Avoiding Design That Will Fail?

Climate Action and Resilient Communities

Cole Roberts, PE, LEED AP
cole.roberts@arup.com
415-957-9445

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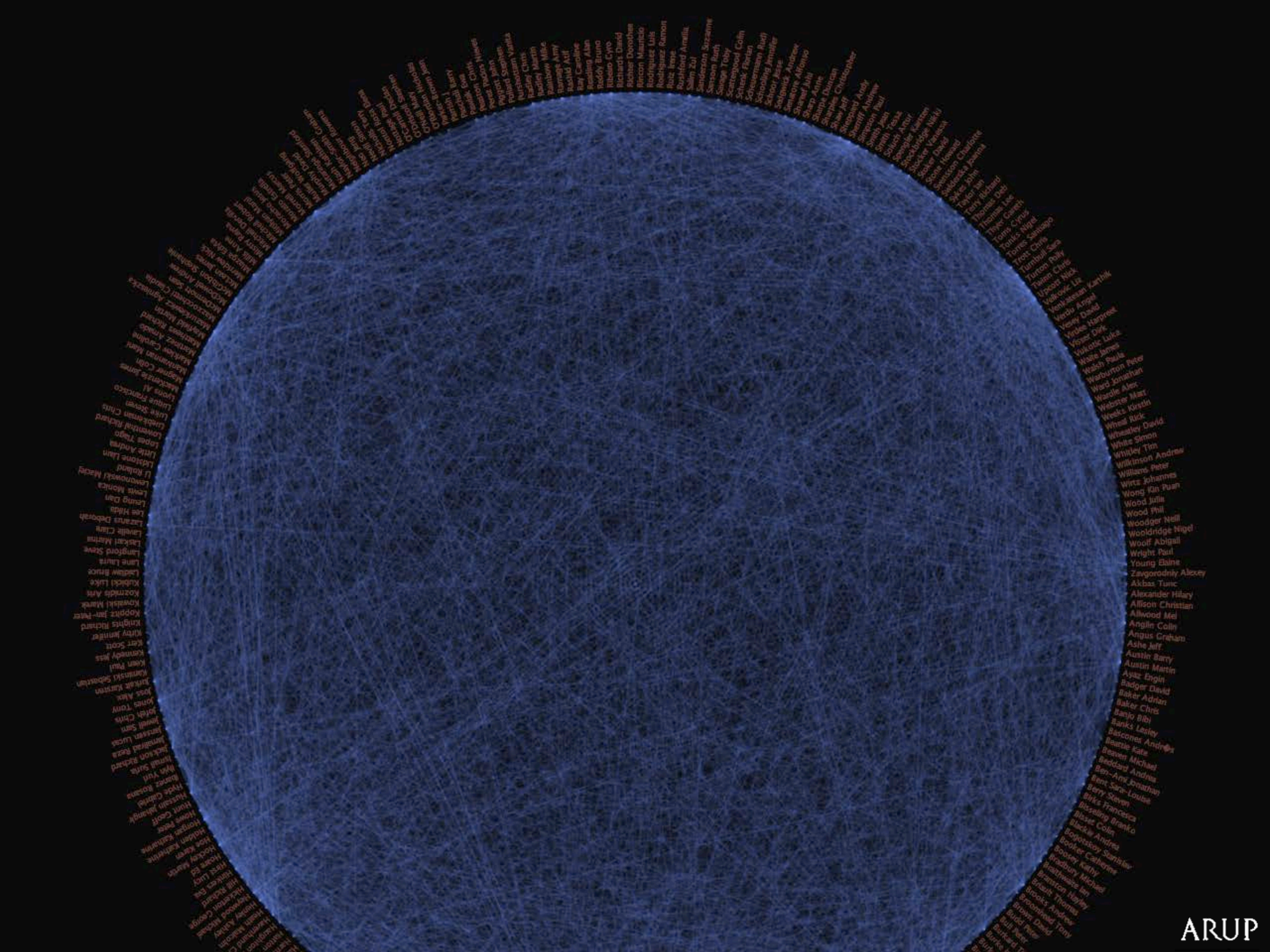
Wilkinson Andrew
Williams Peter
Wirtz Johannes
Wong Kin Puan
Wood Julie
Wood Phil
Woodger Neill
Wooldridge Nigel
Woolf Abigail
Wright Paul
Young Elaine
Zavgorodniy Alexey
Akbas Tunc
Alexander Hilary
Allison Christian
Allwood Mel
Anglin Colin
Angus Graham
Ashe Jeff
Austin Barry
Austin Martin
Ayaz Engin
Badger David
Baker Adrian
Baker Chris
Banks Lesley
Barnes Michael
Barnett Andrea
Barry Steven
Bilka Francesca
Bogdanov Stanislav
Bowden Colin
Brown Michael
Burton Kay
Cahill Chris
Cameron Nick
Campbell Liz
Carter Alan
Chadwick Dirk
Chalmers Luke
Chan Kamalik
Chilcott Jon
Clarke Chris
Cleaver Sam
Cole Ian
Collins Chris
Cooper Tim
Cox Ian
Crowe Dirk
Davies Huw
Davies Rupert
Dawson Christian
Dawson Tristan
Dean Barrie
Dobson Mike
Dodd Ann
Dolan Ted
Donnelly Mary
Dunlop Alastair
Dyer Colin
Eaton Graham
Edwards Ruth
Ellis-Jones Simon
Emmens Matthew
Fenwick Andrew
Fewtrell Alan
Fish Laurence
Fisher Mark
Fleck Alan
Forbes Alan
Forster Anthony
Fraser Suzanne
French Dawn
French Neil
Frisby Martin
Fuller Peter
Gaffney Jane
Gardiner Barry
Gibbons Alan
Gilbert-Scott Bruce
Gill Andrew
Glover Ian
Godwin Pete
Golding Andy
Gorman Teresa
Gorse Stephen
Graham Stirling
Grant Malcolm
Gray Darren
Grech Ellis
Green Dominic
Grindley Keith
Guthrie Bruce
Hackney Paul
Hall Peter
Hall Tim
Hamilton Andrew
Hargreaves Alasdair
Harris Adam
Harris Richard
Hawkins Brian
Haynes Martin
Heard Gordon
Henderson Nigel
Hennessy Peter
Henry Graham
Hickman Paul
Hill Rupert
Hoare Lucie
Hockey Dale
Holden Laurence
Holgate Mark
Holmes Chris
Hopkins Andrew
Howard Cilla
Howell Rab
Hudson Alex
Hudson Keith
Hughes David
Hunt Tim
Hurst Geoff
Hussain Saj
Hyde Tom
Ibbotson Mike
Iles Simon
Inch Graham
Ingram Catherine
Jackson Adam
Jackson Ben
Jackson Kevin
Jamieson Ben
Jarvis Ian
Jeffries Nigel
Jenner Steven
Jennings Paul
Johnson Tim
Jones Dave
Jones Diane
Jones Greg
Jones Nicholas
Jordan Bridget
Joseph Stephen
Kanellopoulos Panos
Karadimas Nicholas
Karanikas Nicholas
Kavanagh Richard
Kelly Jennifer
Kerr Stuart
Kerrison Rob
Kilsby Chris
King Andrew
King Dominic
Kitney Phil
Knight Richard
Kopplin Jan-Peter
Kotsikonas Angela
Kozarski Piotr
Kozlowski Adam
Kozlowski Mark
Kozomara Arta
Kriese Andrew
Kubicki Mark
Kuczera Piotr
Kumar Ajith
Kwan Edmond
Lacey Stephen
Lam Thomas
Lamb Graham
Lane Laura
Langdon Bruce
Langford Steve
Lasker Martin
Lavelle Ciara
Lazarus Deborah
Le Hair Gaynor
Leahy Terry
Lee Hilda
Leung Gabriel
Lewis Monica
Lewkowicz Maciej
Li Roland
Lidstone Iain
Lim Andrea
Lister Tom
Liu Xiaohang
Livesey Richard
Llewellyn Huw
Lloyd Chris
Lopez Francisco
Lowe Alistair
Lowe Jonathan
Lowndes Stephen
Lucas Mark
Lynch Simon
Lyons Eoin
Macleod Graham
MacRae Sandy
Maguire Gerard
Maher Bill
Mahoney David
Maiden Wayne
Malik Shahzad
Malin Jo
Mallinson Denise
Manning Phil
Manser Ged
Manton Graeme
Marchant Hayden
Marsh Christopher
Martin Claire
Martin Roger
Martindale Andy
Mason Claire
Mason Paul
Massie Alex
Mathias Bryn
Matthews Steven
Maunder John
May Hamish
McAlpine Alistair
McArdle Kenny
McBride Charles
McCann Julie
McCarthy Tony
McCluskey Conor
McCormack Jane
McCulloch Andrew
McEleavy Shaun
McFarlane Austin
McGarry Sean
McGinley Ed
McGrath Alan
McGrath Finbarr
McGuirk Chris
McKeever Ivor
McKenna Paul
McKinney Bronagh
McLaughlin Mark
McNamara Skene
McNeill Ilidh
McQuaid Matt
Mehmet Ali
Meiklejohn Duncan
Melvin Murray
Merrick Rob
Metcalfe Alasdair
Michael Alfred
Michalareas Vasilis
Micklethwaite Paul
Middleton Robert
Miller Andrew
Miller Bruce
Miller Karen
Milligan Barry
Mills Nicholas
Milne Graeme
Mitchell Stewart
Moohan Gordon
Moore Craig
Moore Gareth
Moore Julian
Moorhouse Jane
Morahan Andrew
Morgan Matthew
Morris Jonathan
Morris Nigel
Mortimer Jim
Moseley Oliver
Moss Adam
Mossman Alan
Motevalli Golnaz
Moxham Roger
Muirhead Alan
Mulcahy Geraldine
Mullarkey Mark
Munro Alasdair
Murphy Denis
Murphy John
Murray Sorcha
Nagle John
Nash David
Nelson Jane
Newton Andrew
Nicholls Graham
Nicholson Adam
Nikolaidis Nikos
Noble Richard
Norbury Julian
Norman Philip
North Patricia
Nugent Ahn-Tu
Nunny Robert
O'Brien Fergal
O'Brien Joanne
O'Callaghan Cathal
O'Carroll Barry
O'Dwyer Mark
O'Hara Terry
O'Leary Dan
O'Neill Brian
O'Reilly Eimear
Odell Noirin
Ogunbadejo Taiwo
Ogunshakin Lekan
Ohlsen Booth Tom
Orr Edward
Ove Arup
Owen Aaron
Paddon Rachel
Padfield Nicholas
Page Steven
Paget-Brown Alicia
Pagett Nicola
Pakenham Nicholas
Palmer Tamsin
Papa Fenia
Parker Simon
Parkin John
Parnell Eva
Parry Harry
Pascoe Rupert
Patel Kayvan
Patel Mahesh
Pawson John
Pay Simon
Peaston Matthew
Pedreschi Rob
Pell Frischmann
Perchard Andrew
Perkins Eric
Perkins Will
Phillips Dafydd
Phillips Huw
Phillips Peter
Pimbley Jeremy
Pimm Matthew
Pinder John
Pinkerton Steven
Pittock Jane
Pollard Stephen
Poon Simon
Potter Mike
Potts Alan
Powell Darren
Power Peter
Prentice Matthew
Preston Bob
Price Gareth
Price Mike
Pridham Brian
Prior Jeremy
Pritchard Francis
Proctor Matthew
Pryke Geoff
Purnell Robert
Quarmby Huw
Quinlan Terry
Rahilly Mike
Randall Martin
Rankin Gordon
Rankine Hamish
Ratcliffe Nathan
Rawlinson Hannah
Redfern Gordon
Rees Jonathan
Reid Steven
Rhodes Jason
Rice Peter
Richards Huw
Richardson Sue
Ridge Mark
Riley Nicholas
Ringham Andrew
Roach Pamela
Robbins Rebecca
Roberts Gareth
Roberts Ifan
Robertson Graeme
Robinson Andrew
Robinson Ian
Robinson Mike
Rodgers Christina
Rogers Ben
Rogers Paul
Rogers Richard
Rolfe Nicholas
Romero Lucia
Rossetti Nicholas
Rowe Amanda
Rowlands Tim
Rudd Chris
Rumble Peter
Russell Alec
Russell Mark
Ryan Mike
Sabapathee Sharon
Sabin Lea
Sadler Stephen
Sadler Terry
Sainsbury Simon
Salama Ahmed
Salter Mike
Sanderson Matthew
Sandham Glenn
Saunders Charlie
Saunders Ian
Saunders Roger
Scanlon Mark
Schaffer Mark
Schmidt Christian
Schofield Jon
Scott Alastair
Scott Douglas
Scott Mackie Partnership
Scott Wilson
Scrivener Adam
Seaton Jamie
Sellwood Nigel
Shanks Eann
Shankster Laurence
Sharkey Simon
Sharland Simon
Shaw Andrew
Shaw Matthew
Shelley Stephen
Shelton Barry
Shepherd Felicity
Shepherd Paul
Sheppard Robert
Sheridan Guy
Sherlock David
Shires Martin
Short Brian
Sibbons Gary
Siddall Stephanie
Silk Dominic
Simkins Robert
Simmonds Mark
Simmons Christine
Simpkin Ben
Sinclair Douglas
Singapore Arup
Singh Kate
Skates Jason
Skelton Jeremy
Skinner Andrew
Skinner Claire
Skinner Ian
Slaughter Andy
Smith Adrian
Smith Ben
Smith Christopher
Smith Jeremy
Smith Rory
Smith Stephen
Smith Tim
Smithers Mark
Snaith Ian
Soane James
Sofianos Sean
Solomon Rachel
Somerville Stephanie
Southern Marie
Spackman Caroline
Speirs Jane
Spencer Nick
Spooner Julian
Sprague Mike
Squire Sarah
Stacey Mark
Stanier Peter
Stanley Matthew
Stannard Matthew
Stansfield Graham
Steadman Philippa
Steedman Carol
Stein Rob
Stenson Fiona
Stephen Mark
Stephenson Carl
Stevens Jane
Stevenson Christine
Stewart Cameron
Stewart Rob
Stirling Alastair
Stockley Mark
Stoker Richard
Stone Jerry
Storey Julian
Stothard Peter
Strachan Group
Stratful Simon
Street Nigel
Strickland Lloyd
Strong Simon
Stuart Mark
Studd Richard
Sturgeon Mhairi
Sturrock Jared
Styles Colin
Sugden Chris
Summerfield Mark
Sutherland Hannah
Sutton Gemma
Swaffield Carolyn
Swain Richard
Swallow Ben
Swan Andrew
Sweeting Ben
Tang Weng Fai
Taylor Emma
Taylor Rob
Taylor Robert
Taylor Roger
Taylor Stuart
Tebbs Kevin
Telford Tim
Thackray Williams
Thomas Barnaby
Thomas Dominic
Thomas Huw
Thomas Julian
Thomas Richard
Thompson Paul
Thorne Stephen
Thornton Jerry
Threlfall Richard
Tierney Martin
Tilley Rob
Tilly Mark
Timms Stephen
Tinkler David
Tipper Graham
Titheridge Michael
Tomlinson Ricky
Tong Ian
Toogood Mark
Toogood Toby
Tordoff Mark
Townsend Andrew
Townshend Anna
Trevelyan Angus
Trewin Nicholas
Trice Ryan
Trow Geoff
Truscott Mark
Tsang Peter
Tuck Robert
Tuckett Simon
Turnbull Jeremy
Turner Andrew
Turner Callum
Turner Richard
Tyas Caroline
Tyler-Whittle Michael
Uff John
Ure Douglas
Usmani Haroon
Vaid Nilesh
Van Mierlo Sebastian
Vanhoutte Kirsten
Vaughan Richard
Venables Terry
Vickers Ricky
Vickery Mark
Vigar Geoff
Vincent Nick
Viner Ged
Violeau Alain
Vivian-Neal Julian
Vogler Christian
Von Malaise Henrik
Wadey Paul
Wadia Zubin
Wakefield Rosemary
Wakeham Julian
Walbank Angela
Walden Rory
Walker Andrew
Walker Chris
Walker Simon
Wall Matthew
Wallace Duncan
Wallace Stuart
Wallbank Anna
Walsh Paddy
Walsh Paul
Ward Ben
Ward Jonathan
Ward Simon
Ware Guy
Warmington Mike
Warnock-Smith Richard
Warren Peter
Waterhouse Ronald
Watkins Gary
Watkins Jonathan
Watson Julian
Watson Mike
Watt David
Watts Graham
Webb Steve
Webber Mark
Weeks Kirsty
Weetman Clive
Welch Andrew
Welford Richard
Wells Mark
Wenman Ian
West Nicholas
Westbrook Simon
Wetherill Stephen
Whalley Joanna
Wheeler Andrew
Wheeler Greg
Whibley Mark
White Huw
White Marie
Whitehead Alan
Whitehead Rupert
Whitfield Michael
Whittall Arup
Wickenden Mark
Wilkes Joanna
Wilkins Nigel
Wilkinson Eleanor
Wilkinson Howard
Wilkinson Paul
Williams Adrian
Williams Elfed
Williams Gareth
Williams Keith
Williams Richard
Williamson Chris
Willis Carol
Willis Graham
Willmott Associates
Wills Mike
Wilshaw Andrew
Wilson Bill
Wilson Mark
Wilson Nicholas
Wilson Peter
Wimpenny Sarah
Winch Guy
Winter Marion
Wolfe Tim
Wong Andrew
Wong Chi Fai
Wong Yiu Fai
Wood Chris
Wood Duncan
Wood Graham
Wood Nick
Wood Stephen
Woodcock Simon
Woodfield Nigel
Woodhead Publishing
Woodman Richard
Woods Ptak Architects
Woodward Clyde
Woodward Ed
Woolley Tim
Wooster Nick
Worsley Peter
Wotherspoon Fraser
Wragg David
Wren Kershaw
Wright Duncan
Wright Gordon
Wright Nicholas
Wright Simon
Wrighton Jeremy
Wyatt Steven
Wyeth Sharon
Yandle Andrew
Yates Anthony
Yeadon Peter
Yeats Graham
Yeoman Mike
Yerrell Peter
Yiu Kenneth
Yong Adeline
Young Andrew
Young Jeremy
Young Robert
Yu Gary
Yuen Foong Yu
Zaczek Mark
Zaki Nadia
Zampetti Elisa
Zeng Limin
Zhao Xiaofeng
Zienkiewicz Olgierd
Zimmerman Eric
Zisman Steven
Zuccarino Ralph
Zuk William

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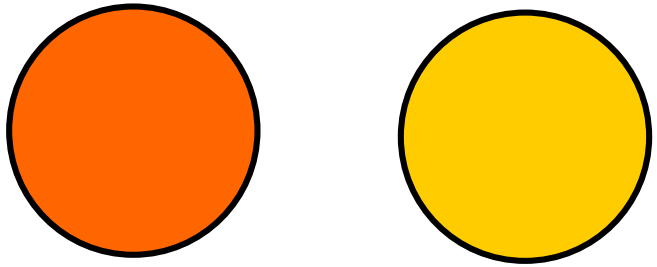
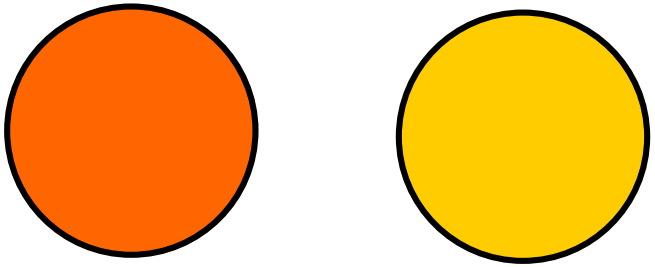
Conversation Topics



