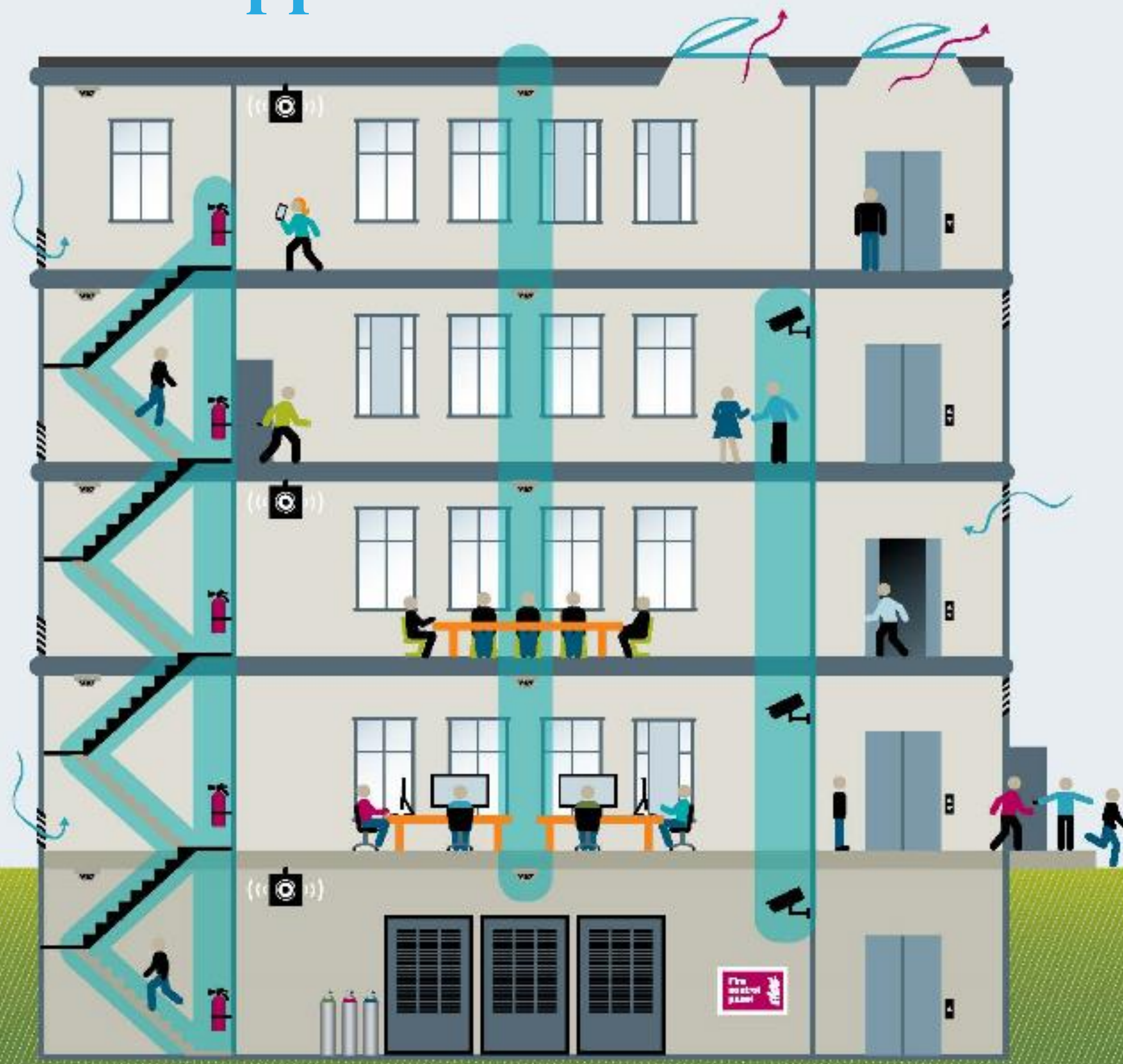
Fire Isolation and Suppression

Sophisticated fire safety systems enable rapid isolation of incidents and evacuation of occupants

Taipei 101, a 101 story tower in Taiwan, sees 40,000 people pass through its doors each day. Fire prevention and emergency reaction plans have been paramount since the start of construction in 2000. The building houses very early warning fire detection systems, smoke detection and expulsion systems and automated fire extinguishing systems, which are coordinated via a central disaster prevention center. Infrared detectors and cameras are installed to detect fire anywhere in the building. Taipei 101 is also equipped with state-of-the-art emergency elevators that travel from ground level to the 90th floor in 50 seconds, allowing emergency personnel to reach a disaster in the fastest possible time. Air pressure in the emergency staircases is automatically controlled to minimize smoke intrusion, allowing people to evacuate from lower levels. 22 emergency shelters are distributed throughout the building to provide temporary shelter for escaping personnel. These advanced emergency systems offer a 'layered' approach to fire safety and ensure rapid response in the event of a disaster. A similar approach has been employed at London's iconic new skyscraper, The Shard, which now stands as the tallest building in Western Europe.[2]



Toolkit for Resilient Cities; © Arup (2014)