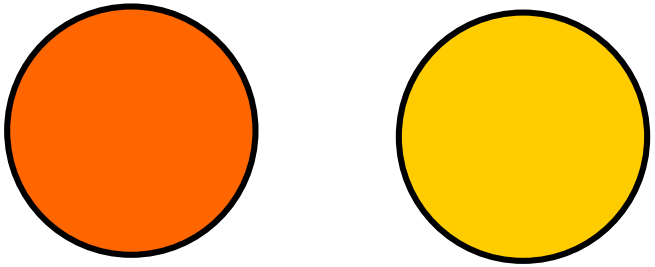
Mitigate **Adapt**

Conversation Topics



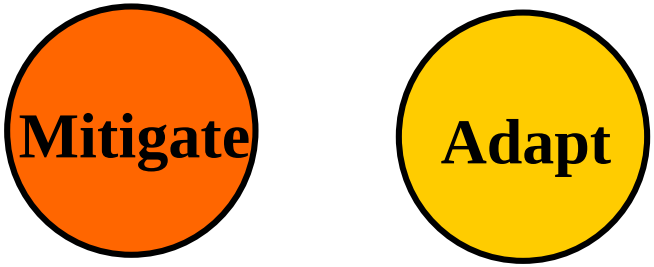
Reduction Resilience

Conversation Topics

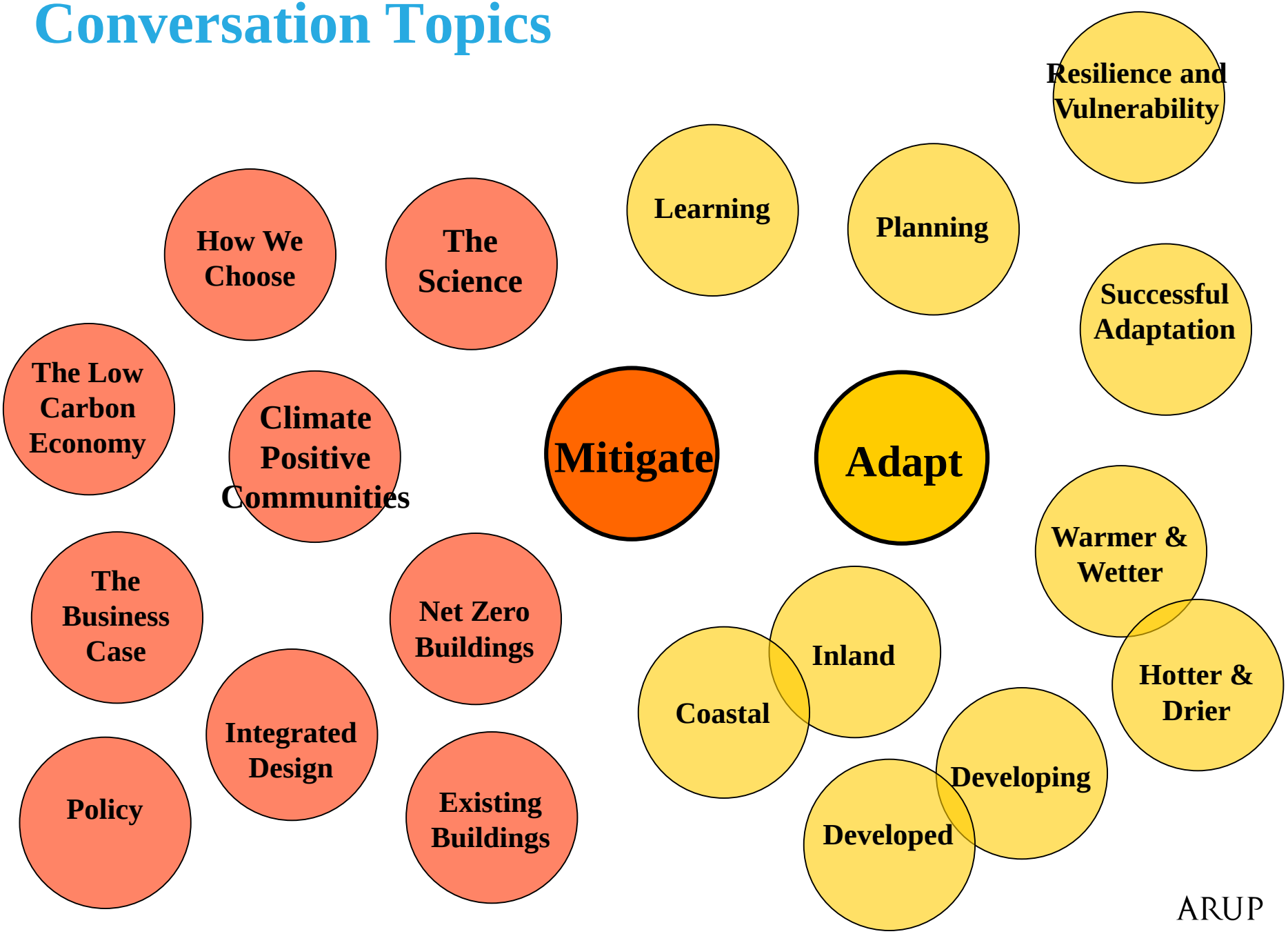


Regeneration **Readiness**

Conversation Topics



Conversation Topics



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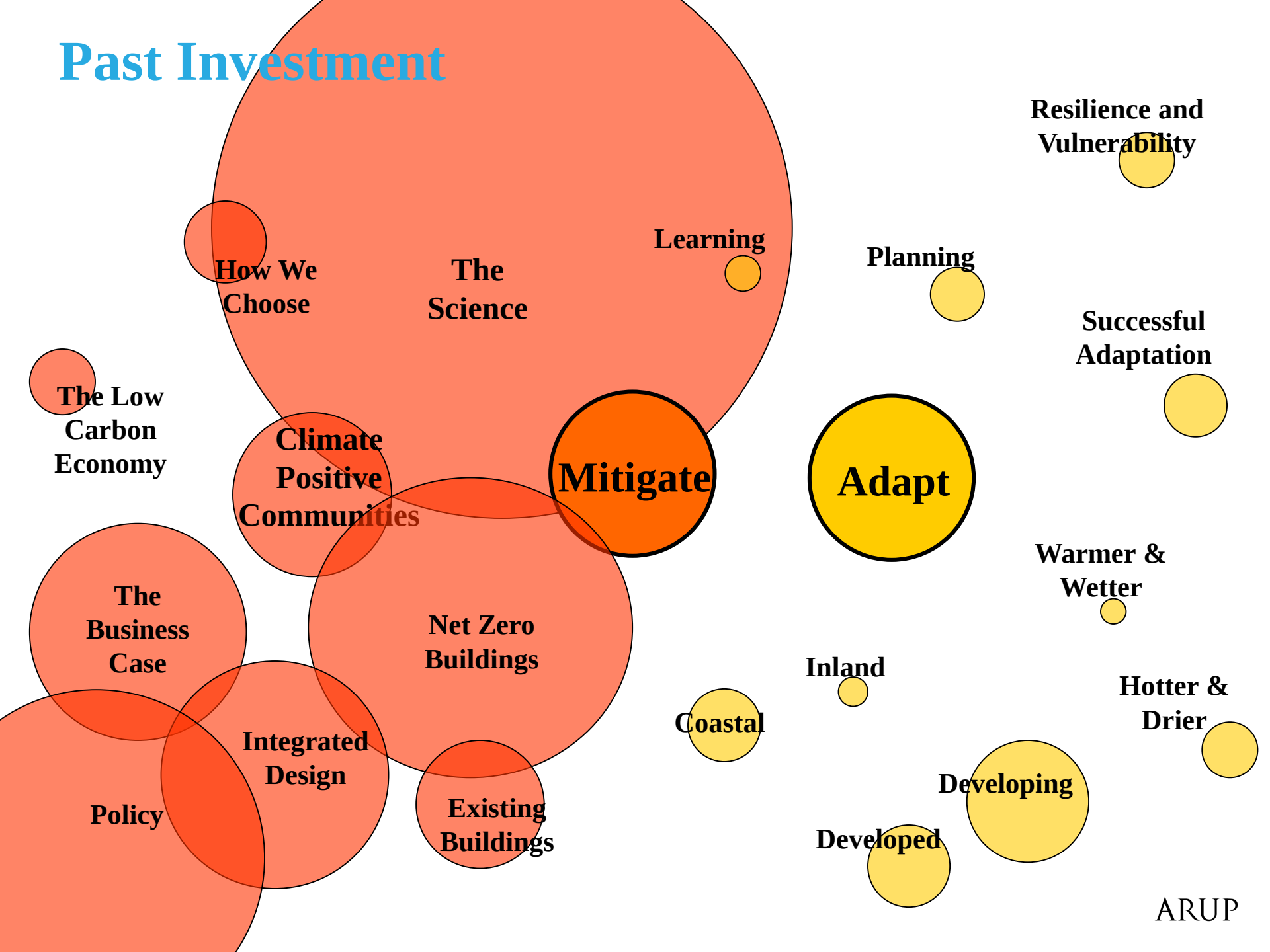
Past Investment
Resilience and Vulnerability
How We Choose
The Science
Learning
Planning
Successful Adaptation
The Low Carbon Economy
Climate Positive Communities
Mitigate
Adapt
Warmer & Wetter
The Business Case
Net Zero Buildings
Inland
Hotter & Drier
Coastal
Integrated Design
Developing
Policy
Existing Buildings
Developed
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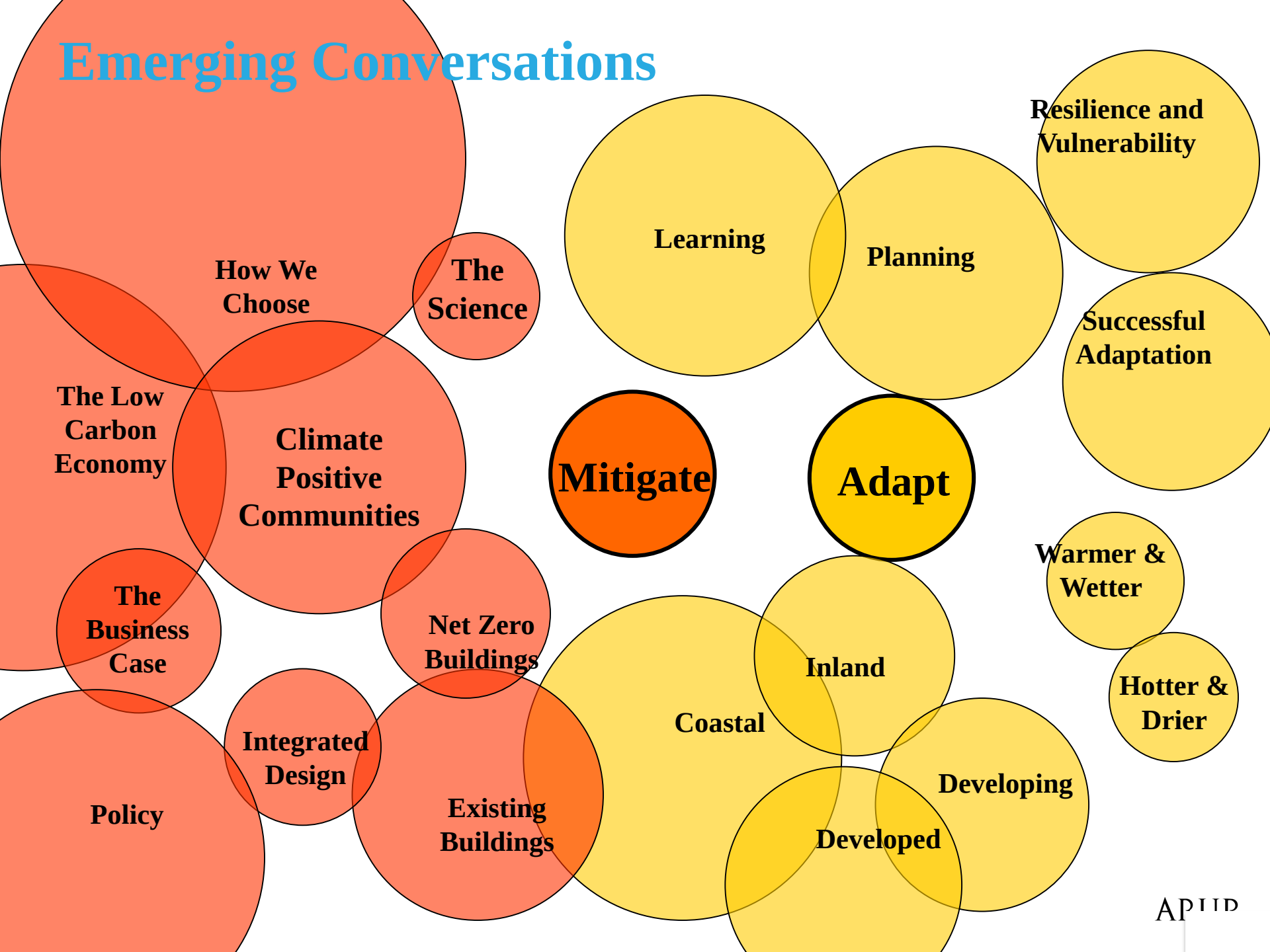
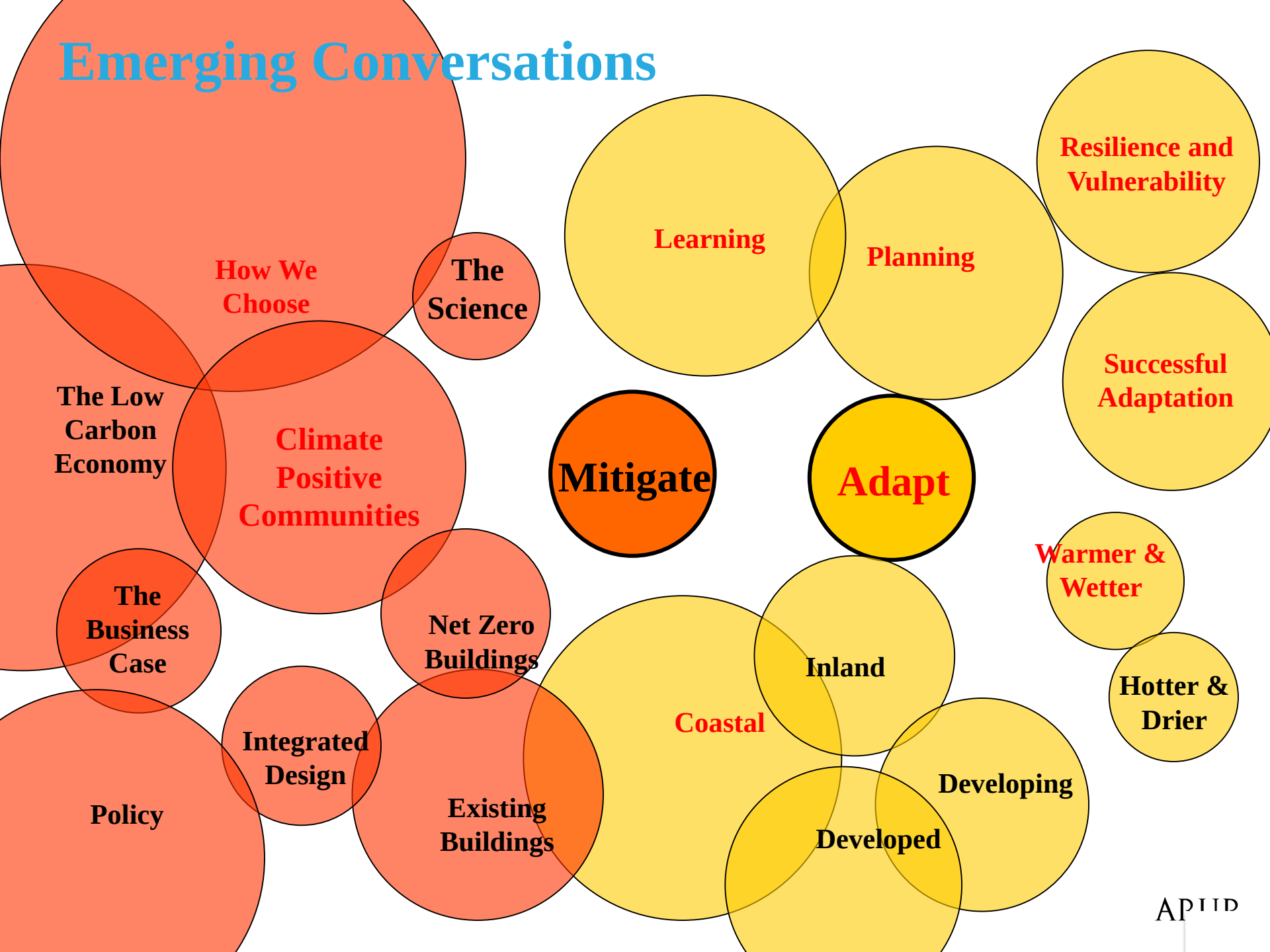
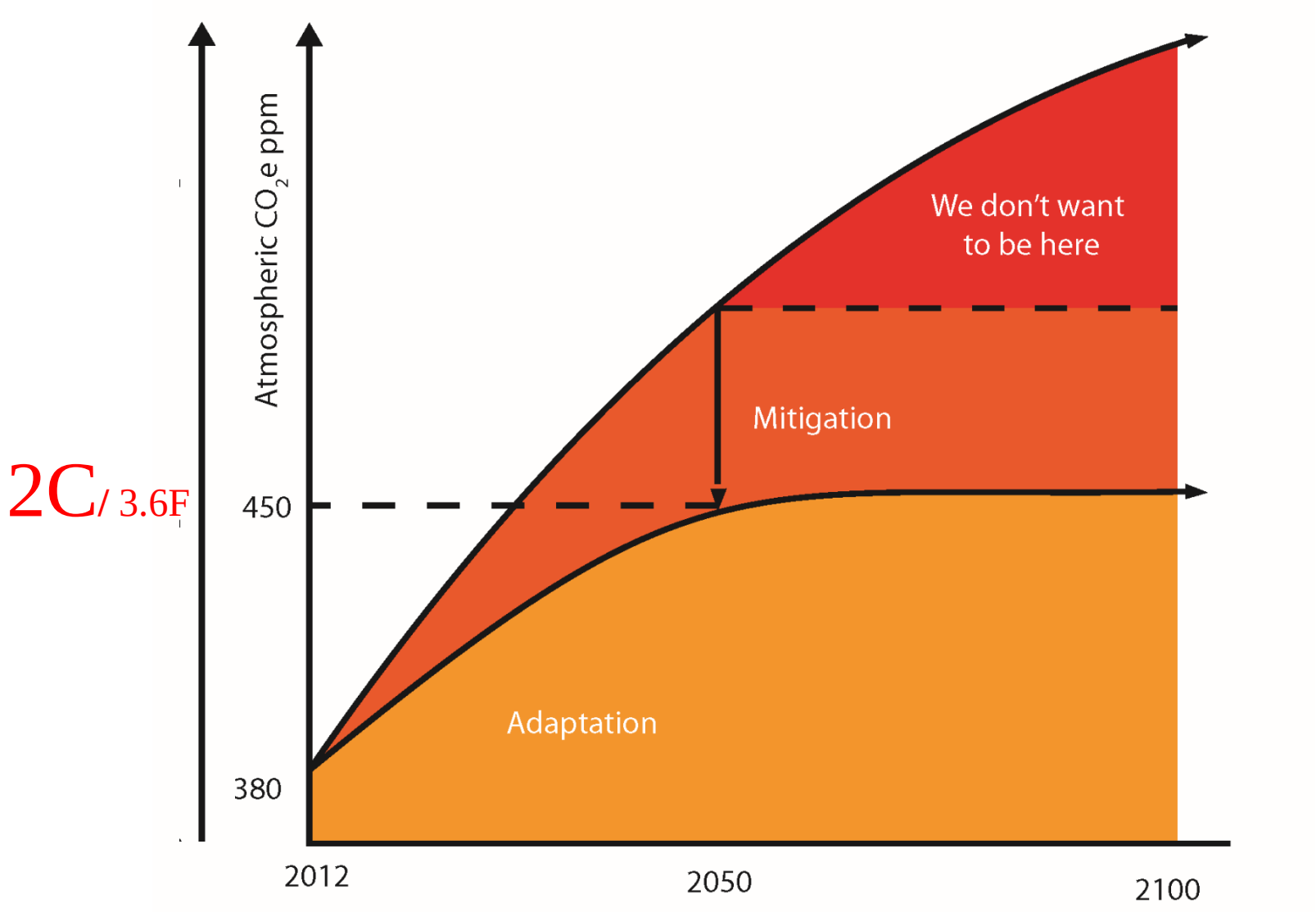
Emerging Conversations



Emerging Conversations




2C/ 3.6F
Atmospheric CO_2e ppm
450
380
We don't want to be here
Mitigation
Adaptation
2012
2050
2100

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Early *& Right* Action

Recognize **a problem**

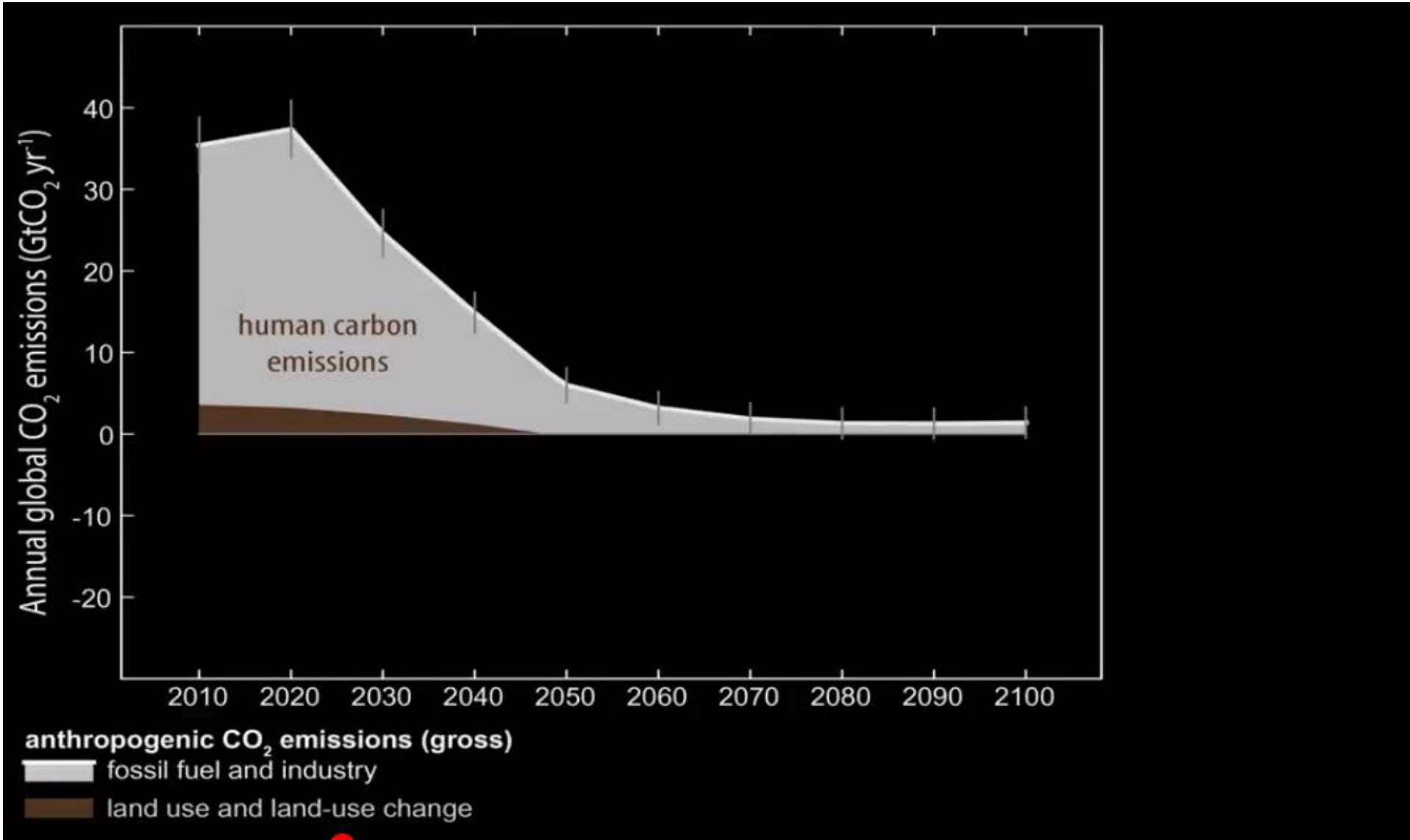
Choose to act **to remedy or avoid the problem**

Act effectively

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

A 66% chance *if we act effectively*

Science 2017, Stockholm Resilience Center, Johan Rockstrom



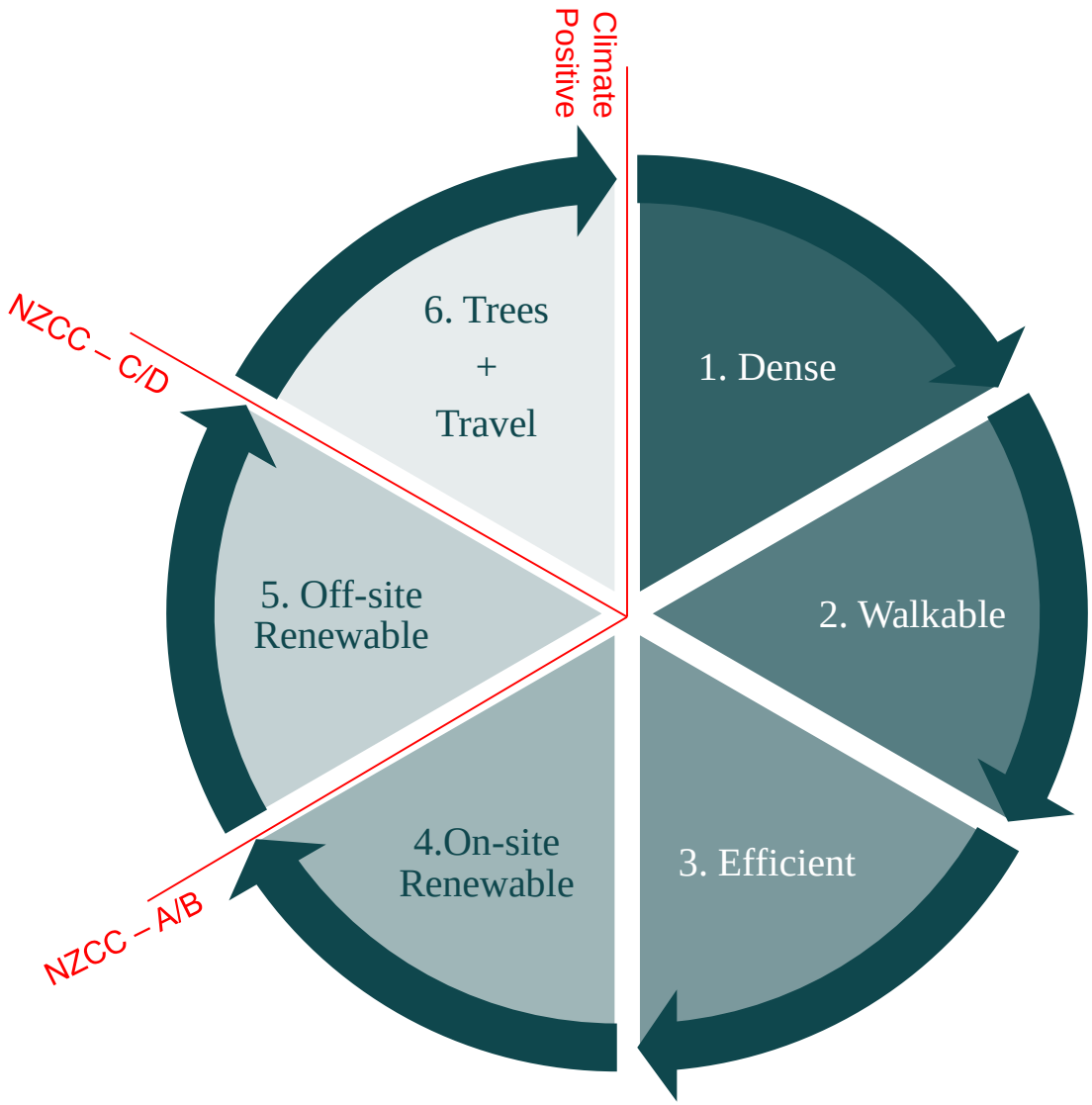
Optimism at the 2018 Global Climate Summit

- The mayors of 19 cities presiding over 130 million city-dwellers including Copenhagen, Johannesburg and Tokyo, made a net-zero carbon pledge for all new buildings by 2030.
- 400 investor members, representing $32 trillion in assets, committed "to accelerate and scale up" climate action to support the Paris Agreement.
- $15 million in pro-bono legal services by 2020 toward climate-related causes, as nine law firms formed the new Lawyers for a Sustainable Economy Initiative.
- The Under2 Coalition now represents 1.3 billion souls and 43 percent of the planet's economy.
- The We Are Still In campaign now counts 3,540 corporate signatories pledging to uphold the Paris Agreement.

Affordable, Resilient, and Healthy

Climate Positive Communities

Effective Action – Climate Positive Community



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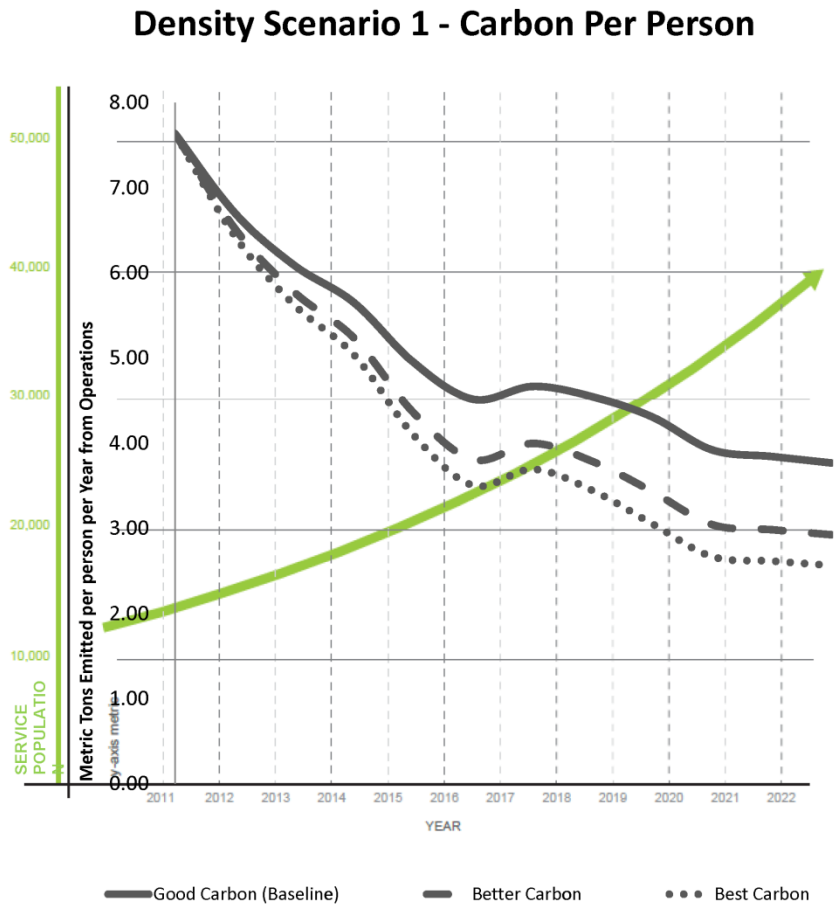
Density Enables Deep Improvements



Density
(FAR of 1x)

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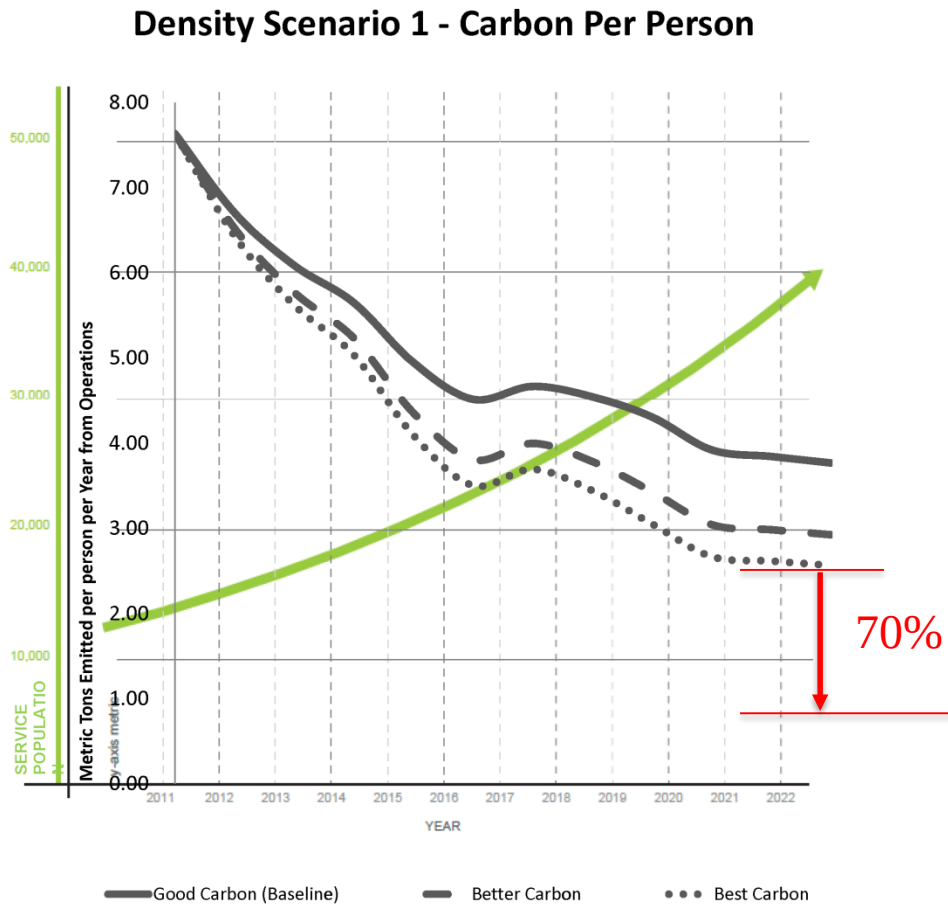
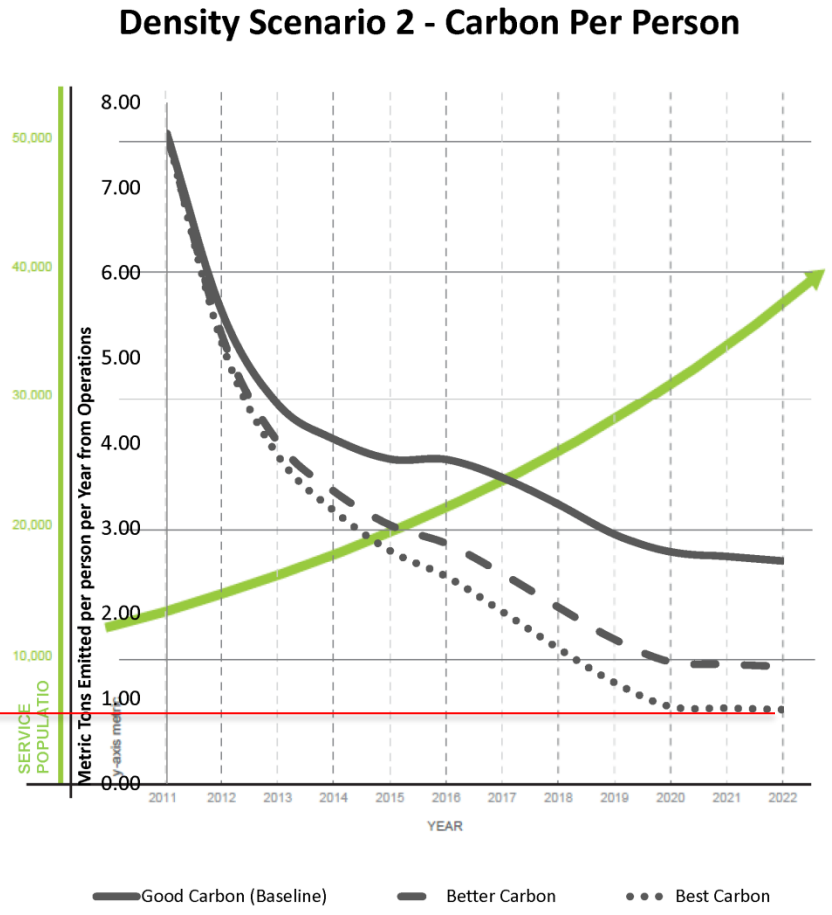
Density Enables Deep Improvements





Density
(FAR of 1x)

2x Density
(FAR of 2x)

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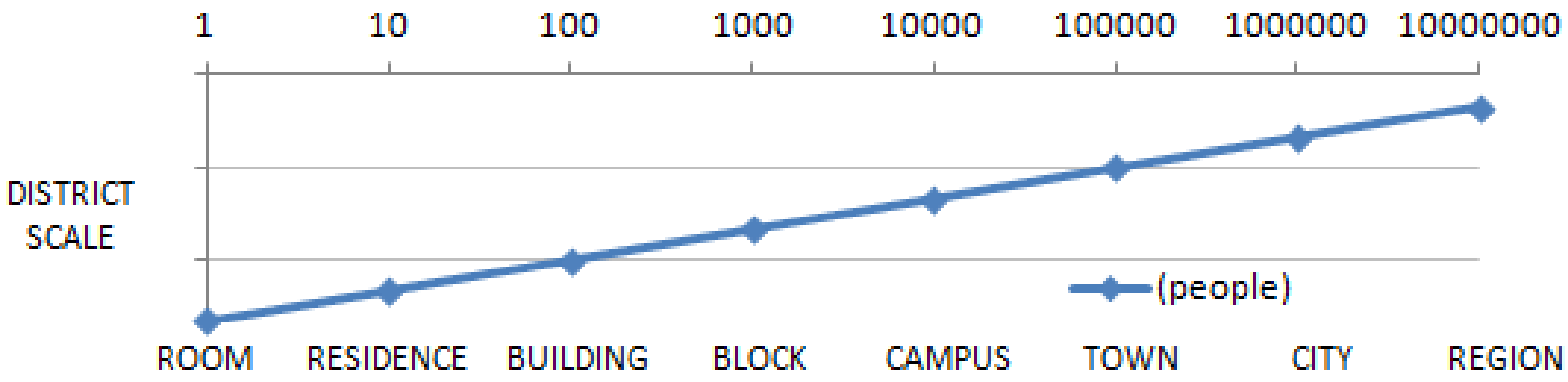
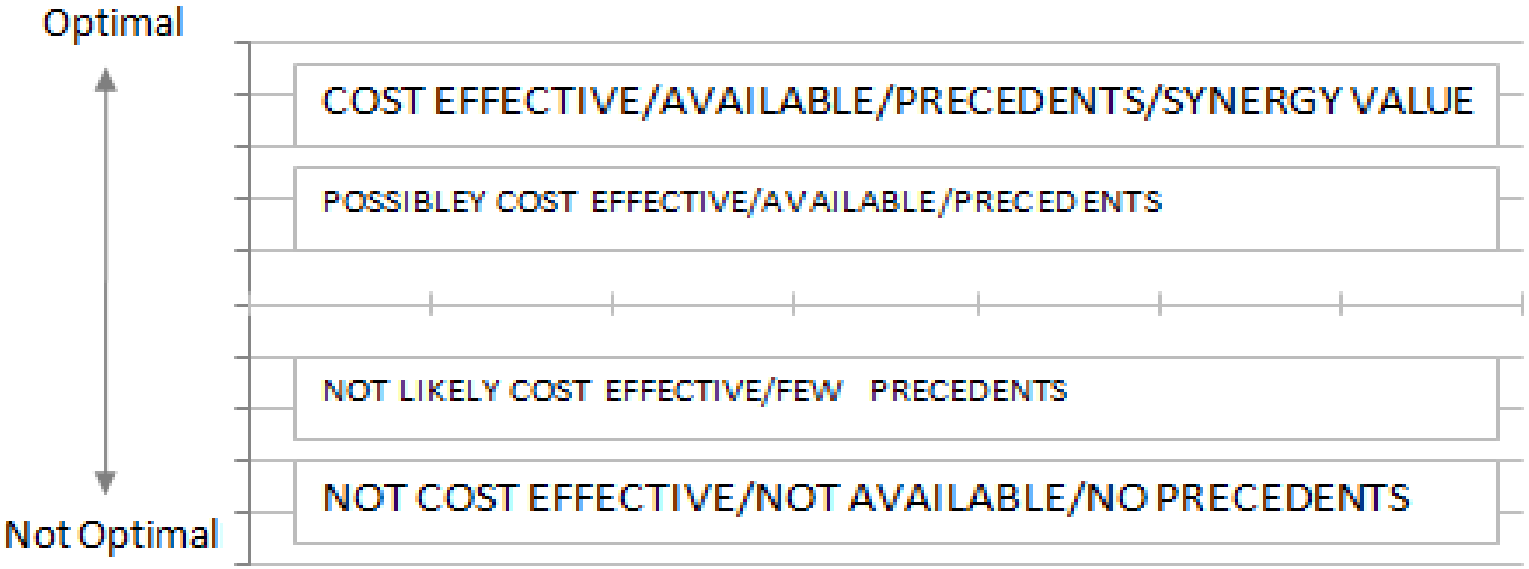
Optimal Scales





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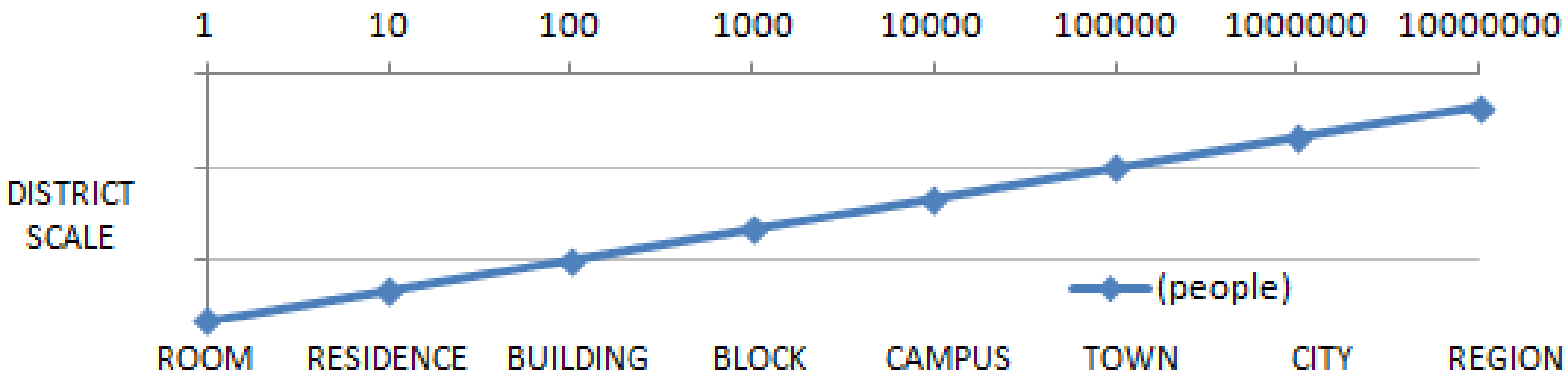
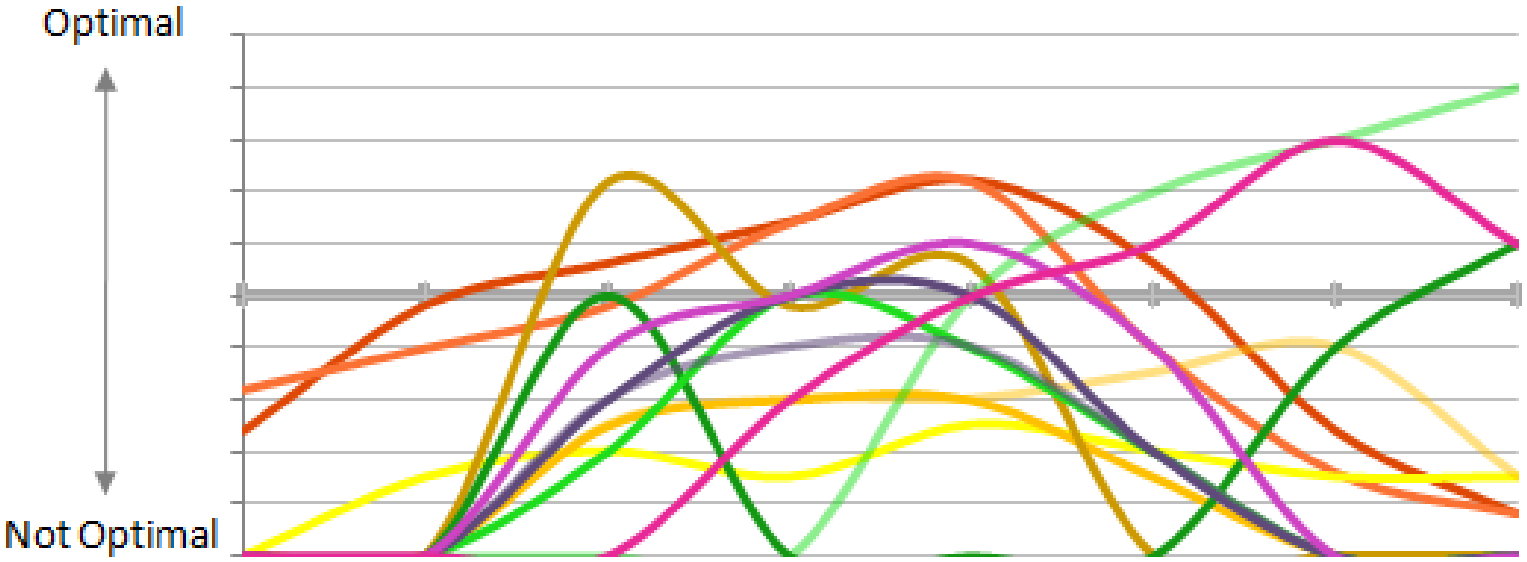
Optimal Scales