Critical Systems Management

Holistic system design secures information flows and communications

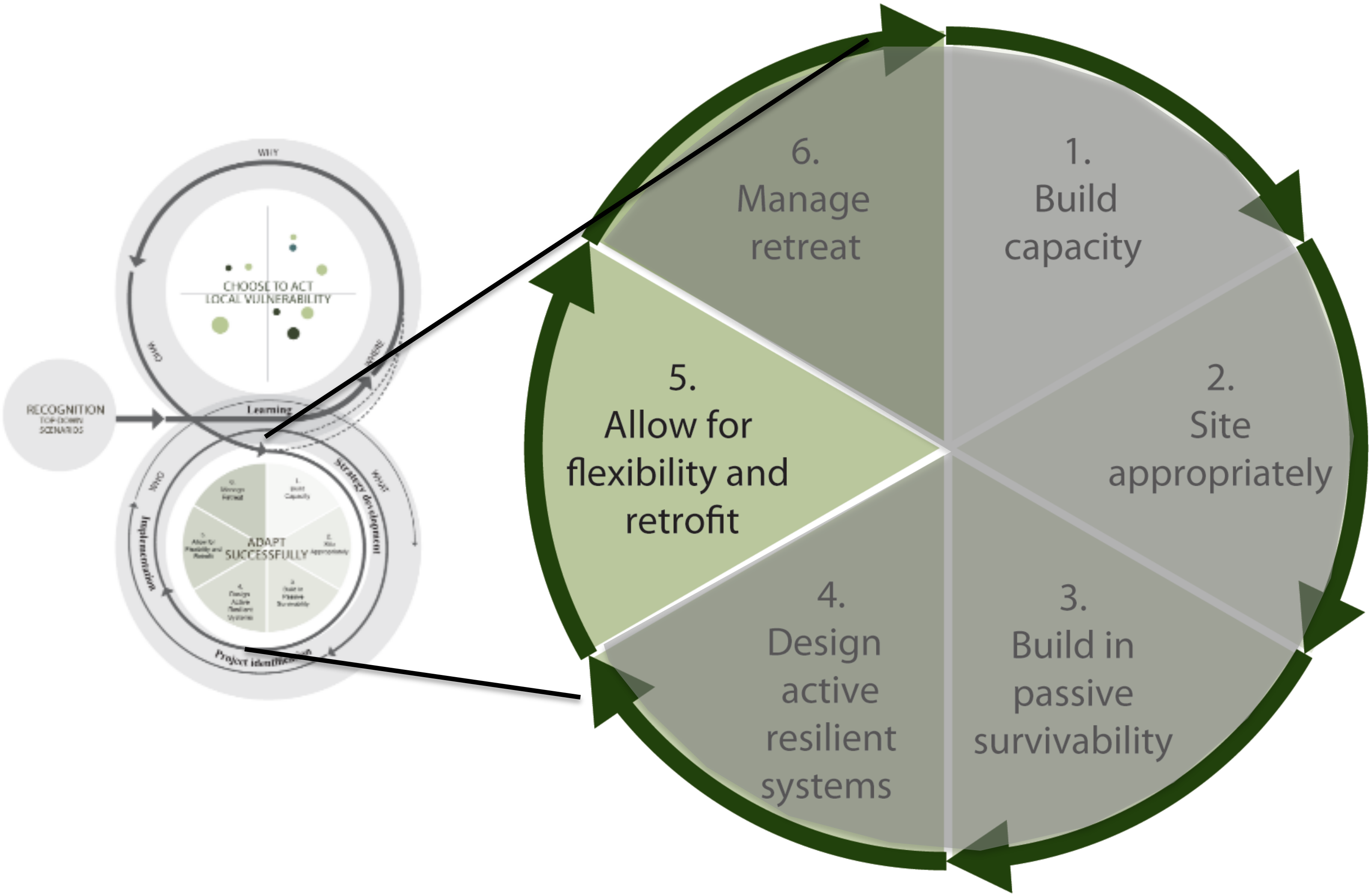
The Safe Host SA data center in Geneva, Switzerland, incorporates a range of data center infrastructure services that promote service reliability and data security. Built-in solutions protect against power supply interruptions, security and fire safety threats, and ensure that servers operate at the correct temperature to protect customer data from changes in environmental conditions. Features of the data center include a central management system, over 800 smoke detectors, fire control panels, nitrogen based extinguishing solutions and video surveillance at all major entrances.

Step 4 - Active Resiliency

Before

After

In Case of Emergency:
How Building Systems Make Facilities More Resilient



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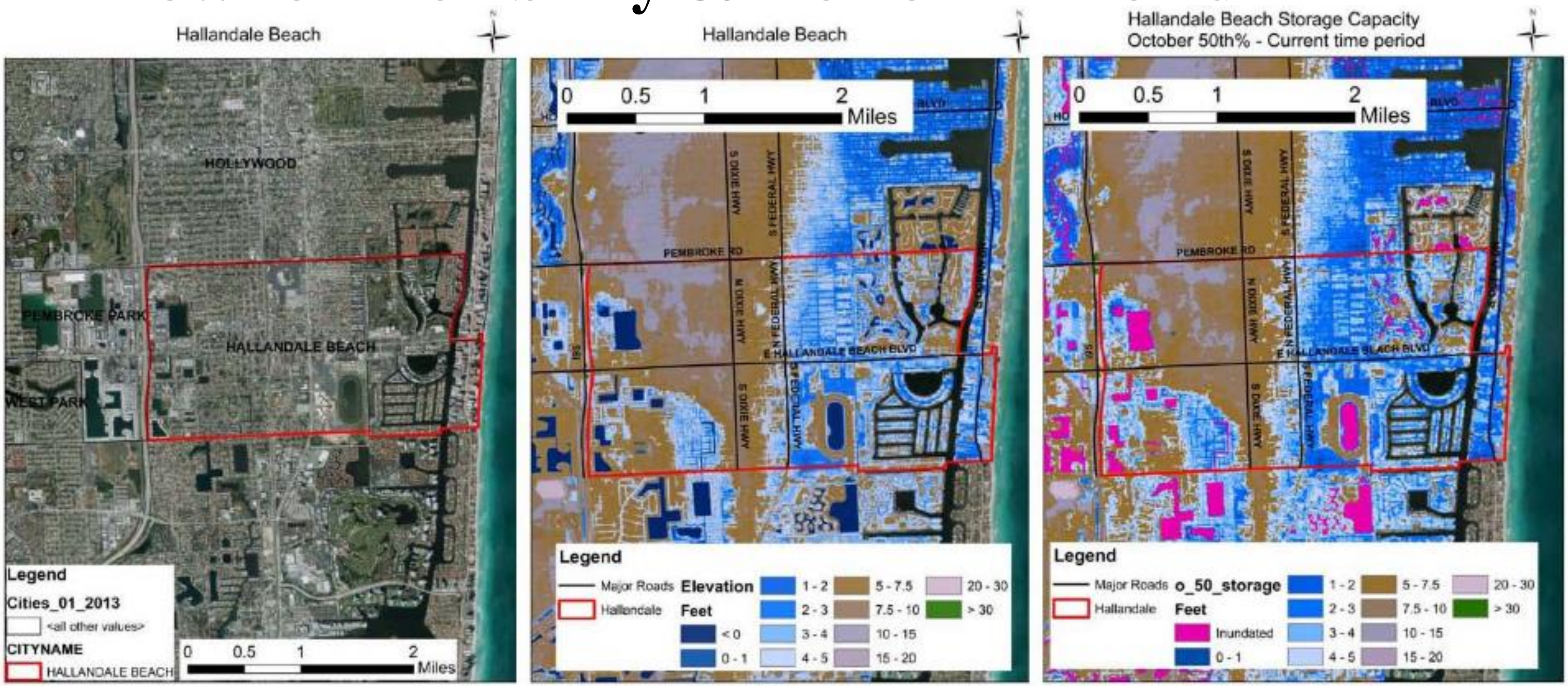
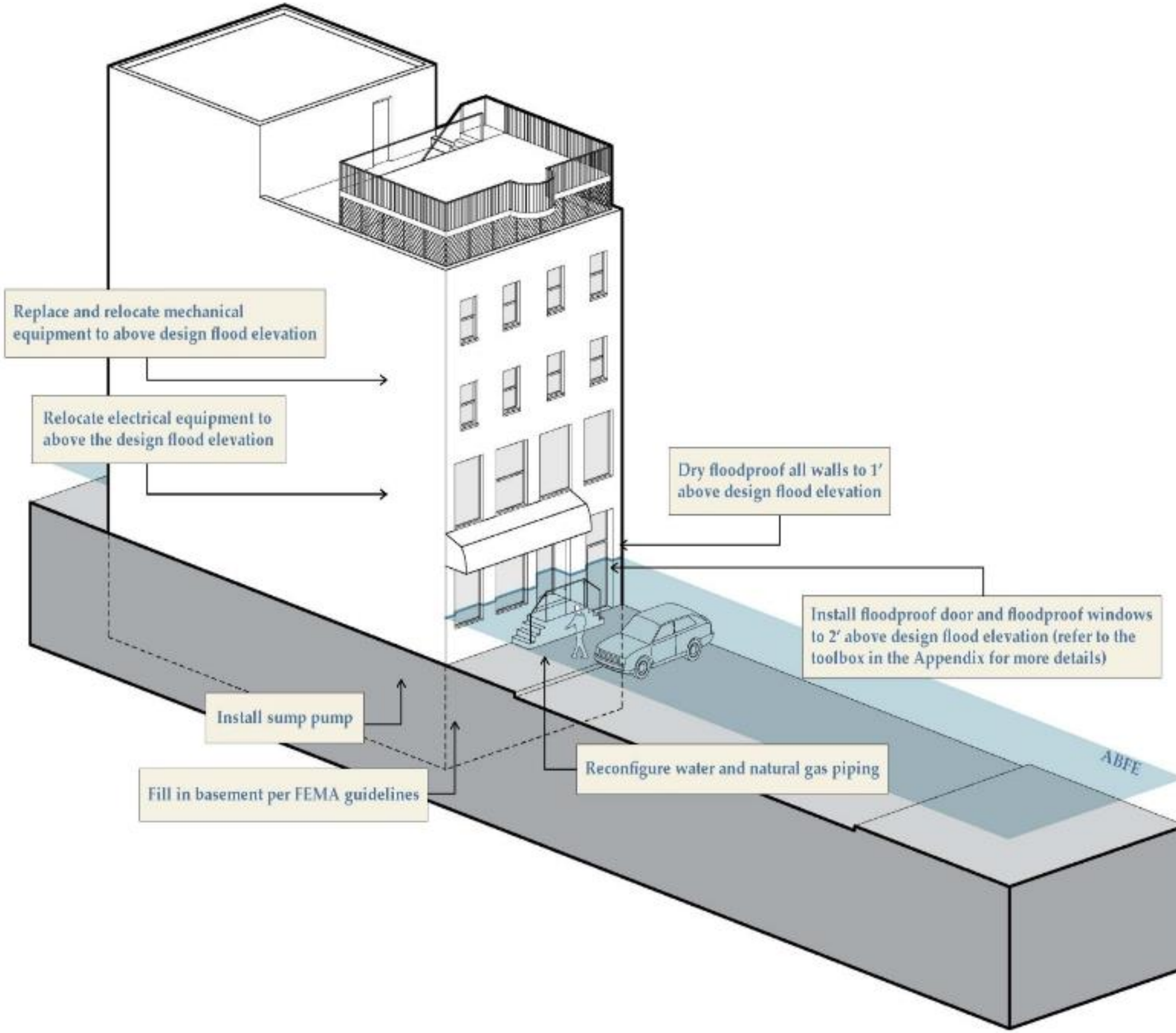
Allow for Flexibility & Retrofit - Florida



One of the major issues involved with climate changes is sea level rise. Florida has experienced 9 inches of sea level rise since 1900. Projections are 2-3 feet by 2100, perhaps more. Modeling done by my students and I at FAU has demonstrated that in low lying areas, sea level rise will also impact groundwater levels, and accelerate inland flooding. The graphs above compare the traditional bathtub model used by most investigators and our model adjusted for groundwater level. We added inland areas of flooding which complicated storm water flooding issues much faster than sea level rise might indicate.