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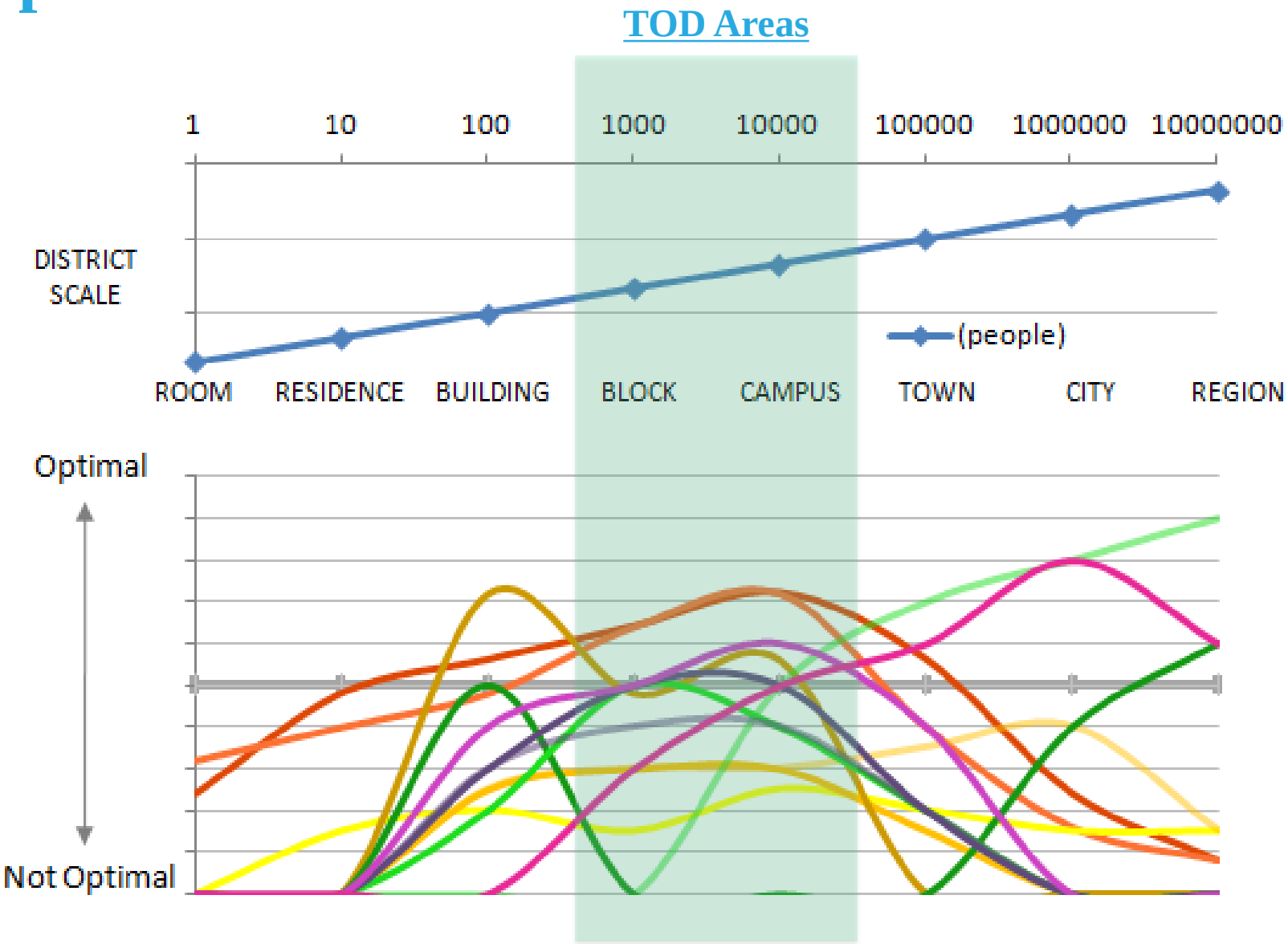
Optimal Scales



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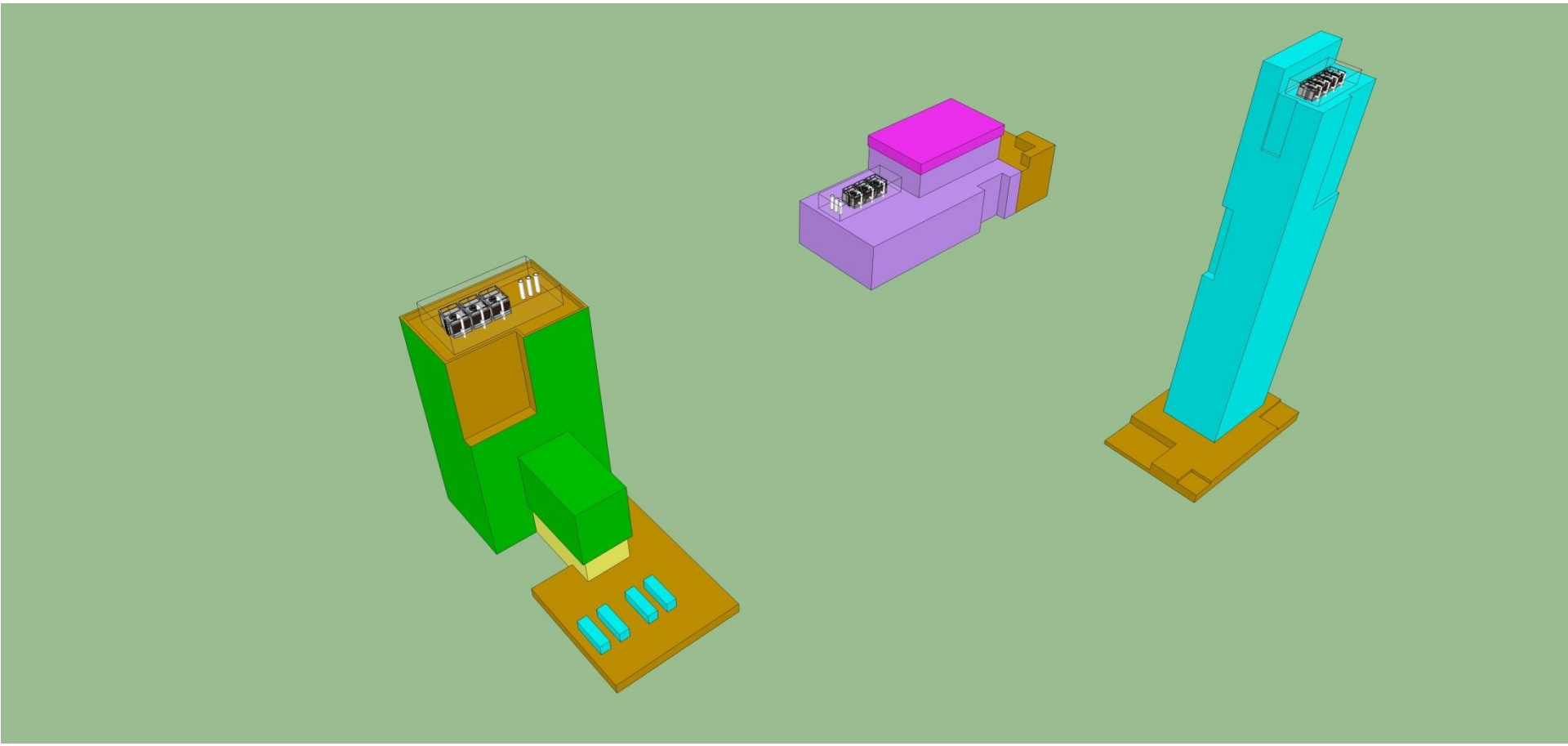

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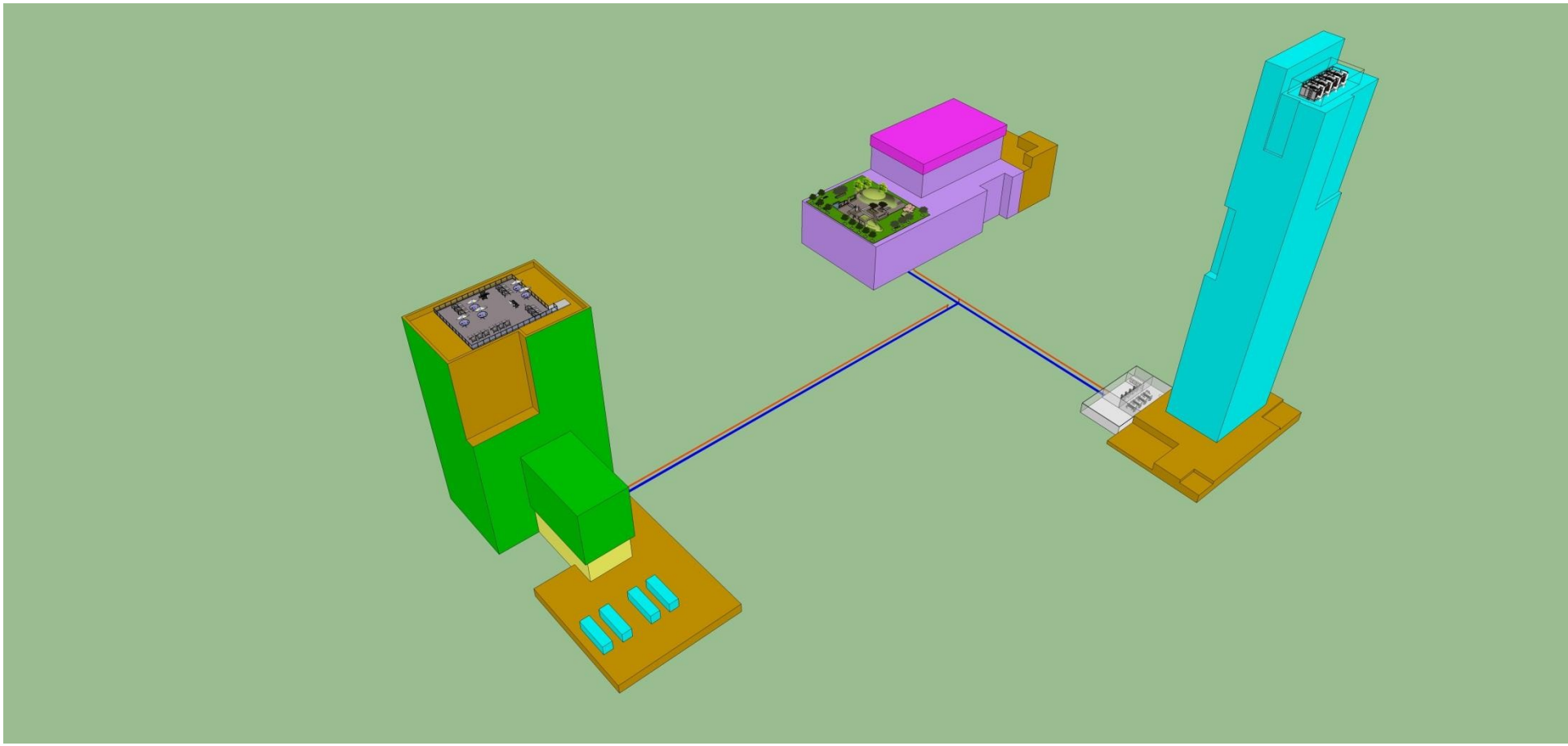

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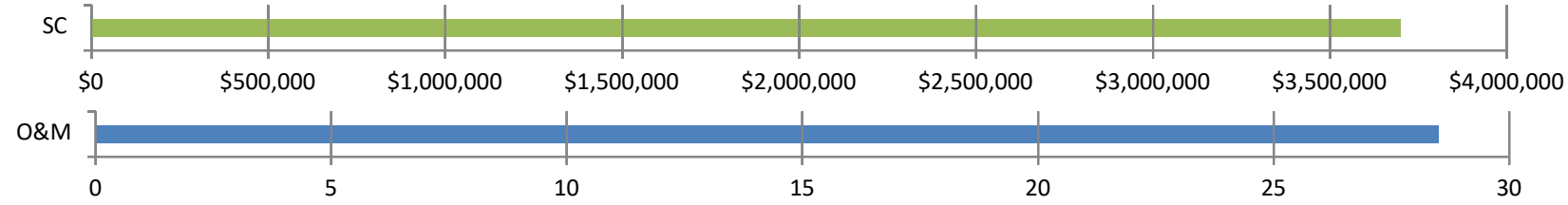
1.0 FTE
1.5 FTE
M$ 0.2/yr
2.0 FTE
2.5 FTE's
M$ 0.9/yr
1.0 FTE
1.0 FTE
M$ 0.2/yr
1.0 FTE
1.5 FTE's
M$ 0.3/yr
1.0 FTE
1.5 FTE's
M$ 0.2/yr
1.5 FTE's
2 FTE's
M$ 0.4/yr
1.0 FTE
1.5 FTE's
M$ 0.4/yr
1.0 FTE
1.5 FTE's
M$ 0.3/yr
1.5 FTE's
2.0 FTE's
M$ 0.4/yr


SC
$0
$500,000
$1,000,000
$1,500,000
$2,000,000
$2,500,000
$3,000,000
$3,500,000
$4,000,000
O&M
0
5
10
15
20
25
30

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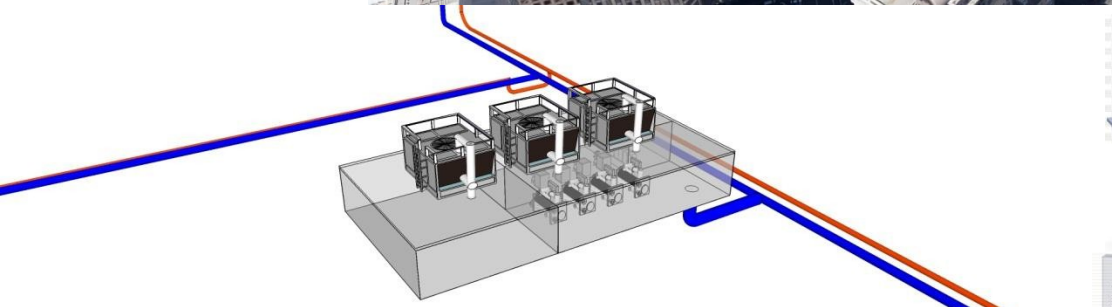
12.0 FTE

16.5 FTE’s

M$ 3.7/yr



5.0 FTE’s

6.0 FTE’s

M$ 1.0/yr

+ Consolidated emissions with tighter controls
+ Building insurability benefit
+ Building occupant safety
+ More sophisticated controls

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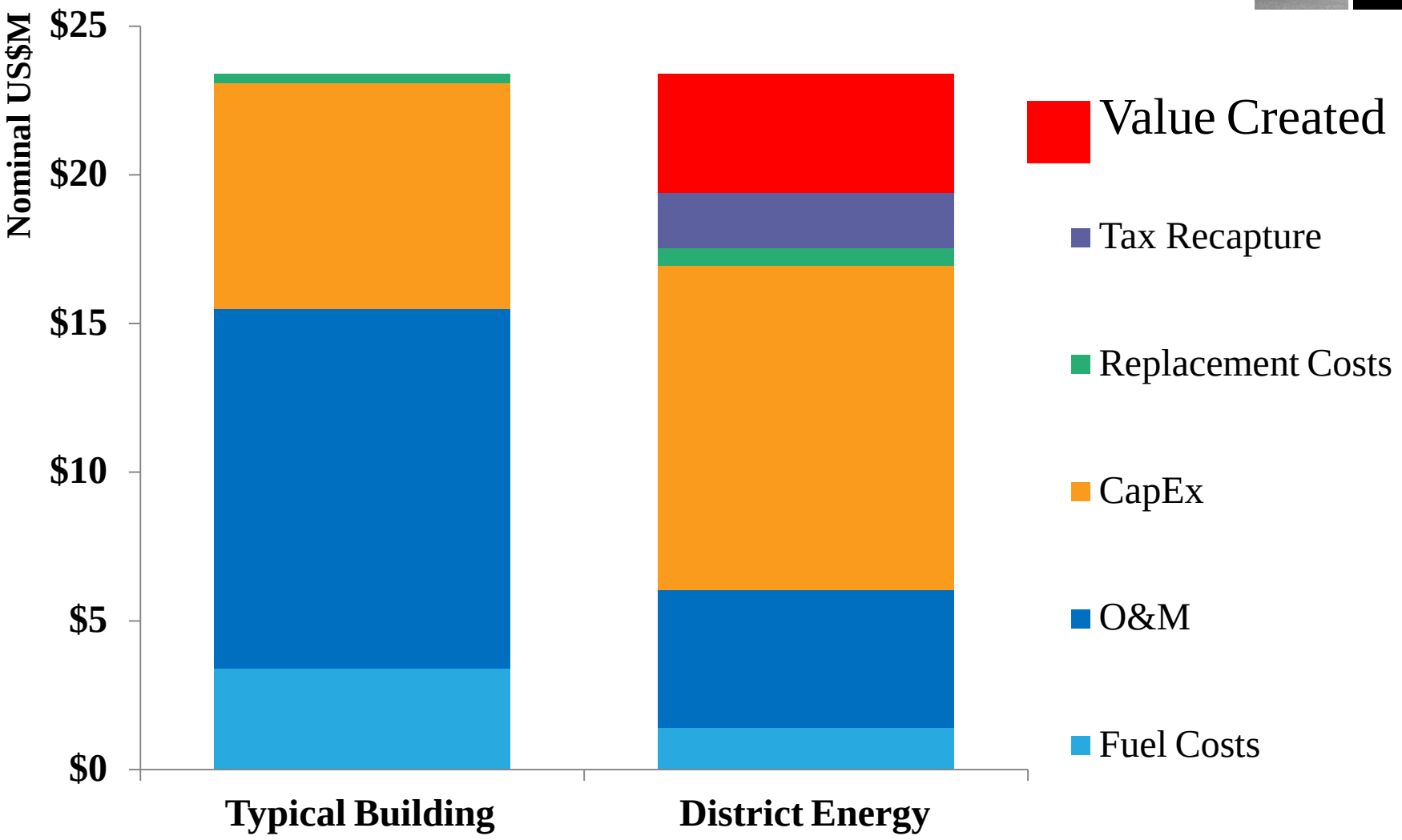
Saving millions of dollars per year

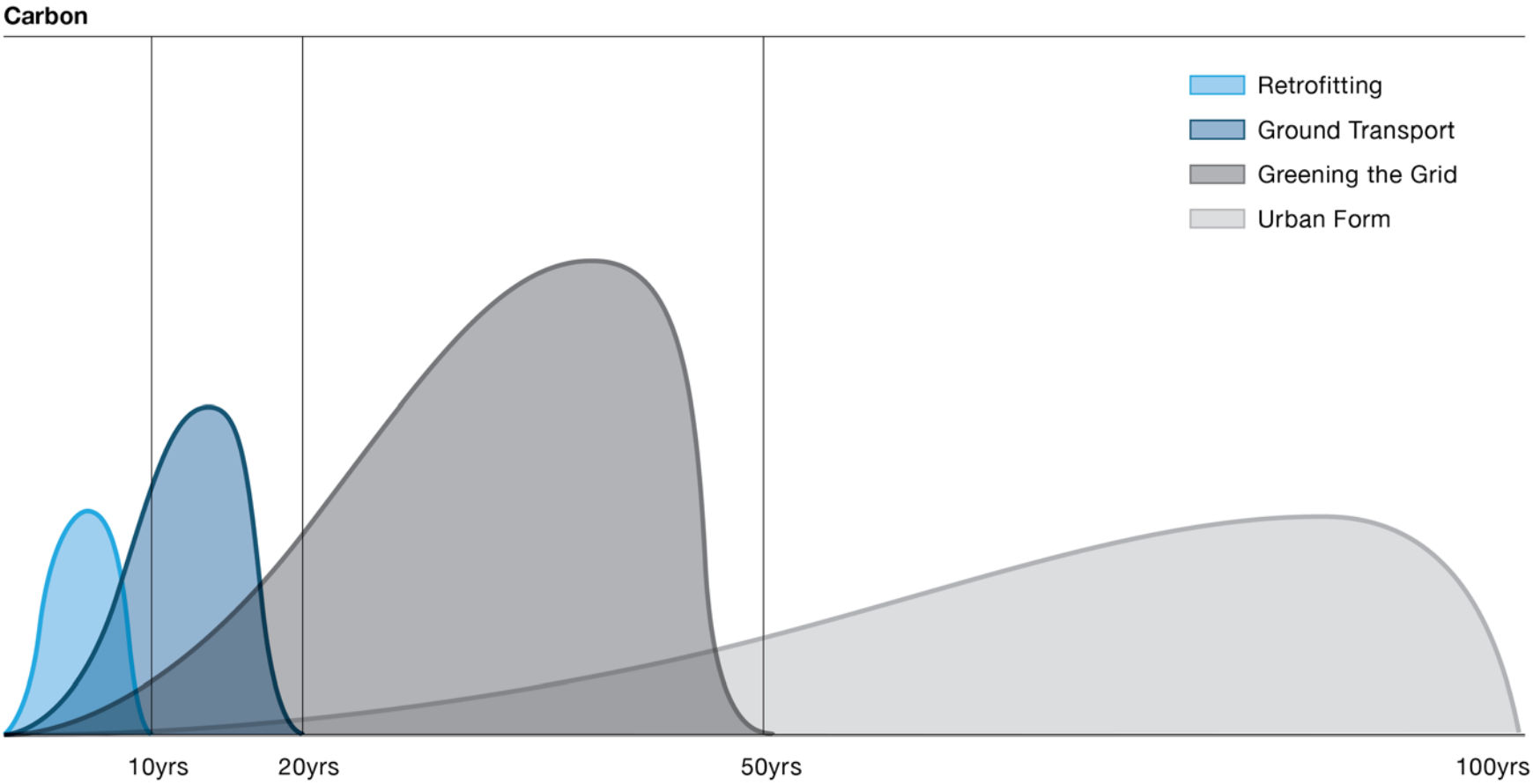
Existing Building | CITY | Retrofit



ARUP SKANSKA SF Environment Our home. Our city. Our planet. A Department of the City and County of San Francisco PERKINS+WILL SHERWOOD DESIGN ENGINEERS ULI Greenprint Center for Building Performance

Establish, Expand, Optimize, Maximize

The need to plan



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Psychology of Decisions

…and the Default Condition

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*

The Default Condition is…

- **Safe** since others did it (think protection in groups)
- **Easy** since we've done it before (think existing tools)
- **Known** since we can see it (think existing data)
- **Inexpensive** since anything better or new should always cost more (think marketing)
- **Hard to change** (think existing city streets)
- **Politically nonconfrontational** (think NIMBY'ism)
- **Appropriate** since it reflects our culture (think the sexy automobile)
- **Financeable** since the financial system knows how to pay for it (think loan underwriting)