Toolkit for Resilient Cities; © Arup (2014)

building OPERATING management

In Case of Emergency:
How Building Systems Make Facilities More Resilient

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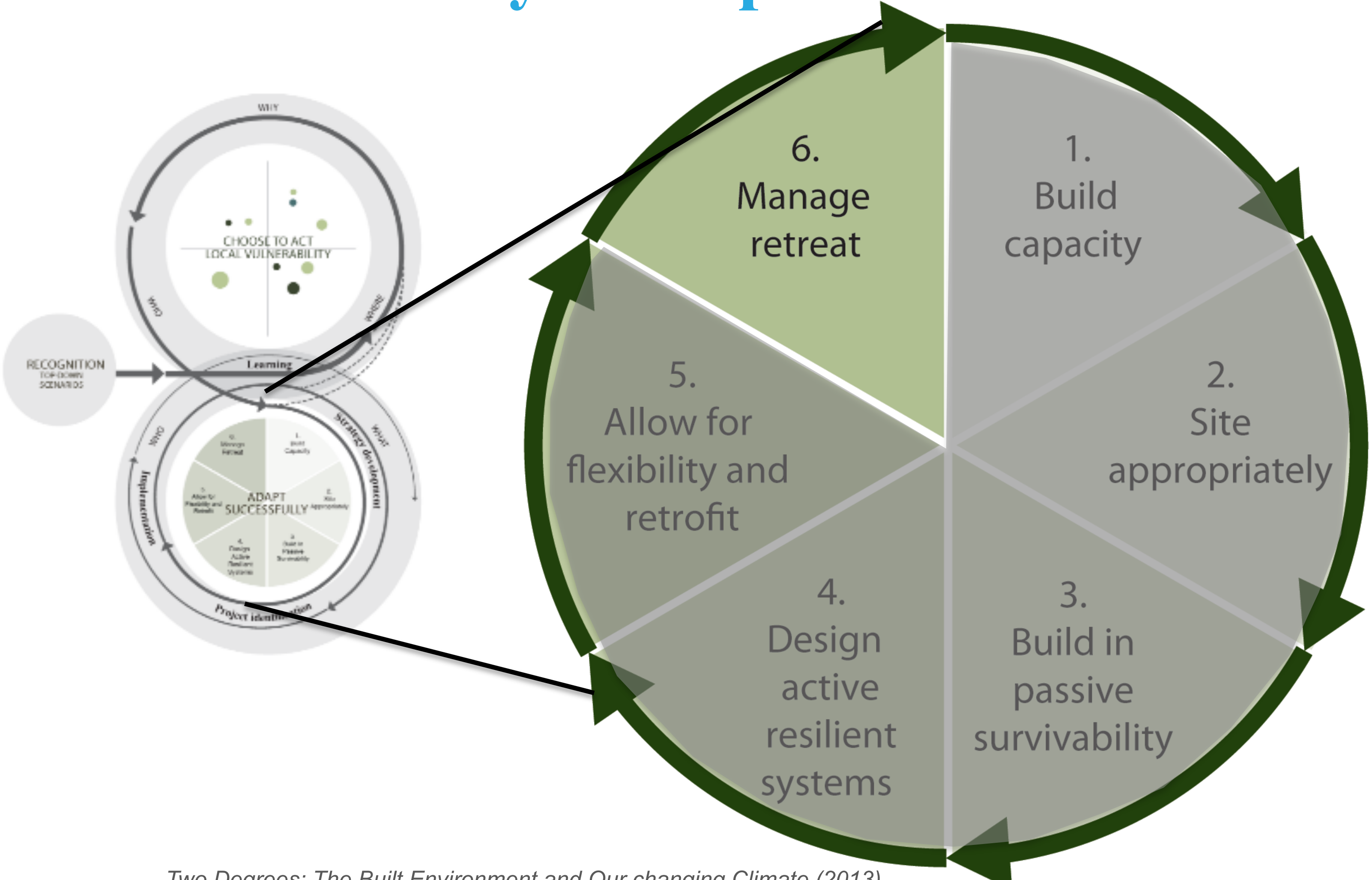
Act Successfully: Comprehensive + Time Based



Two Degrees: The Built Environment and Our changing Climate (2013)

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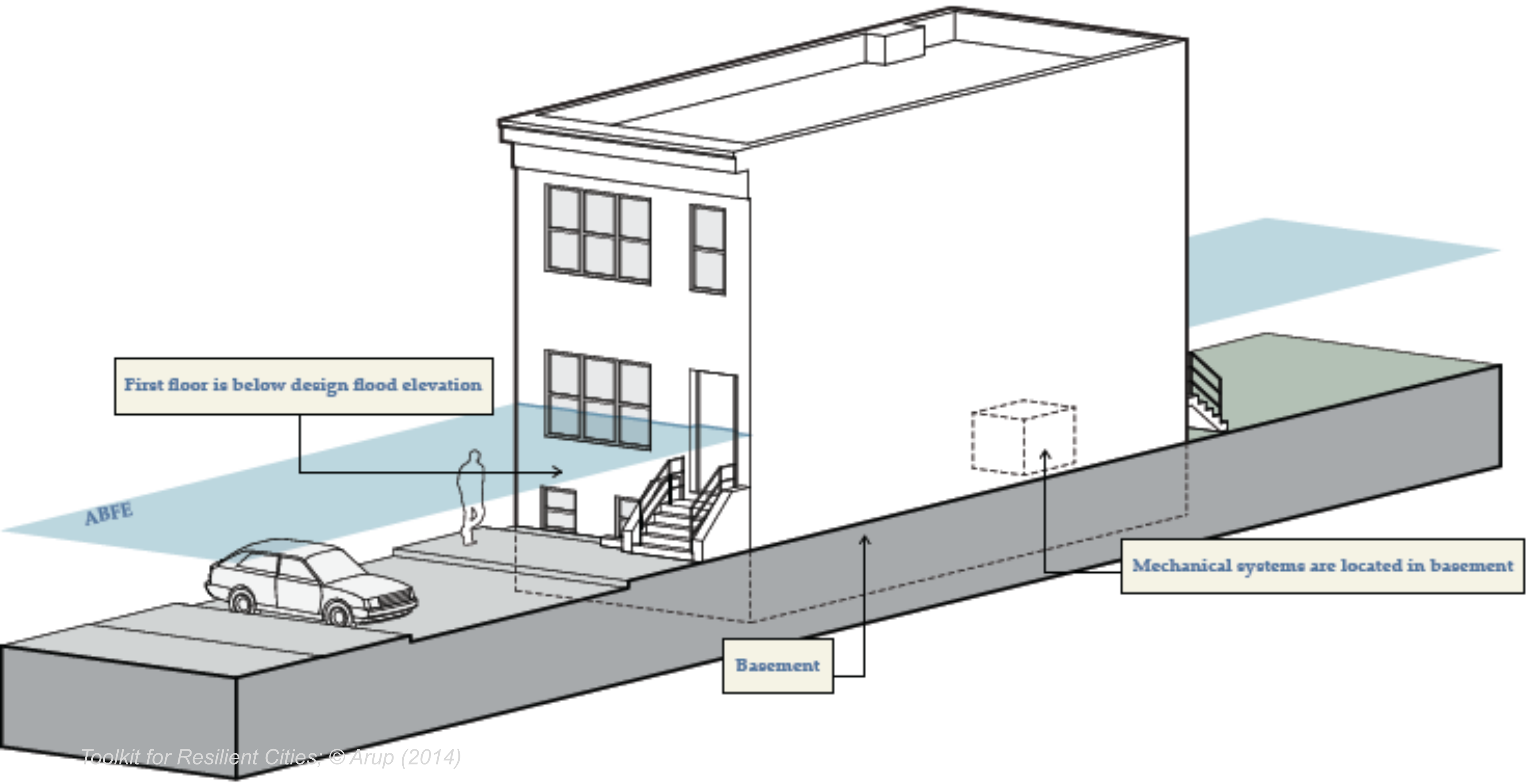
Sandy – Active (& Passive) Resettlement

The saddest story of the hurricane occurred on Father Capodanno Boulevard, when a mother got out of her stalled S.U.V. and took her two young sons from their car seats and tried to reach high ground and the waves swept the children away. They were Brendan Moore, two, and Connor Moore, four. If there were a typographic equivalent of a moment of silence, I would put it here.