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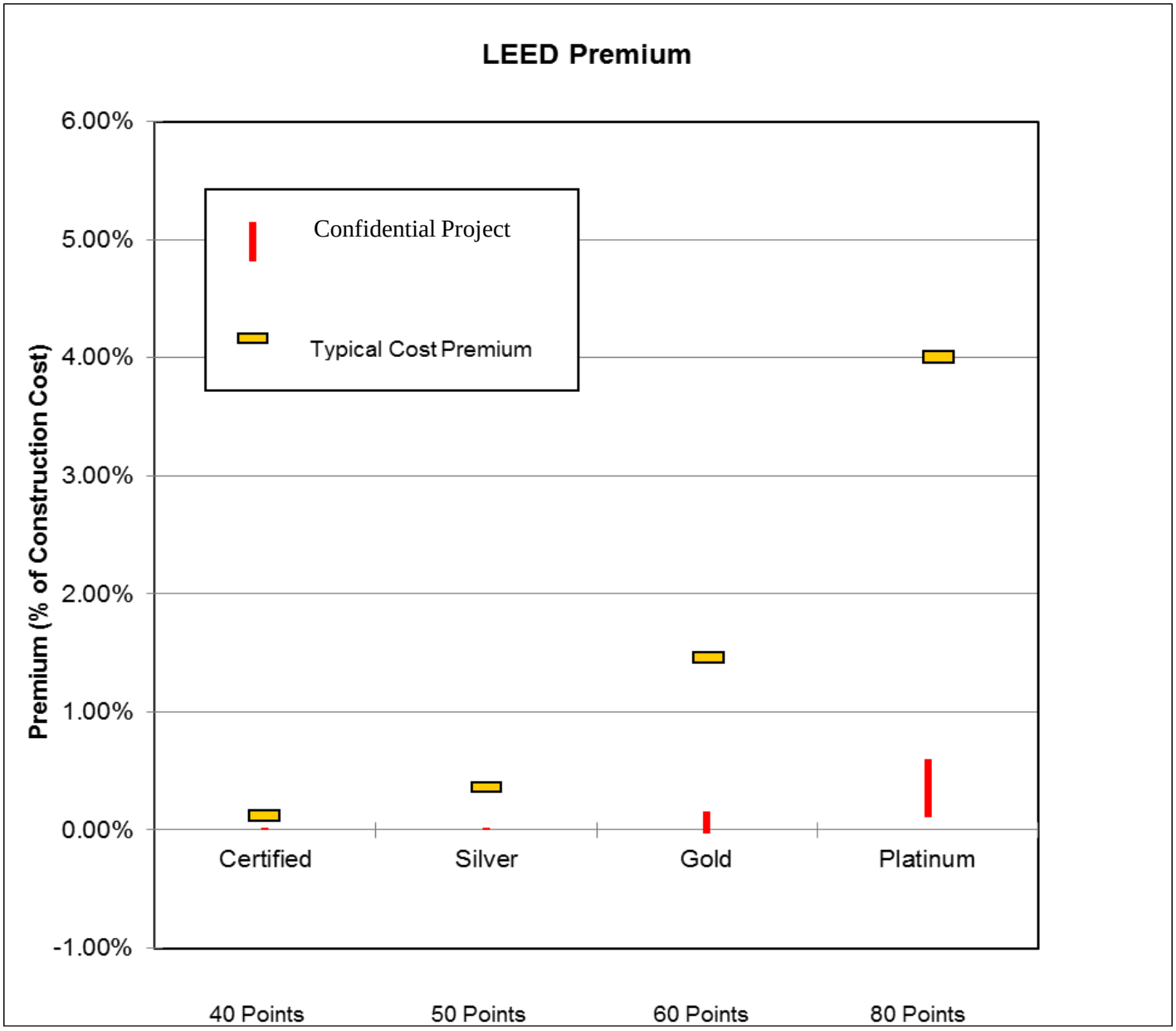
Building Performance Standards



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Adaptation

Resistance & Resilience

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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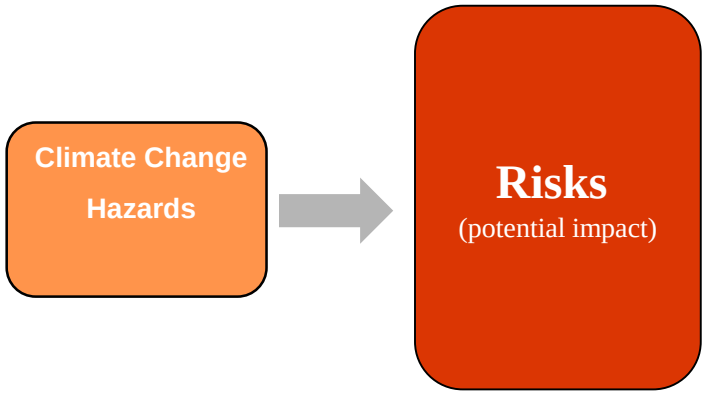
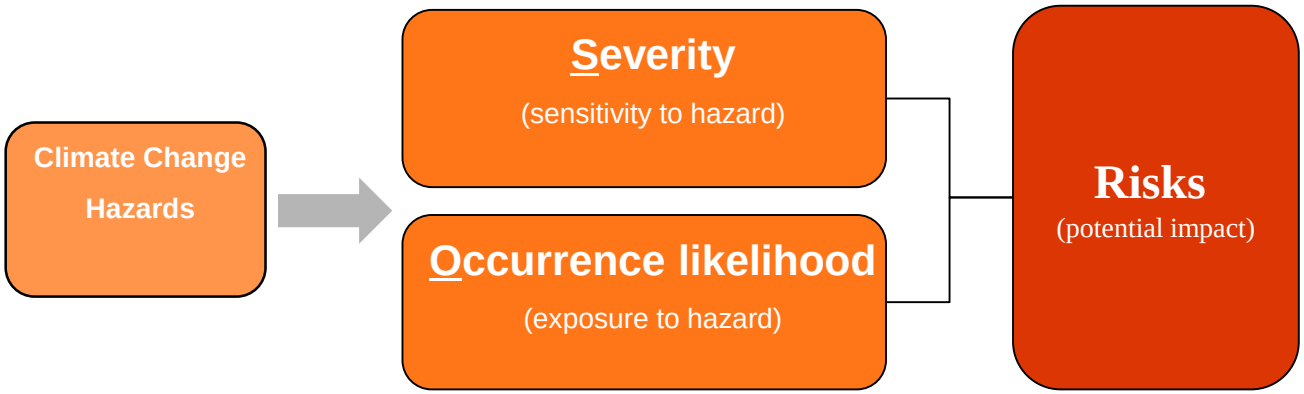
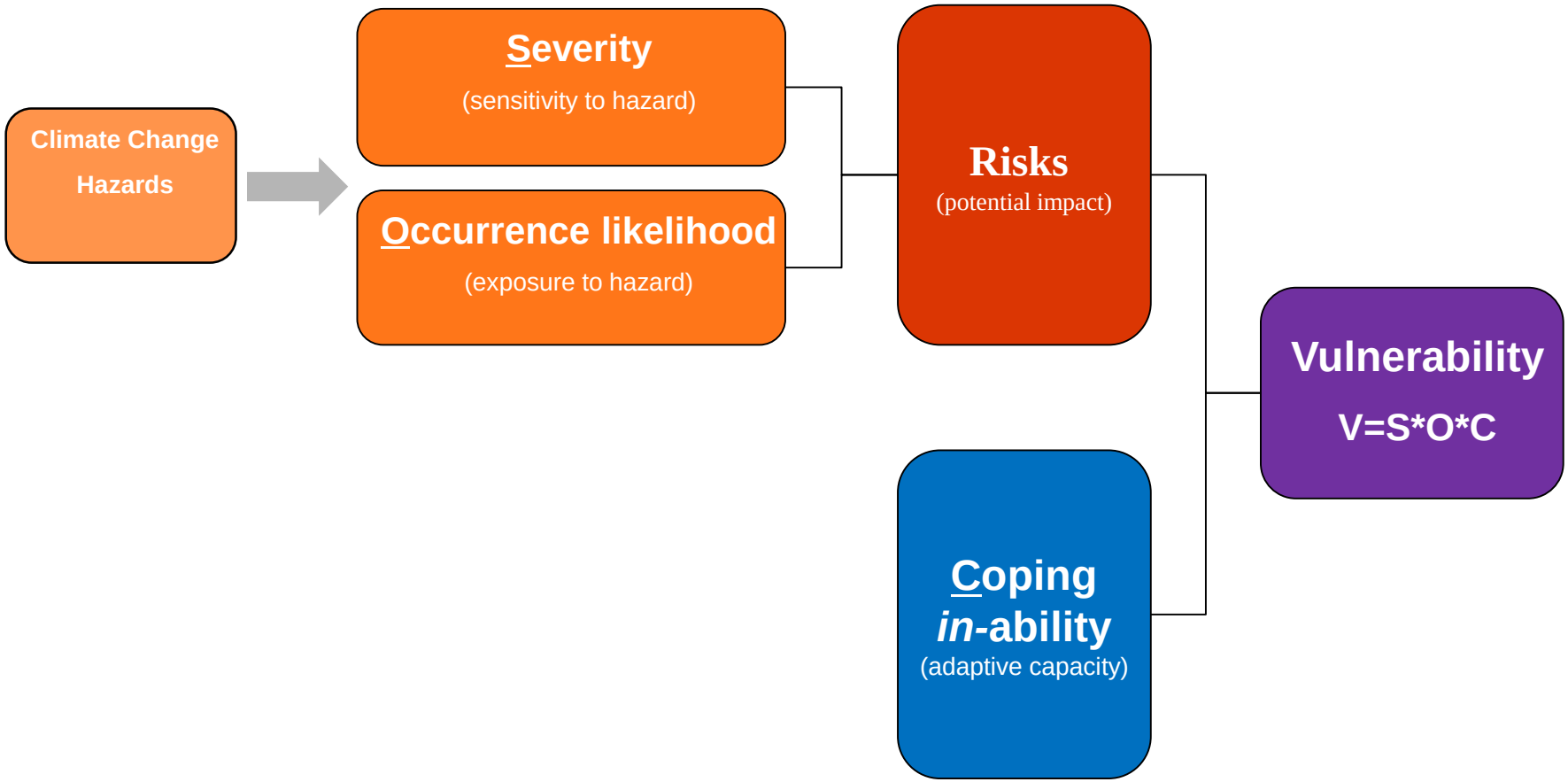
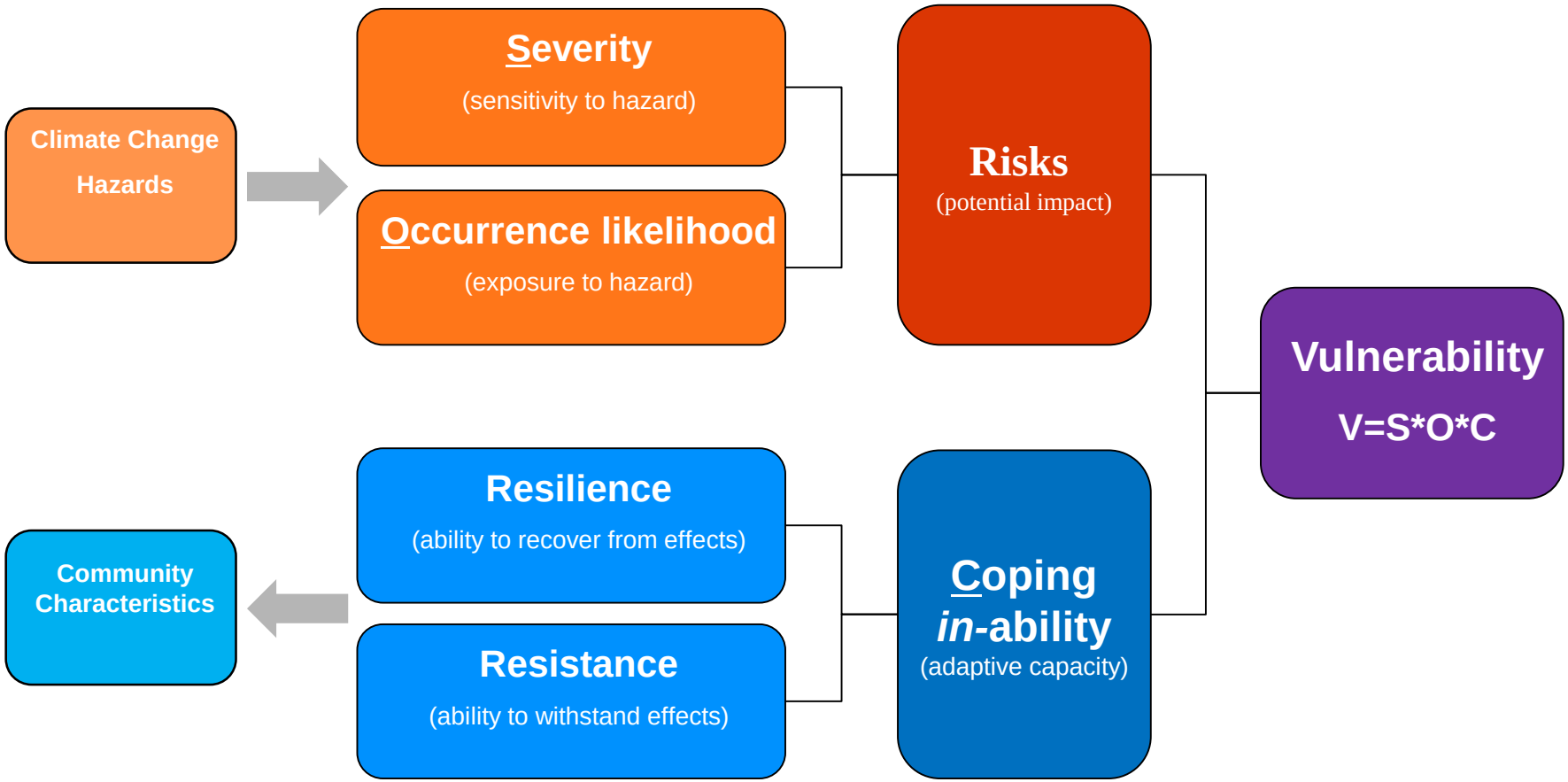
Image: Heidi Nutters

Image: Sergio Ruiz


Climate Change
Hazards
Risks
(potential impact)

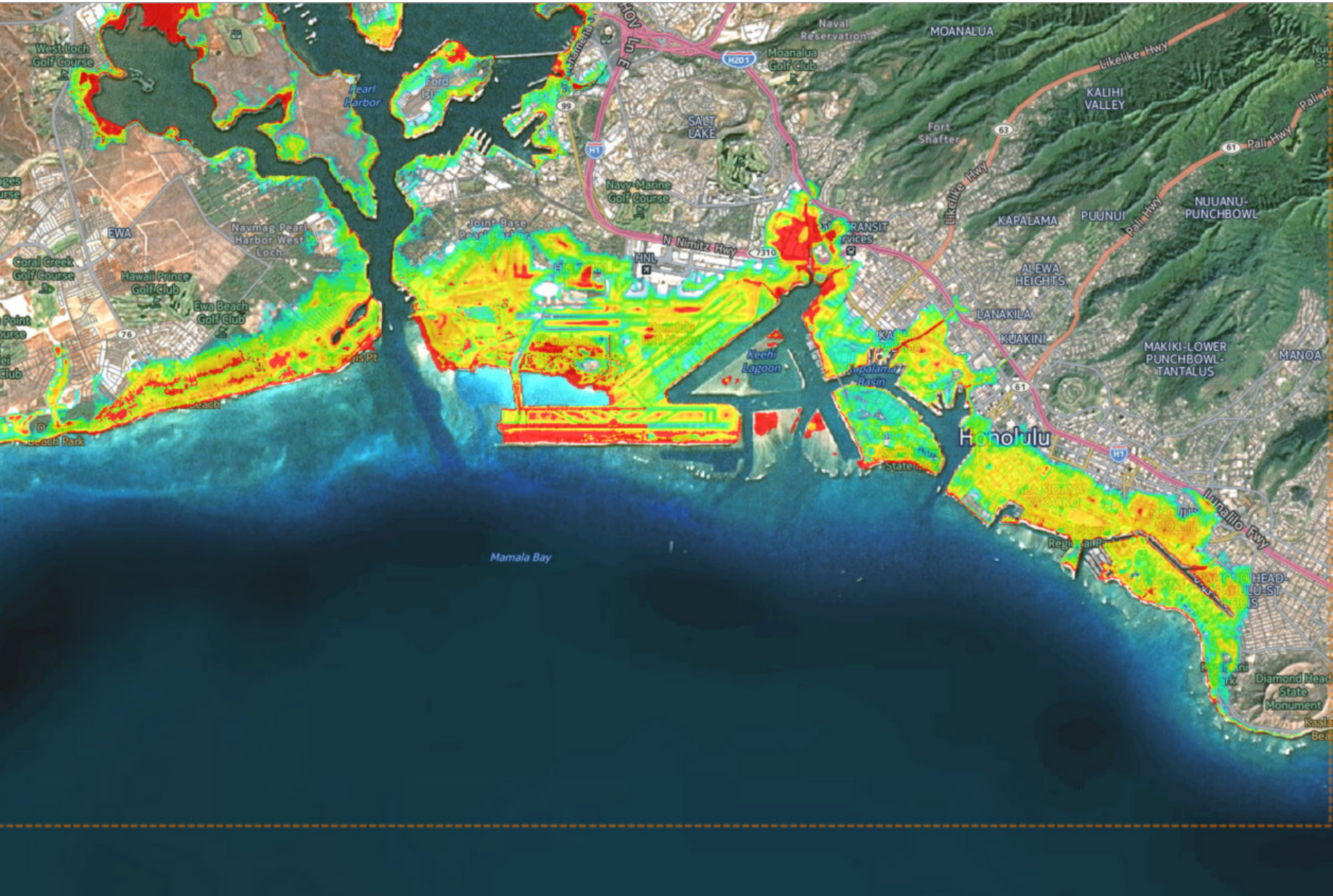

Climate Change Hazards
Severity
(sensitivity to hazard)
Occurrence likelihood
(exposure to hazard)
Risks
(potential impact)

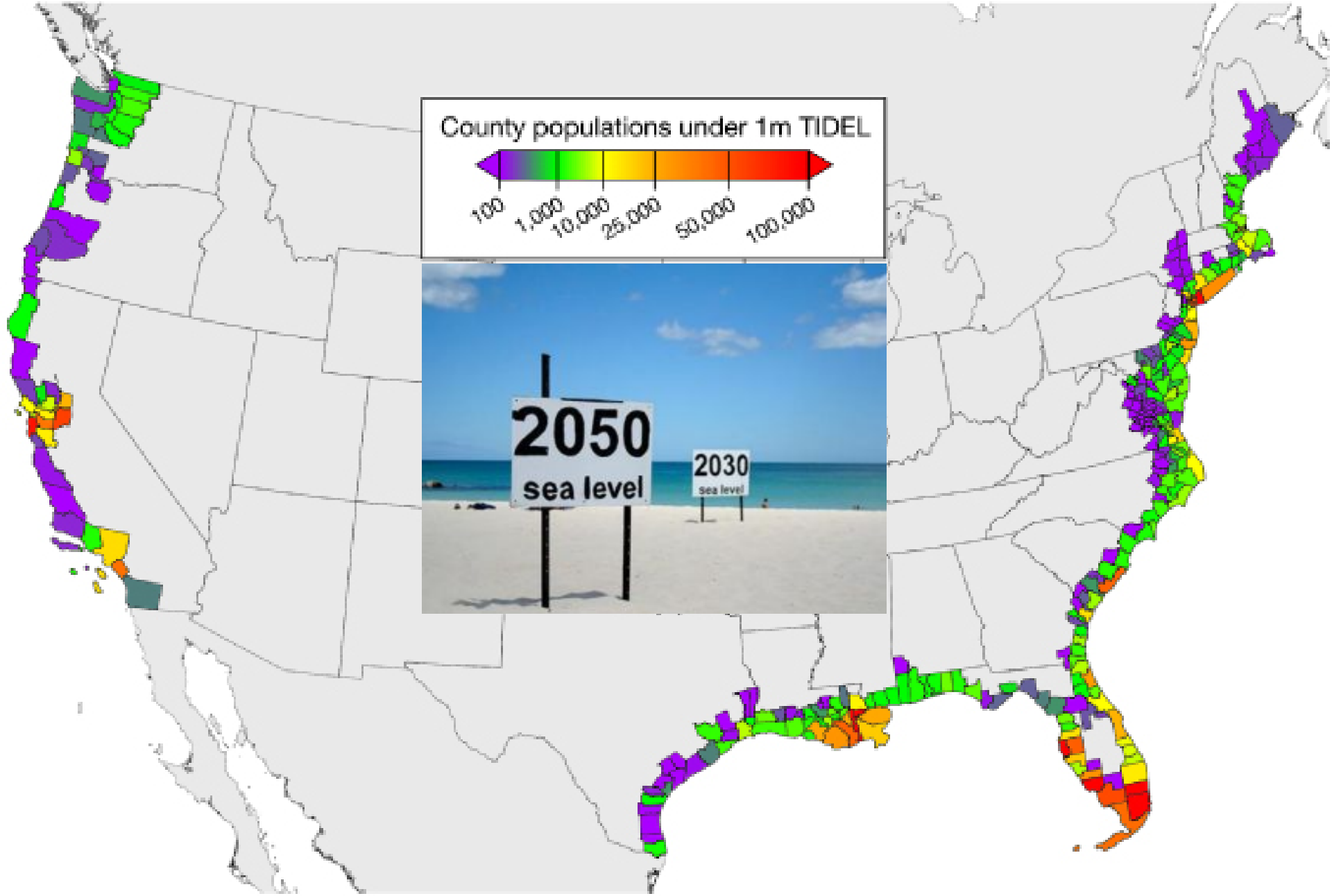

Climate Change Hazards
Severity
(sensitivity to hazard)
Occurrence likelihood
(exposure to hazard)
Risks
(potential impact)
Coping in-ability
(adaptive capacity)
Vulnerability
V=S*O*C


Climate Change Hazards
Severity
(sensitivity to hazard)
Occurrence likelihood
(exposure to hazard)
Risks
(potential impact)
Vulnerability
V=S*O*C
Community Characteristics
Resilience
(ability to recover from effects)
Resistance
(ability to withstand effects)
Coping in-ability
(adaptive capacity)

New Hartford, Iowa

$43B at Risk: Inundation zones +1m sea rise




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

San Francisco – Risk Accumulation?

Risk Accumulation

- **Bay Area: Elevated Seas, Earthquake, Levy Breach, Failed Infrastructure Systems ➔ *"Economic & Health System Failures"***
- **Honolulu: Energy, Water, and Food Import Dependence, Tourism ➔ *"EHSF"***
- **St Louis: Changing Patterns of Precipitation, Proximity to Rivers, Sewer Infrastructure, and Shipping ➔ *"EHSF"***
- **Minneapolis: Retreating Freeze Lines, Monocrops, Wooden Structures, ➔ *"ESF"***

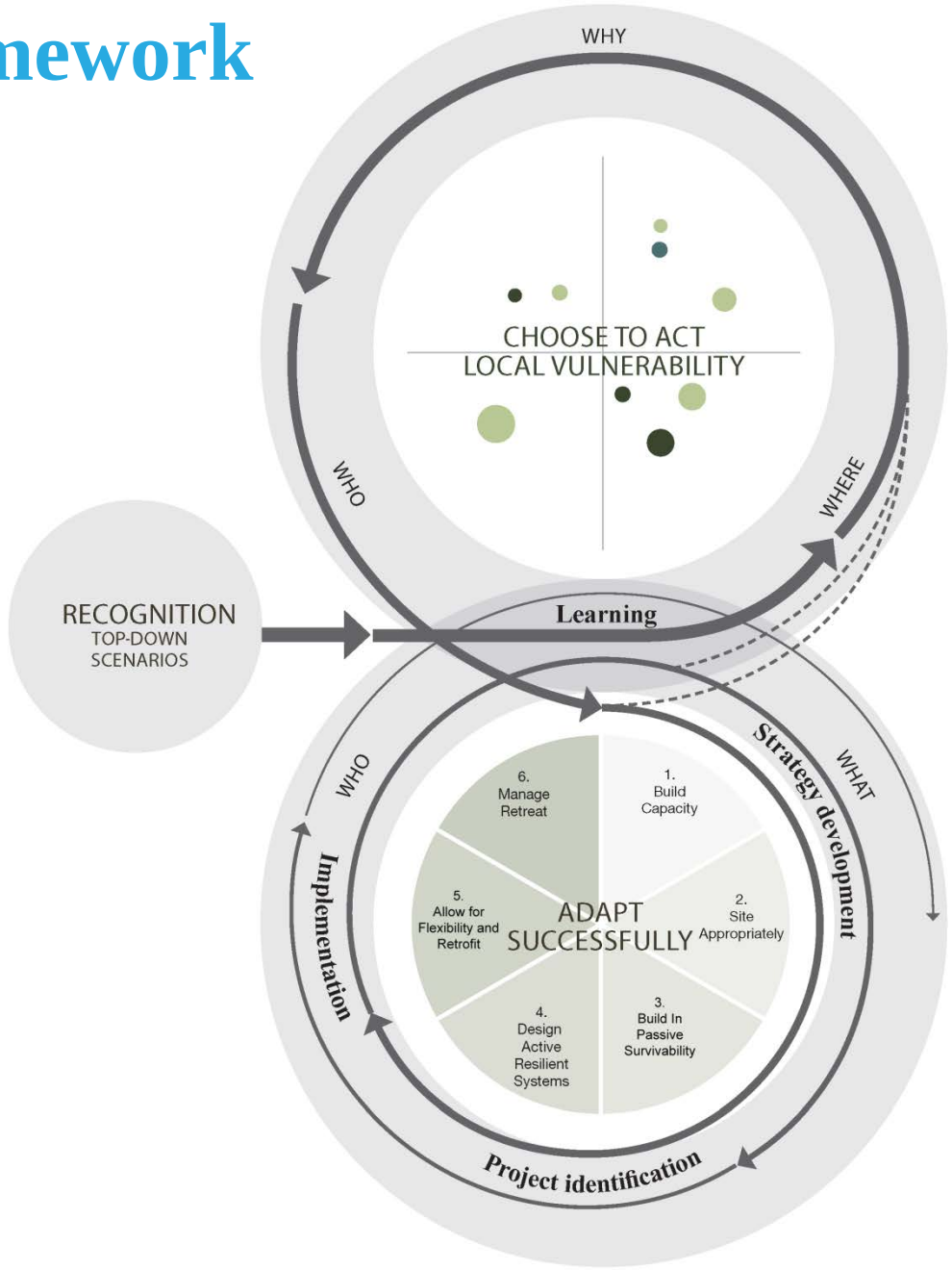
Risk Accumulation

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

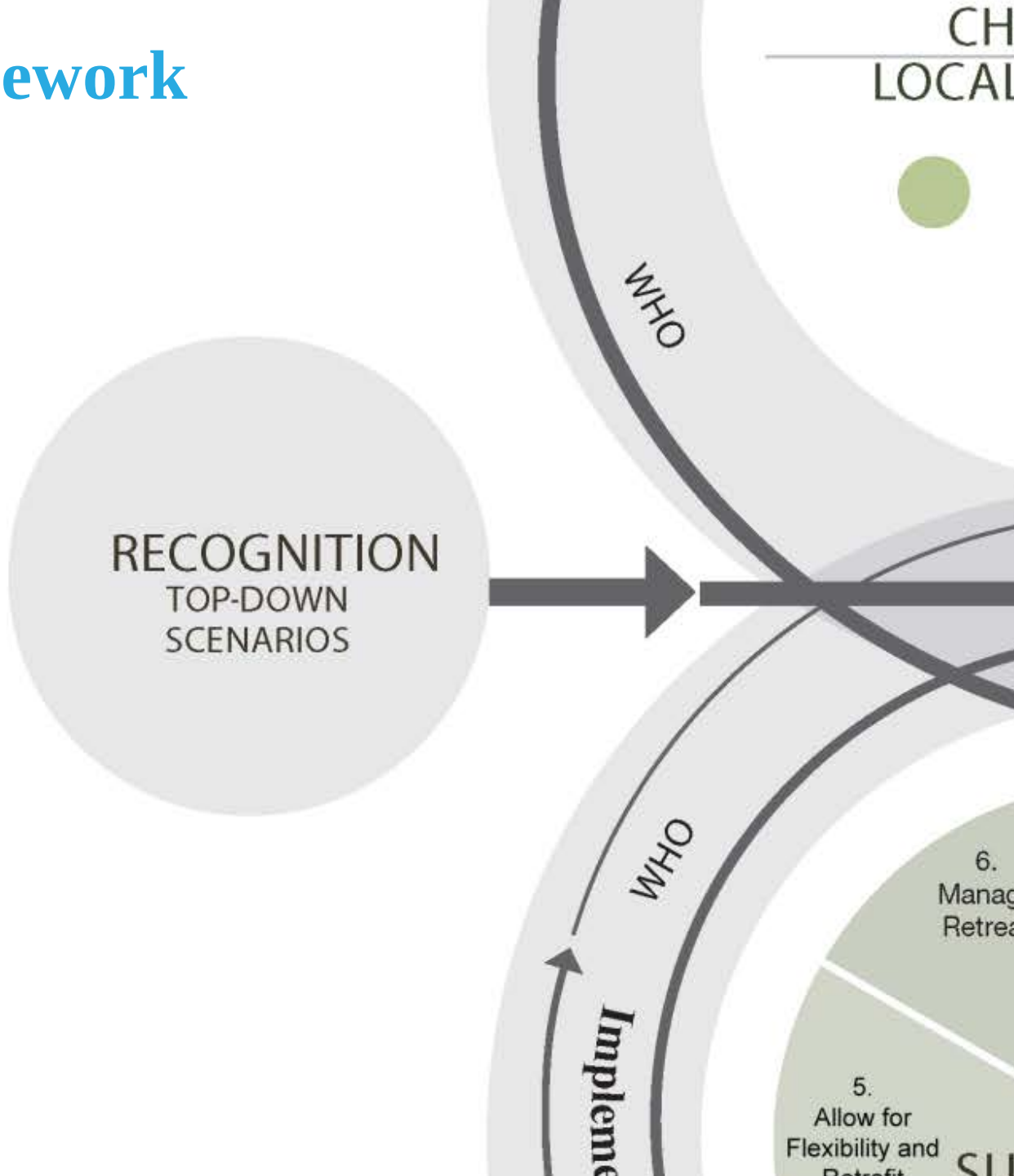
Risk Accumulation

- **Japan**
- **Louisiana**
- **New York City**
- **<u>Inland Europe</u>: Heat Index+ Non-Resilient Buildings +Cultural Norms**
- **➔ 50k dead in 2003**

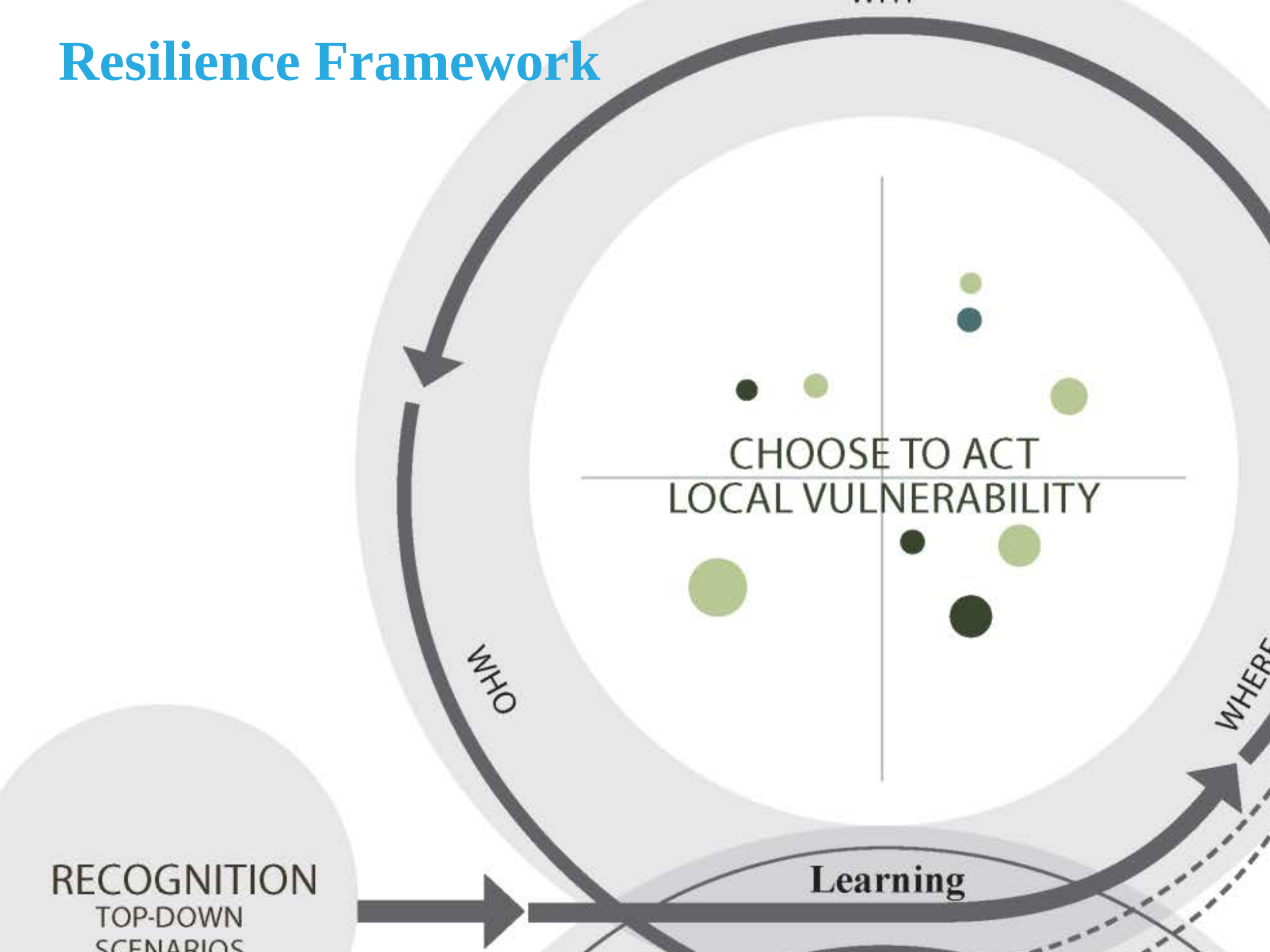
Resilience Framework



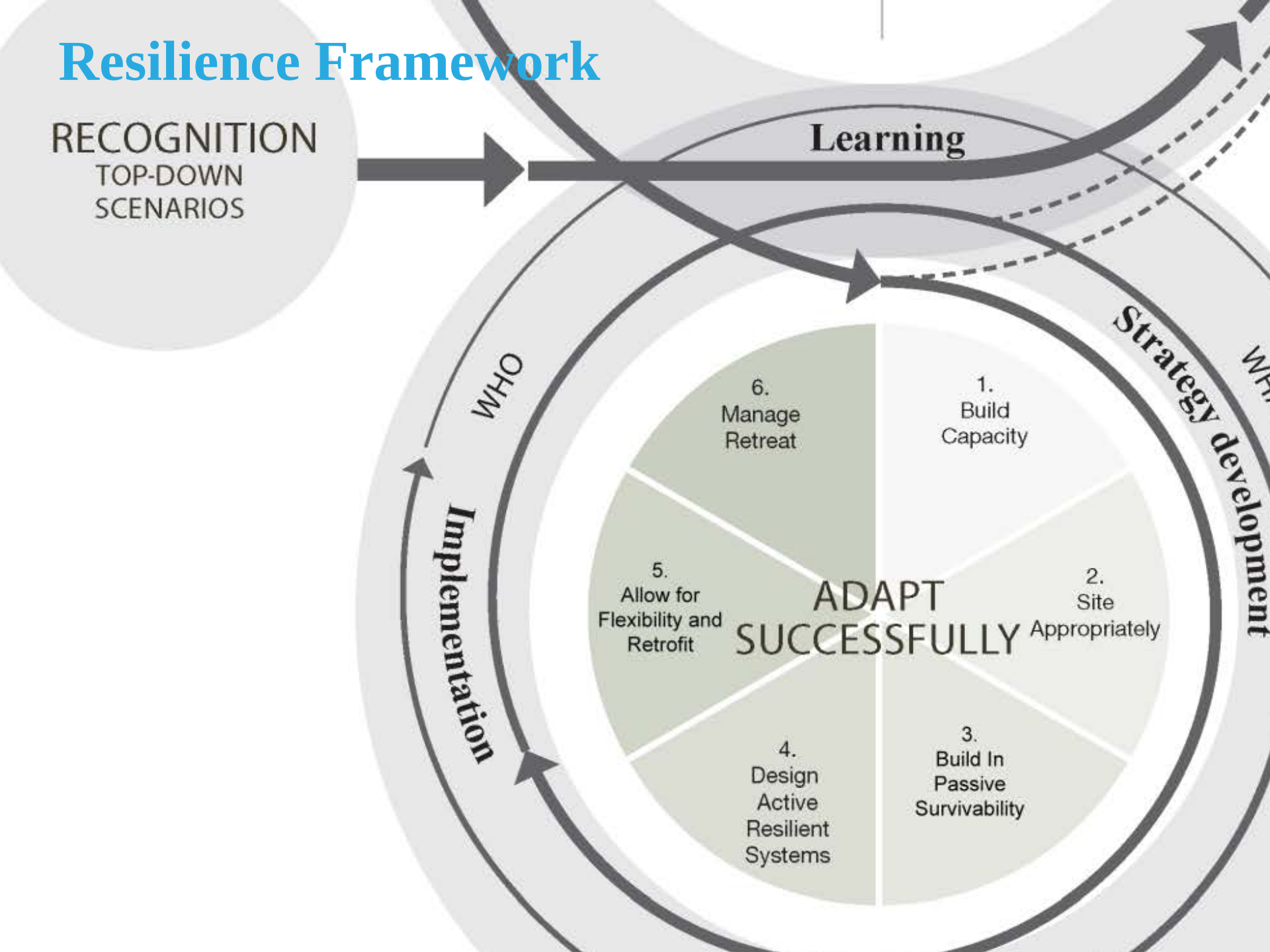
Resilience Framework



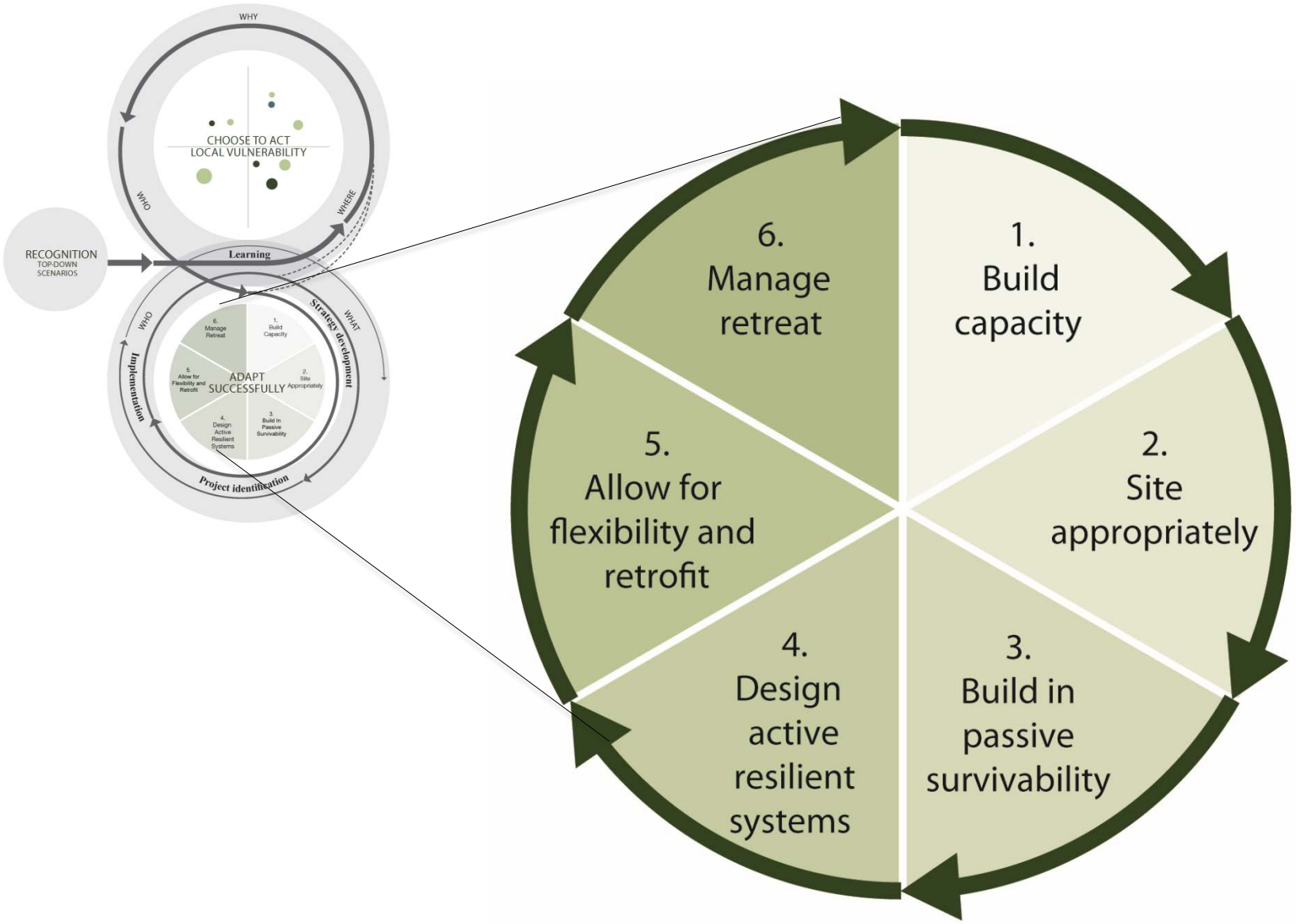
Resilience Framework



Resilience Framework



Act Successfully: Comprehensive + Time Based



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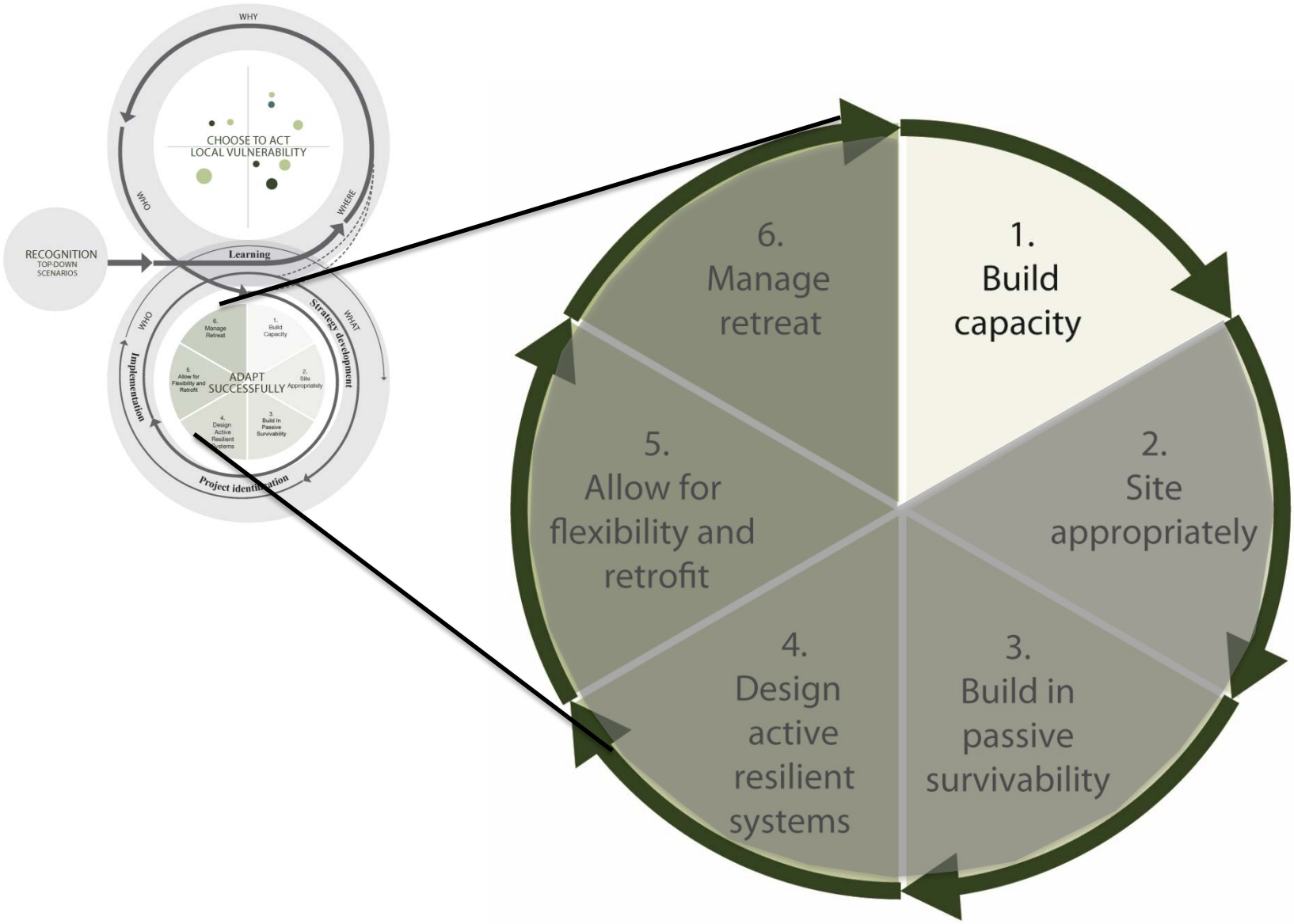
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Katrina – Emergency Response