IAN FRAZIER

ADREES LATIF-REUTERS



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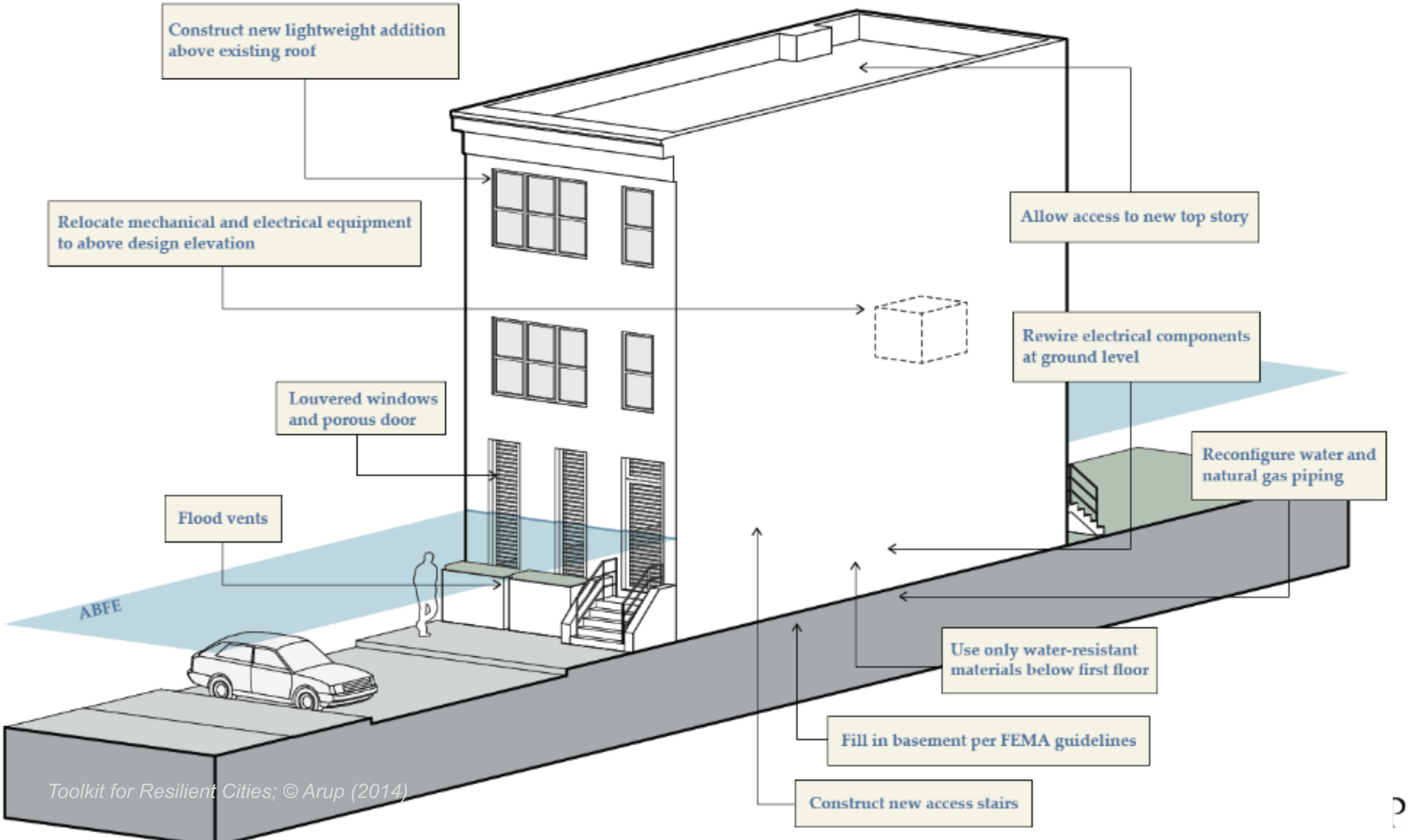
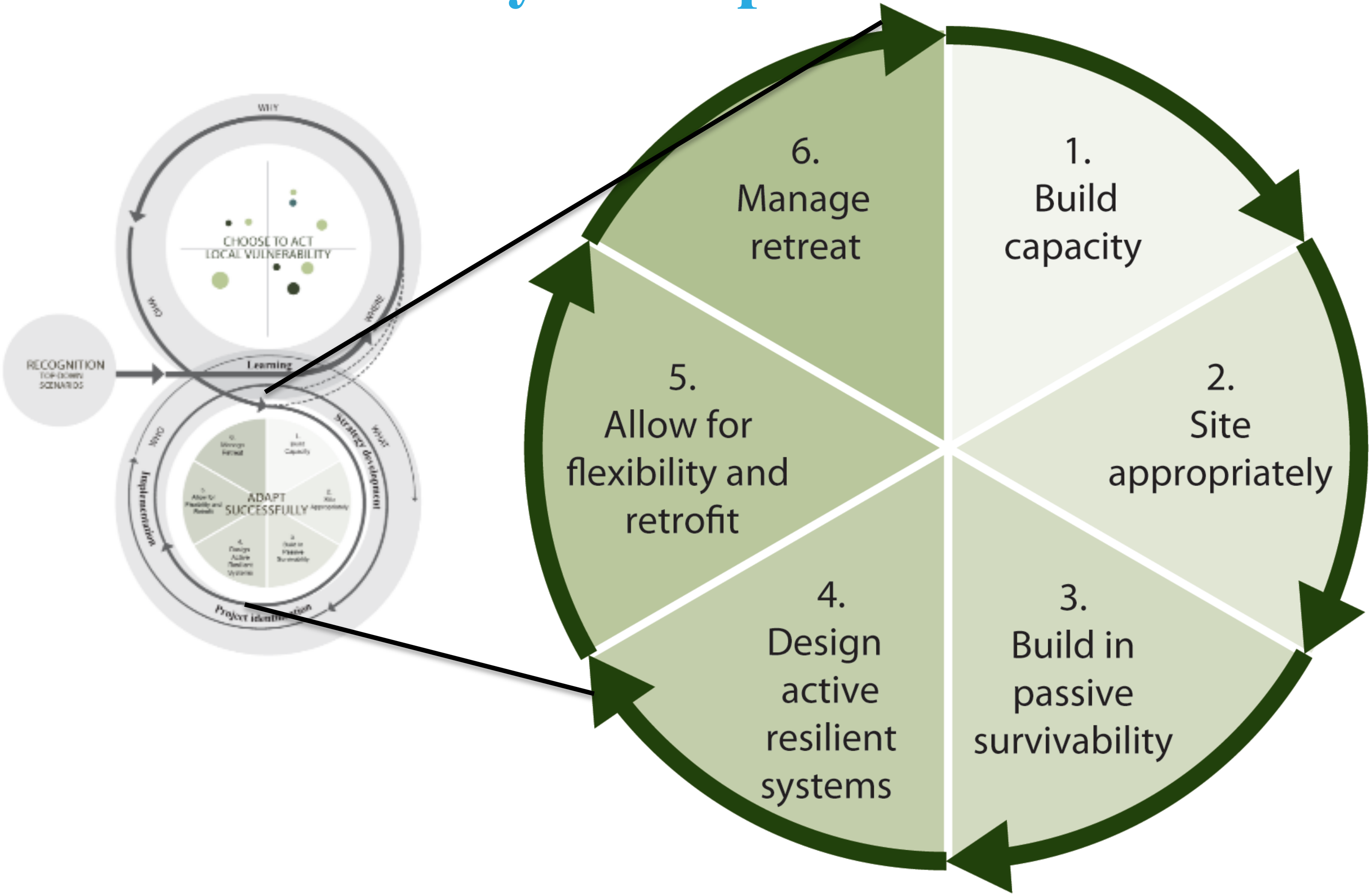
In Case of Emergency:
How Building Systems Make Facilities More Resilient



Toolkit for Resilient Cities; © Arup (2014)