Climate Resilience Design Guidance

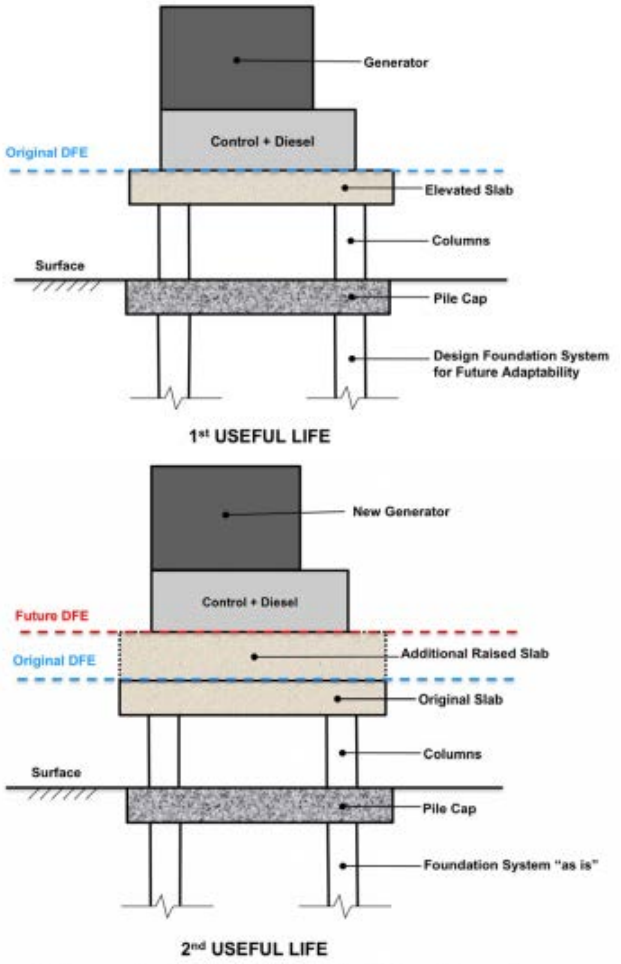
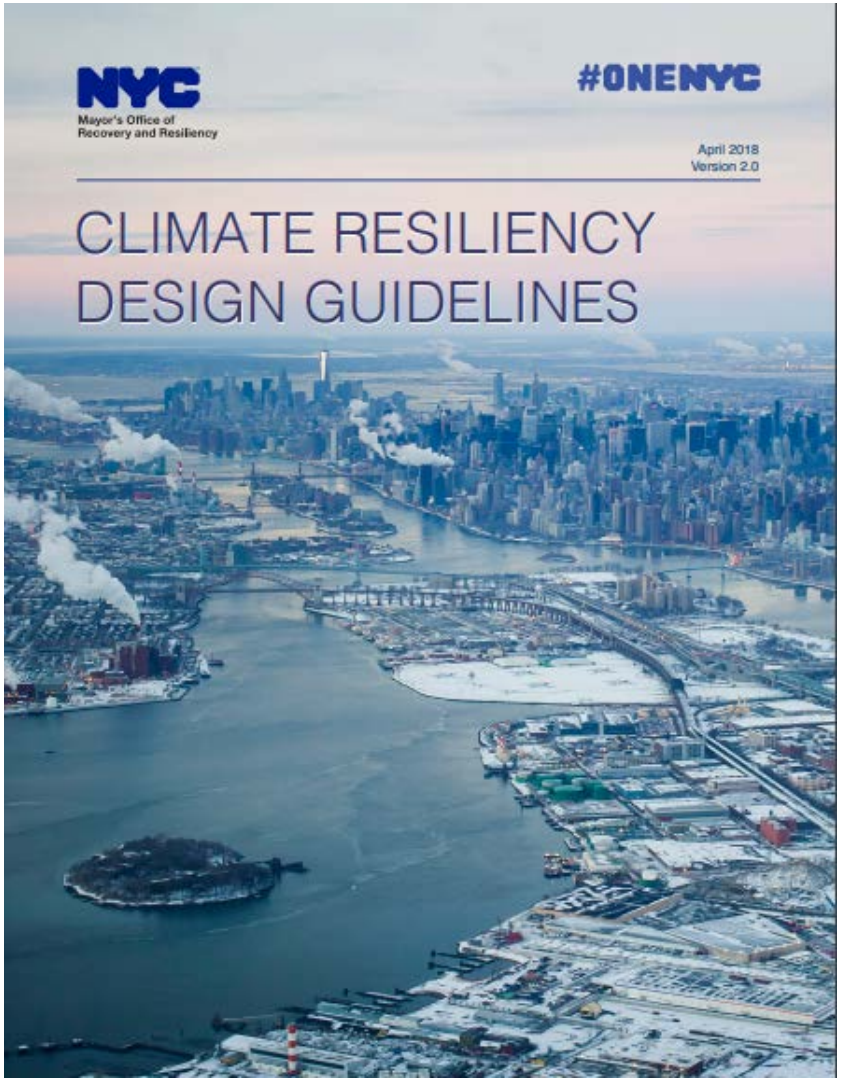


Figure 1 - Example of a flexible adaptation pathway for an outdoor emergency generator and platform



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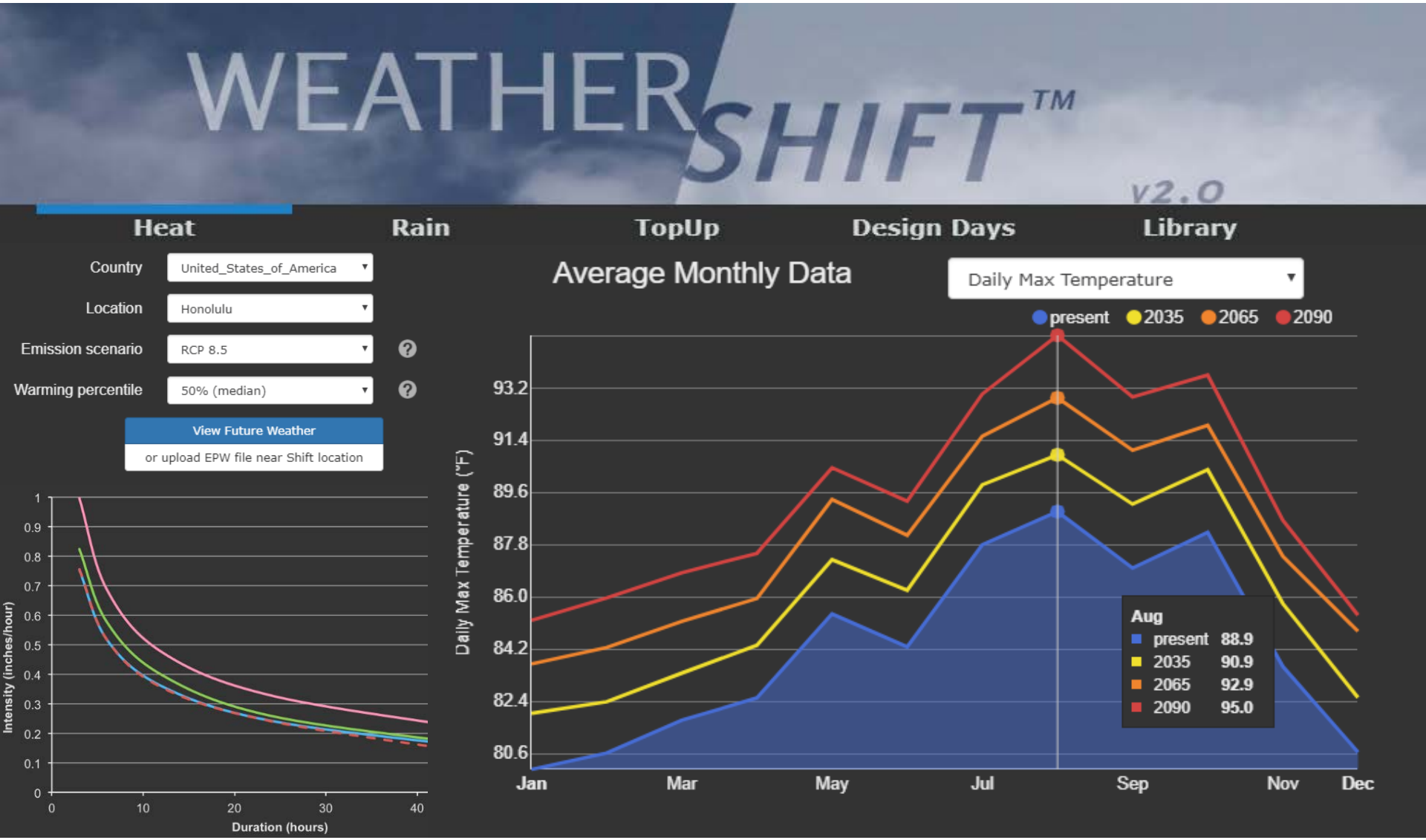
Climate Resilience Design Data



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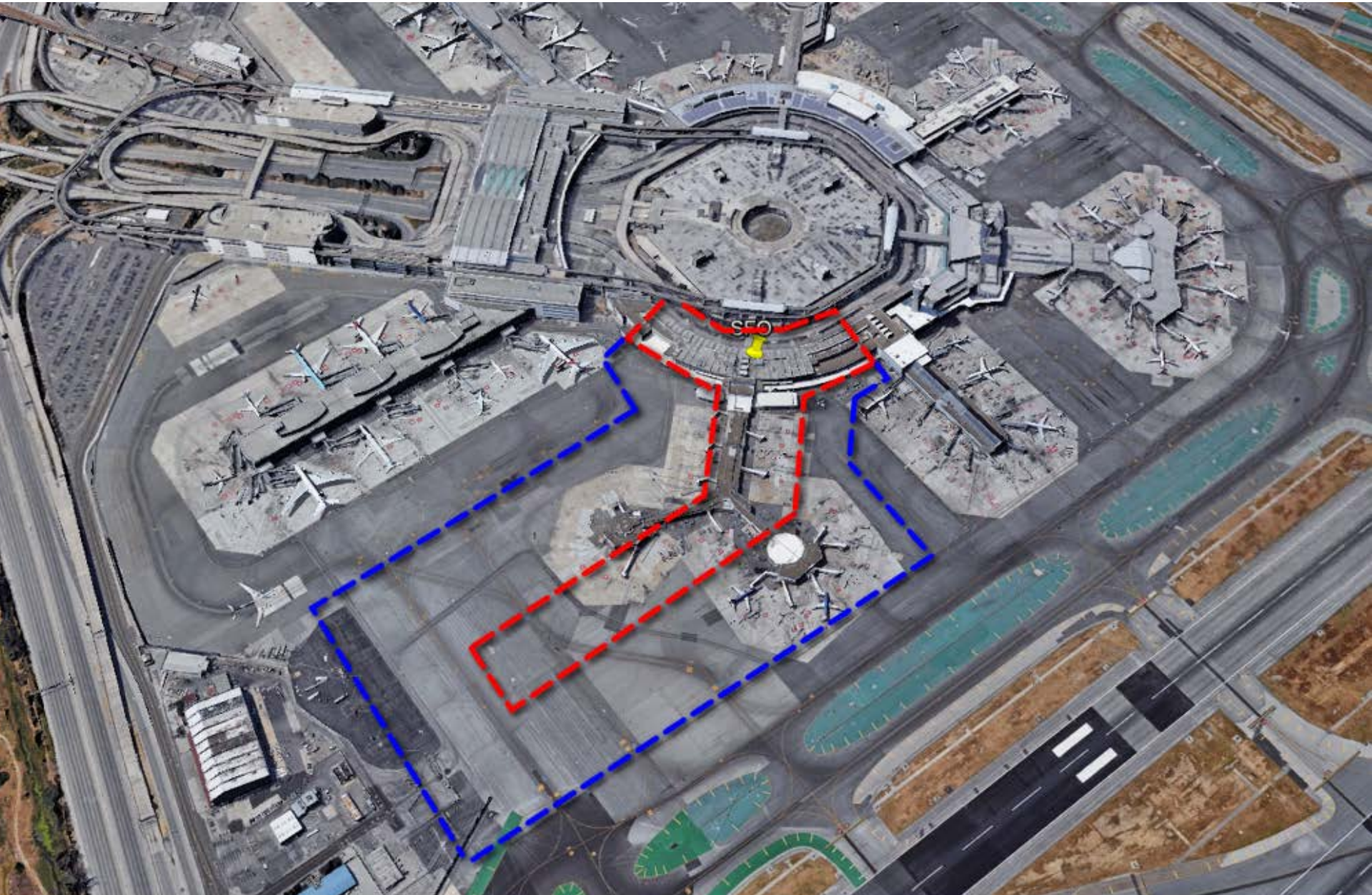
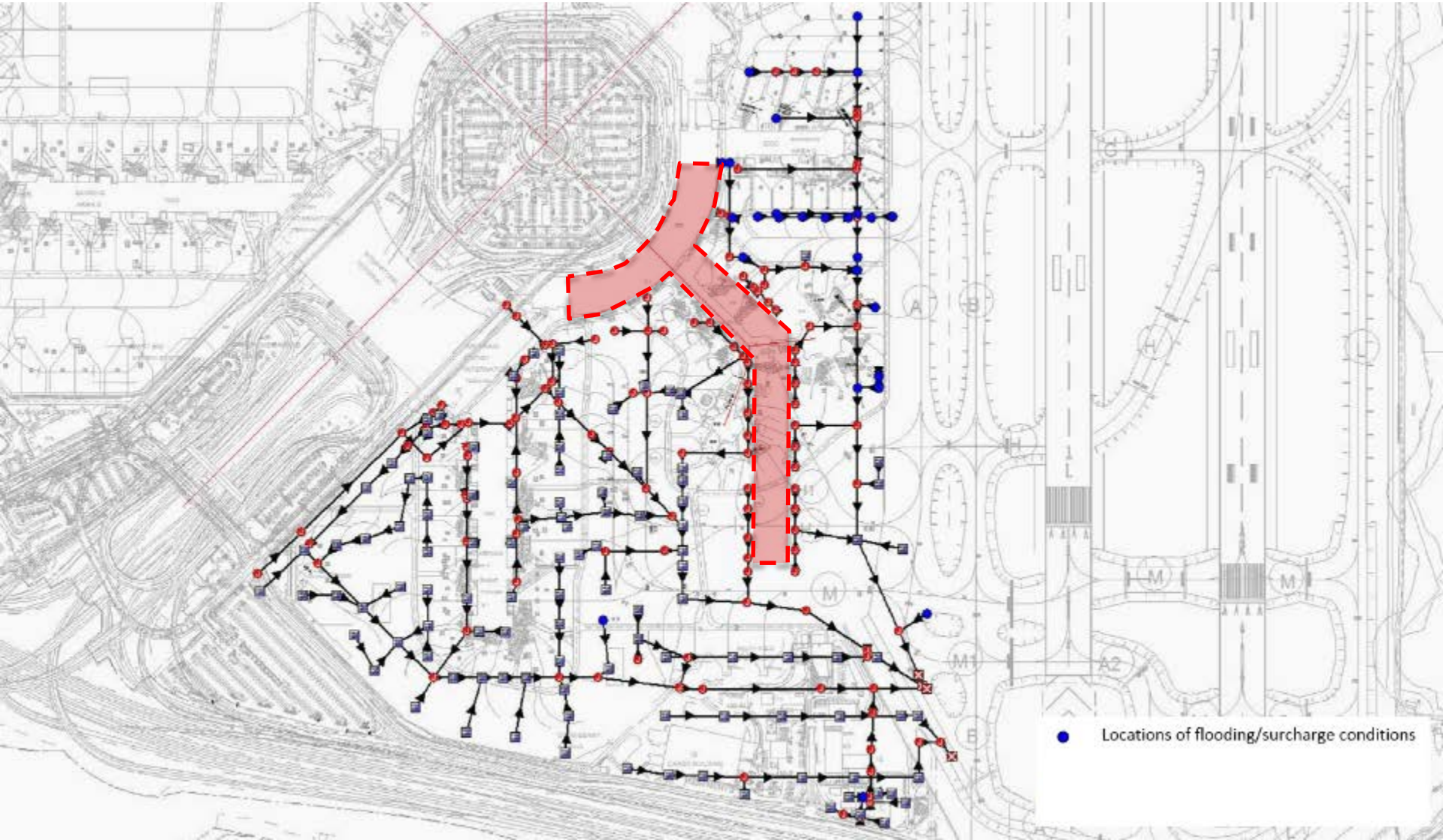
Use case: SFO Terminal 1 Project



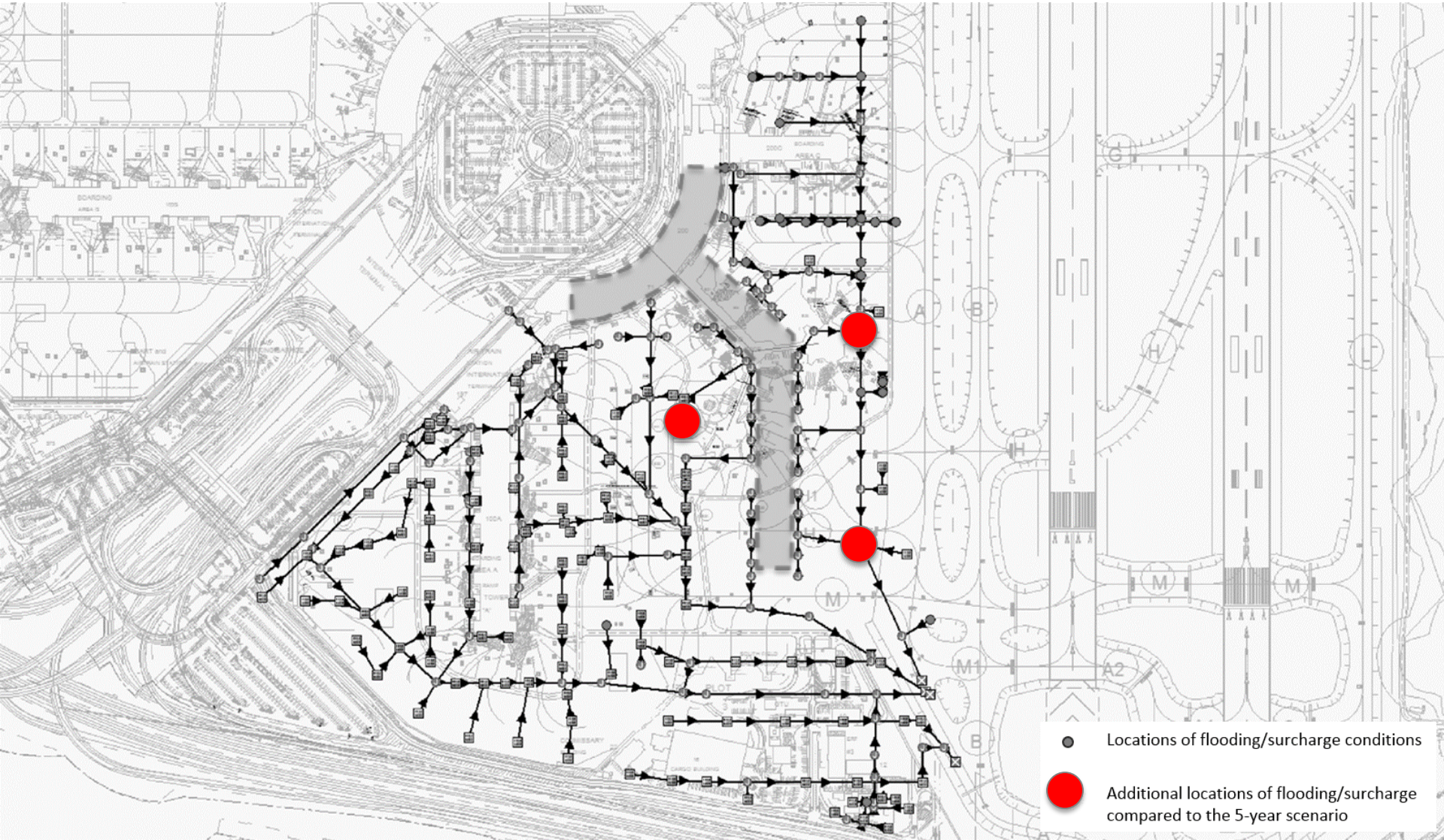
Civil 3D Storm & Sanitary Hydraulic Model

Baseline: 5-Year Design Storm



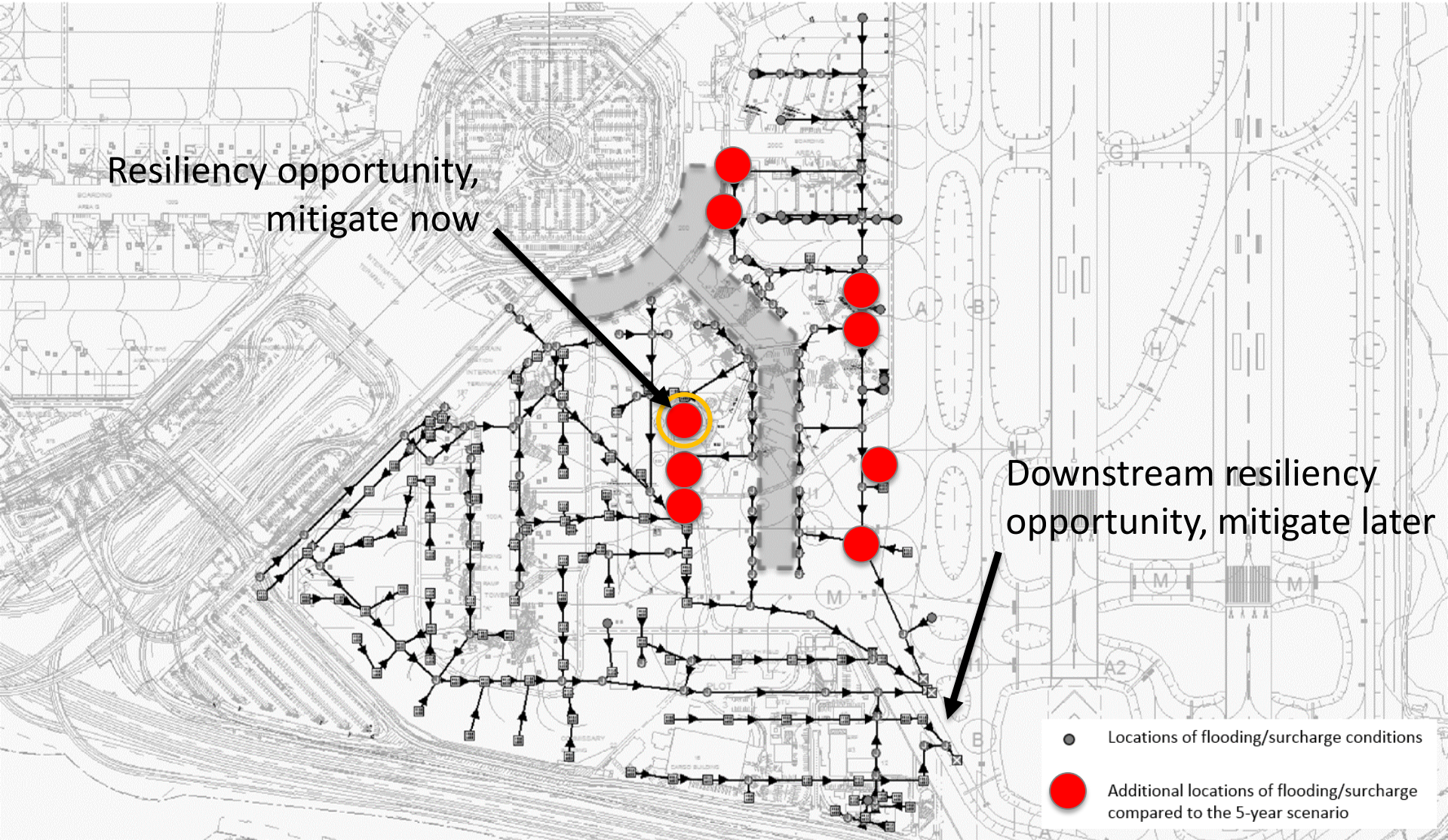
WeatherShift –
50th Percentile High Climate Change Scenario

5-Year Storm at RCP8.5 2090 (~10% more rain)



WeatherShift –
95th Percentile High Climate Change Scenario

5-Year Storm at RCP8.5 2090 (~25% more rain)

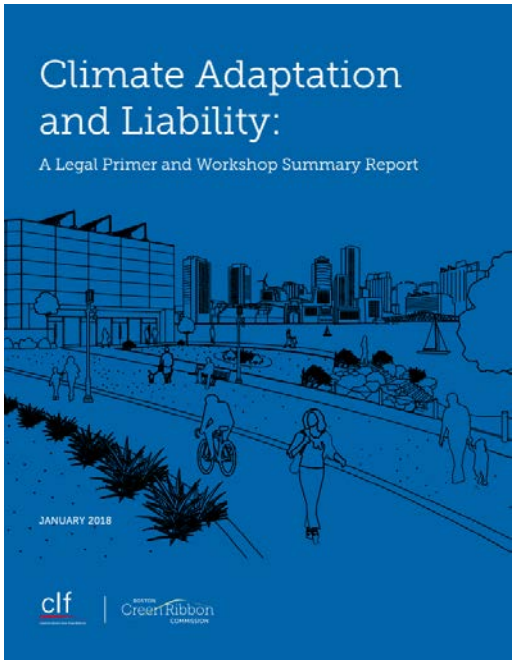


Action has been voluntary. That is changing.