Act Successfully: Comprehensive + Time Based



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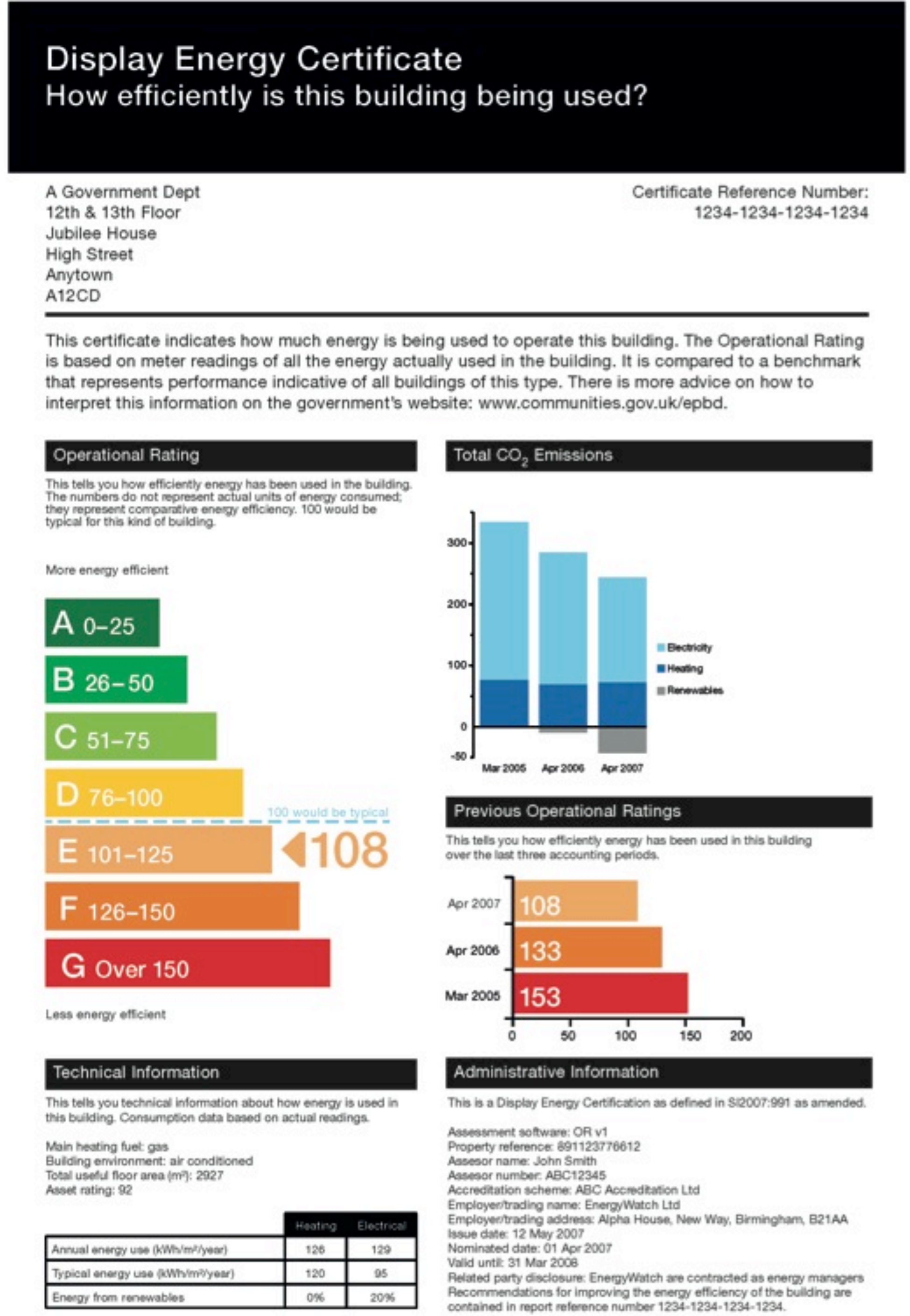
Transparency & Health



Display Energy Certificate
How efficiently is this building being used?

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Anytown
A12CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The Operational Rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the government's website: www.communities.gov.uk/epbd.

Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient

A 0–25
B 26–50
C 51–75
D 76–100
100 would be typical
E 101–125 ◀108
F 126–150
G Over 150

Less energy efficient

Total CO_2 Emissions

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

Technical Information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel: gas
Building environment: air conditioned
Total useful floor area (m^2): 2927
Asset rating: 92

	Heating	Electrical
Annual energy use ($kWh/m^2/year$)	126	129
Typical energy use ($kWh/m^2/year$)	120	95
Energy from renewables	0%	20%

Administrative Information

This is a Display Energy Certification as defined in SI2007:991 as amended.

Assessment software: OR v1
Property reference: 891123776612
Assesor name: John Smith
Assesor number: ABC12345
Accreditation scheme: ABC Accreditation Ltd
Employer/trading name: EnergyWatch Ltd
Employer/trading address: Alpha House, New Way, Birmingham, B21AA
Issue date: 12 May 2007
Nominated date: 01 Apr 2007
Valid until: 31 Mar 2008
Related party disclosure: EnergyWatch are contracted as energy managers
Recommendations for improving the energy efficiency of the building are contained in report reference number 1234-1234-1234-1234.

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REDi™ Rating System

Platinum

Downtime:
Immediate Re-Occupancy (Green Tag expected)
and
Functional Recovery < 72 hours

Direct Financial Loss:
Scenario Expected Loss < 2.5%

Occupant Safety:
Physical injury due to failure of building components unlikely

Gold

Downtime:
Immediate Re-Occupancy (Green Tag expected)
and
Functional Recovery < 1 month[1]

Direct Financial Loss:
Scenario Expected Loss < 5%

Occupant Safety:
Physical injury due to failure of building components unlikely

Silver

Downtime:
Re-Occupancy < 6 months (Yellow Tag possible)
and
Functional Recovery < 6 months[1]

Direct Financial Loss:
Scenario Expected Loss < 10%

Occupant Safety:
Physical injury may occur from falling components (but not structural collapse), fatalities are unlikely

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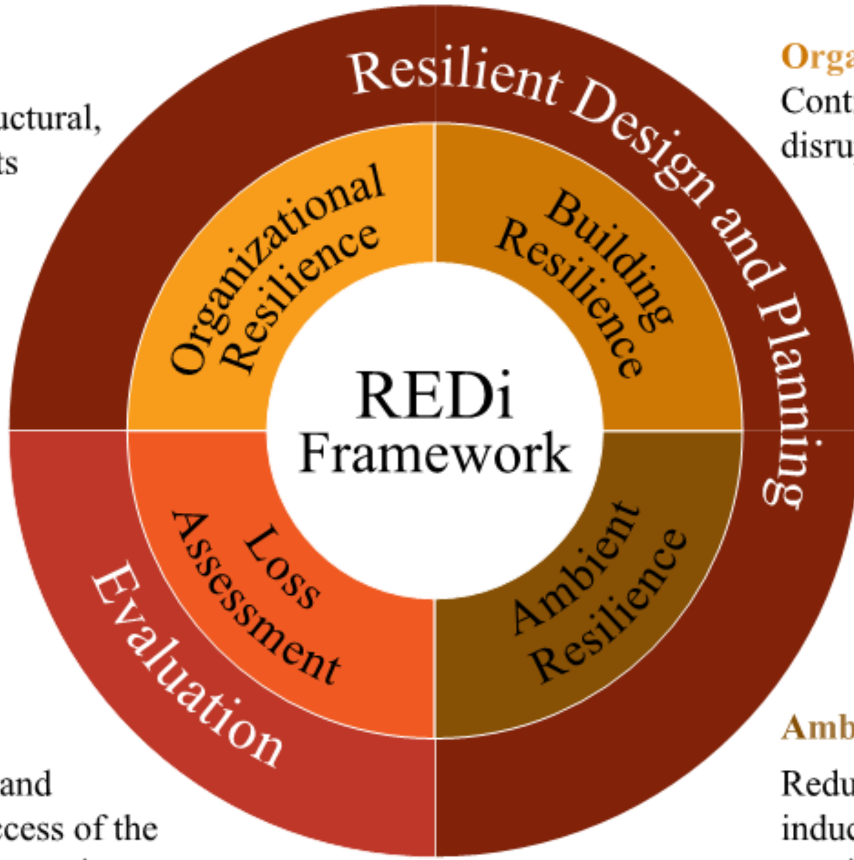
In Case of Emergency:
How Building Systems Make Facilities More Resilient

Building Resilience:

Minimize expected damage to structural, architectural and MEP components through enhanced design

Organizational Resilience:

Contingency planning for utility disruption and business continuity



Loss Assessment:

Evaluate financial losses and downtime to evaluate success of the design and planning measures in meeting the resilience objectives

Ambient Resilience:

Reduce risks that external earthquake-induced hazards damage building or restrict site access

Resilience-based Earthquake Design Initiative (REDi™) Rating System

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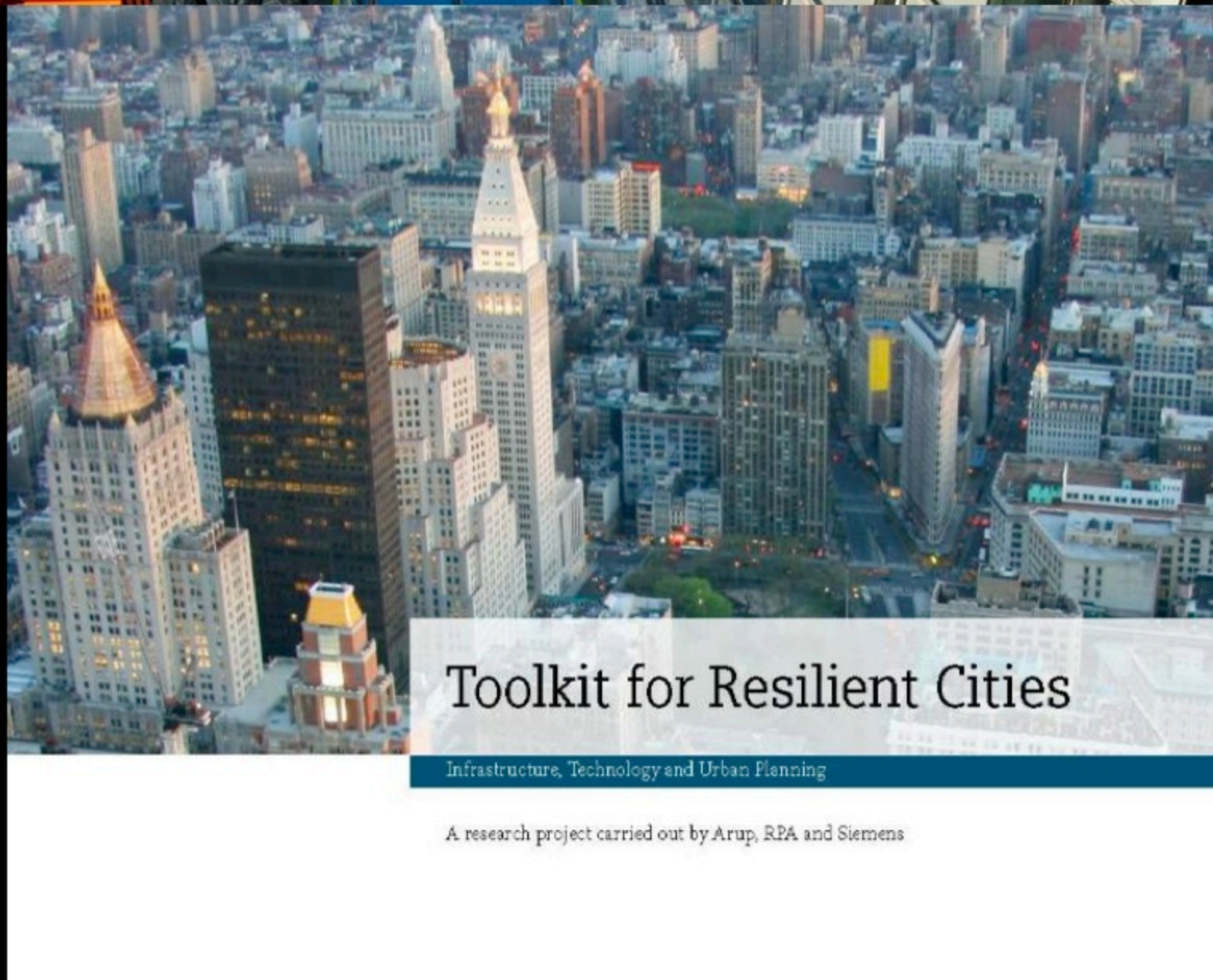
Toolkit for Resilient Cities

Arup, RPA, and Siemens


Toolkit for Resilient Cities

Infrastructure, Technology and Urban Planning

A research project carried out by Arup, RPA and Siemens

Two Degrees

Offered Conversations:

- Today
- On at TwoDegreesBook
- On at TwoDegrees_Book
- In Person at 3 Organizations

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