"Failure to act in the face of climate risk could result in legal liability.

…prevailing practices… [and] explicit standards.... are not the only factors that determine legal responsibility for… failing to act reasonably in the face of ascertainable climate risk.

…obligations can be heightened when considerations of public health or safety are at issue.



clf | Conservation Law Foundation

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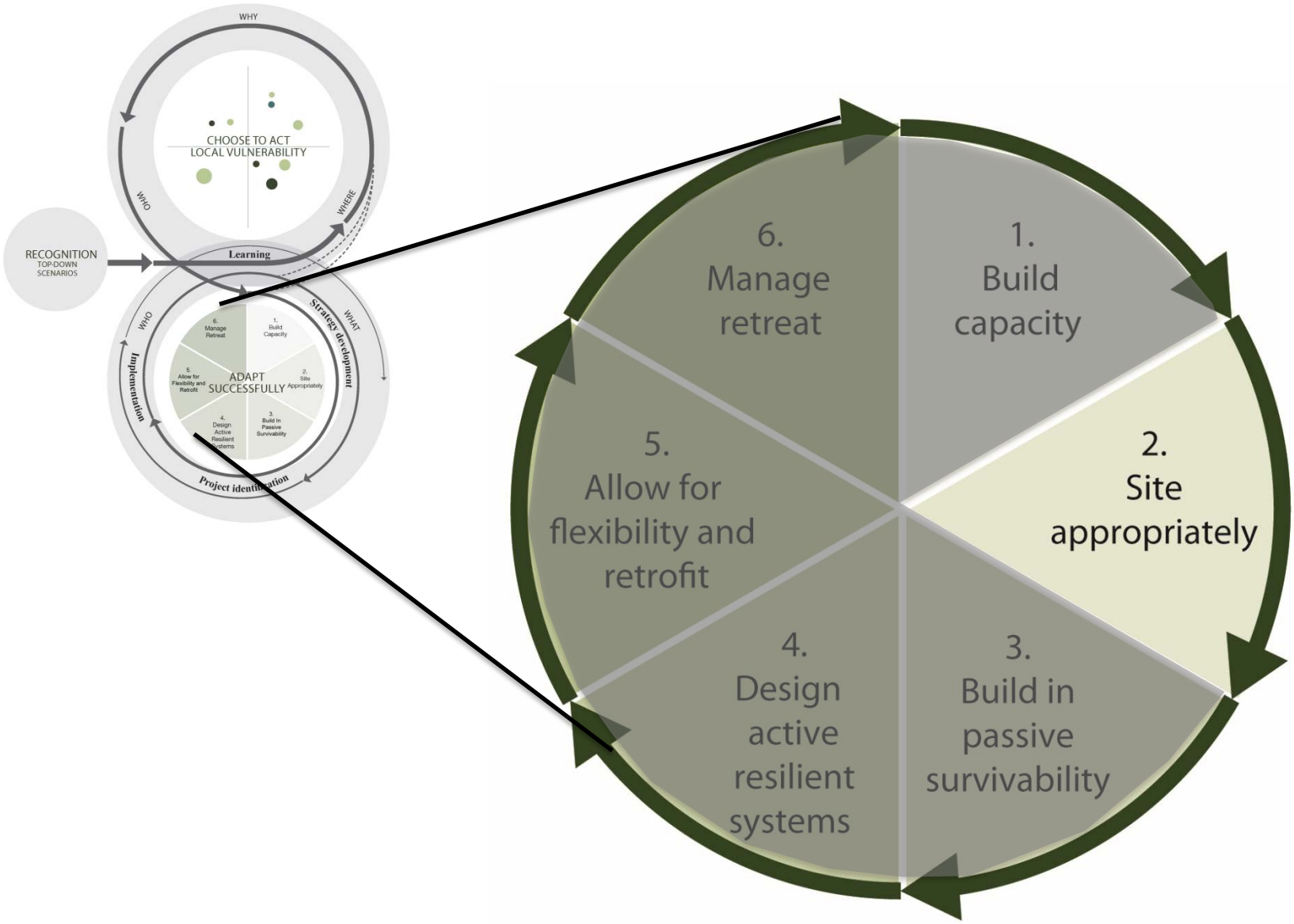
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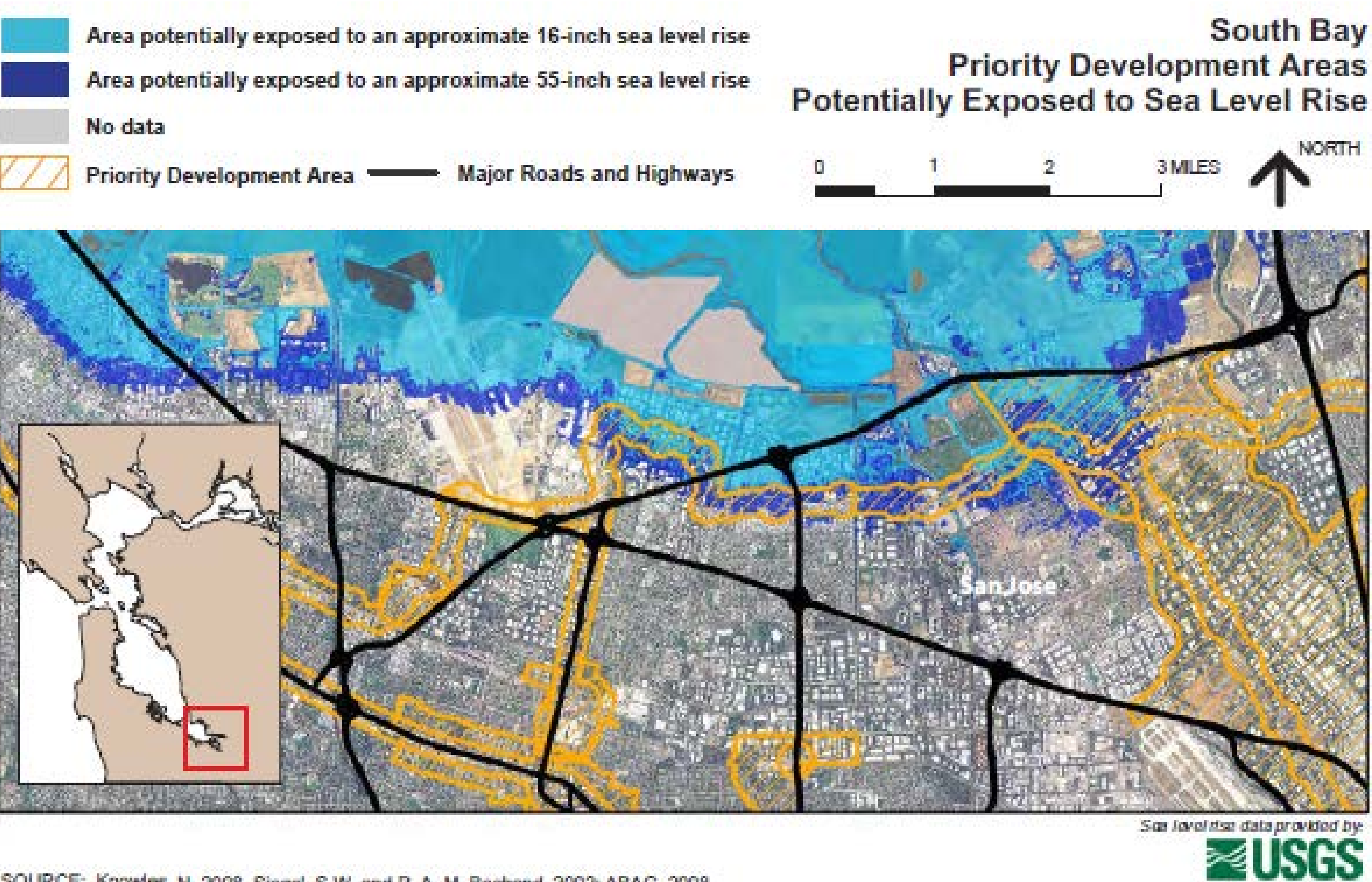
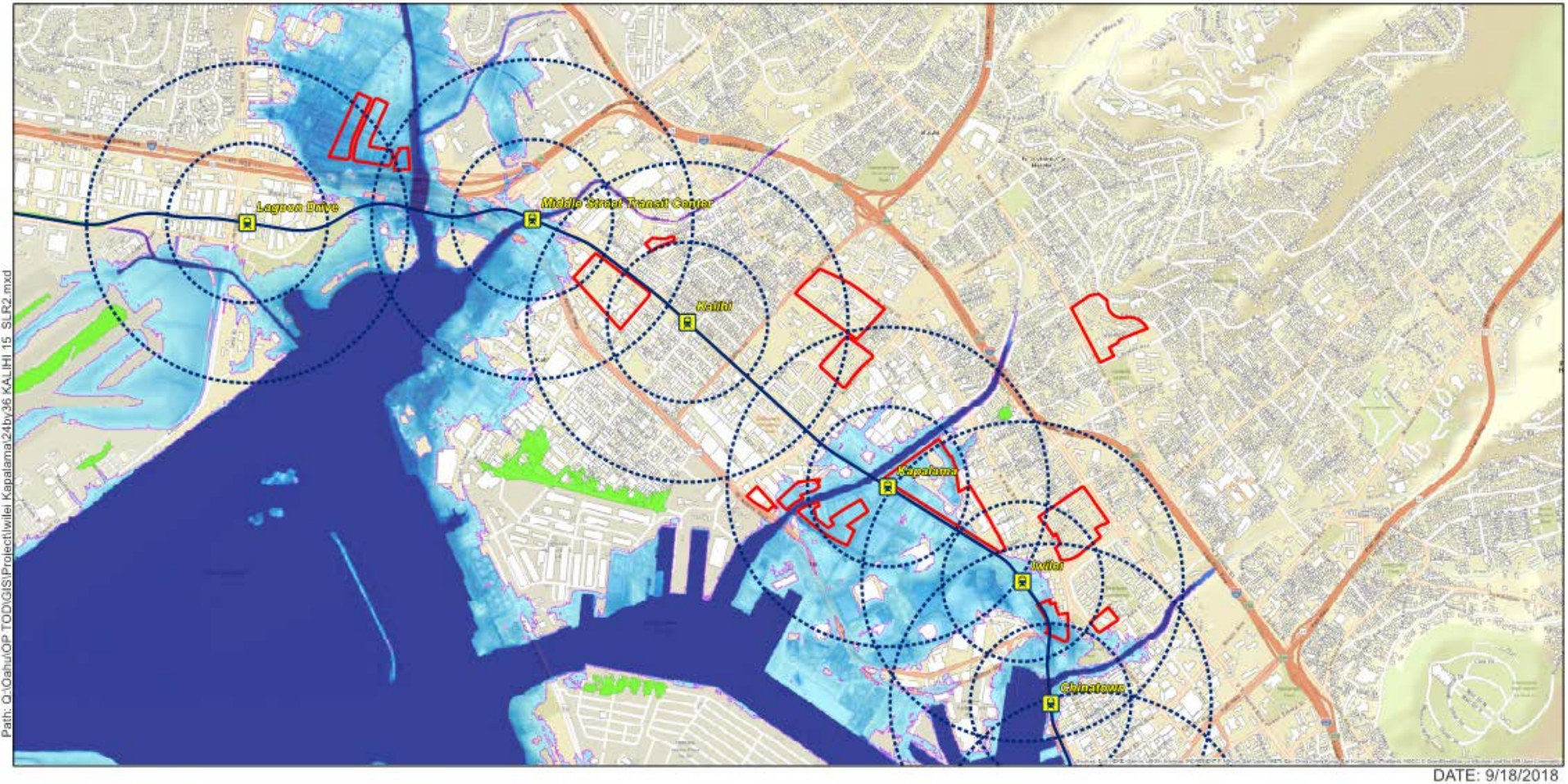
Site Appropriately – Priority Dev. Areas



Site Appropriately – Priority Dev. Areas



Path: Q:\Oahu\OP TOD\GIS\Project\Iwilei Kapalama\24by36 KALIHI 15_SLR2.mxd

DATE: 9/18/2018

LEGEND
- Future Rail Station
- Future Rail Line
- Low-Lying Areas
- Sea Level (~6 ft.)

FIGURE 15 :
Kalihi - Sea Level Rise (~6 ft.)

TOD Station Analysis
OFFICE OF PLANNING — ISLAND OF O'AHU

North

Linear Scale (feet)
0 500 1,000 2,000

PBR HAWAII & ASSOCIATES, INC.

Source: National Oceanic and Atmospheric Administration, 2017. City and County of Honolulu, 2017. ESRI Base Maps, 2016.
Disclaimer: This Graphic has been prepared for general planning purposes only and should not be used for boundary interpretations or other spatial analysis.

De-site – Cheonggyecheon Stream

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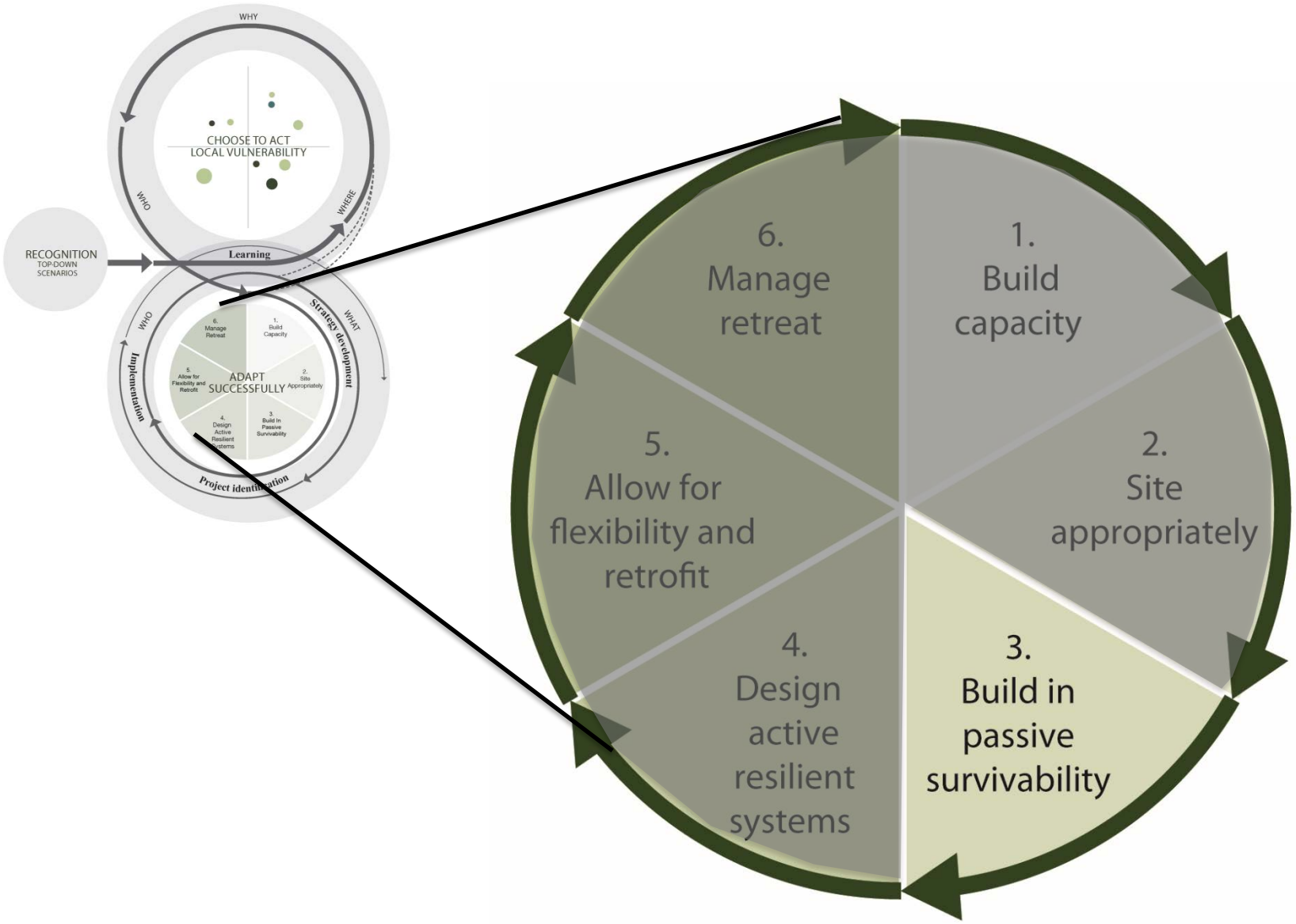
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Water Squares

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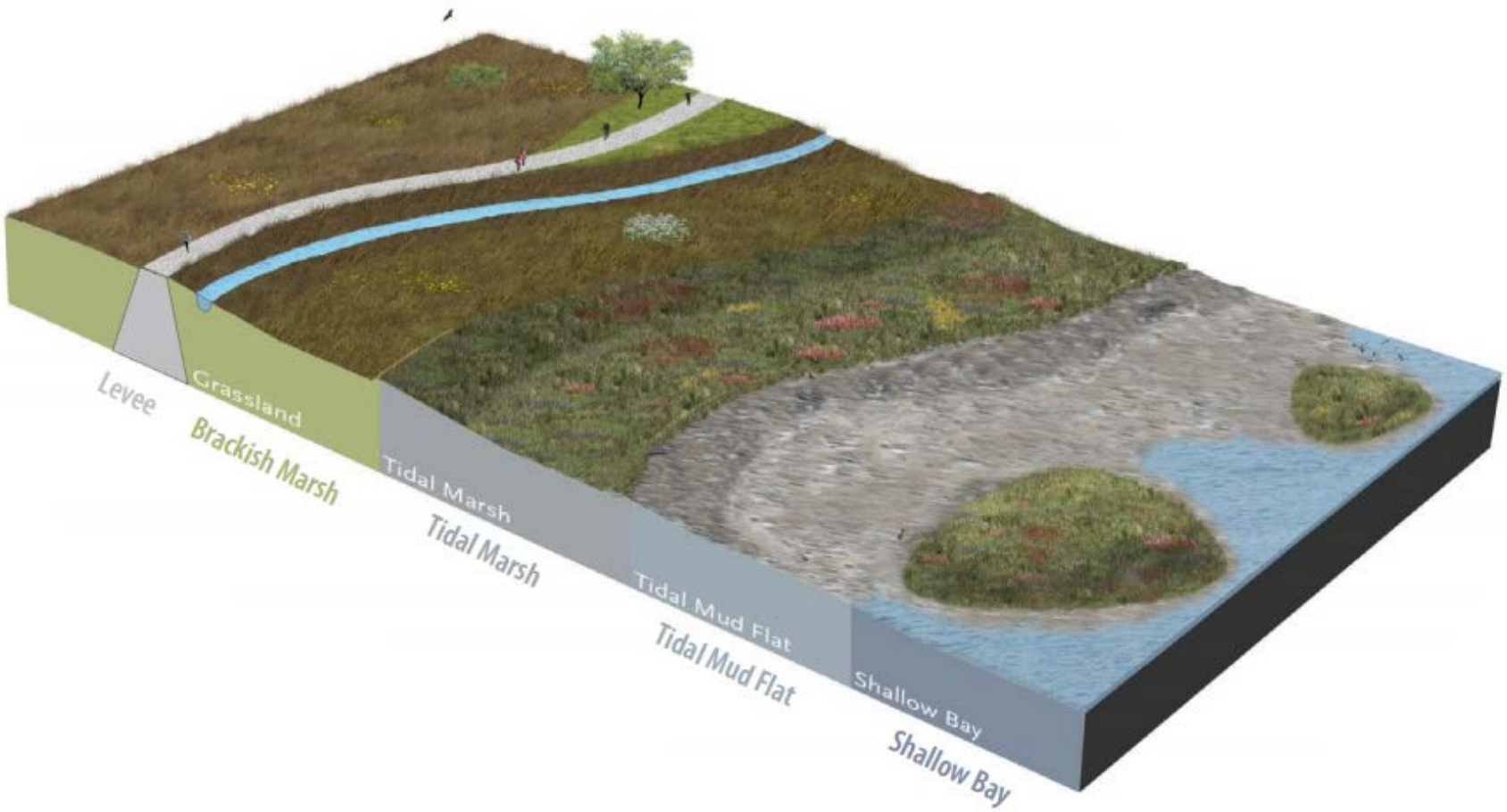
Horizontal Levee



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Shoreline Protection

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Closing off the Creek

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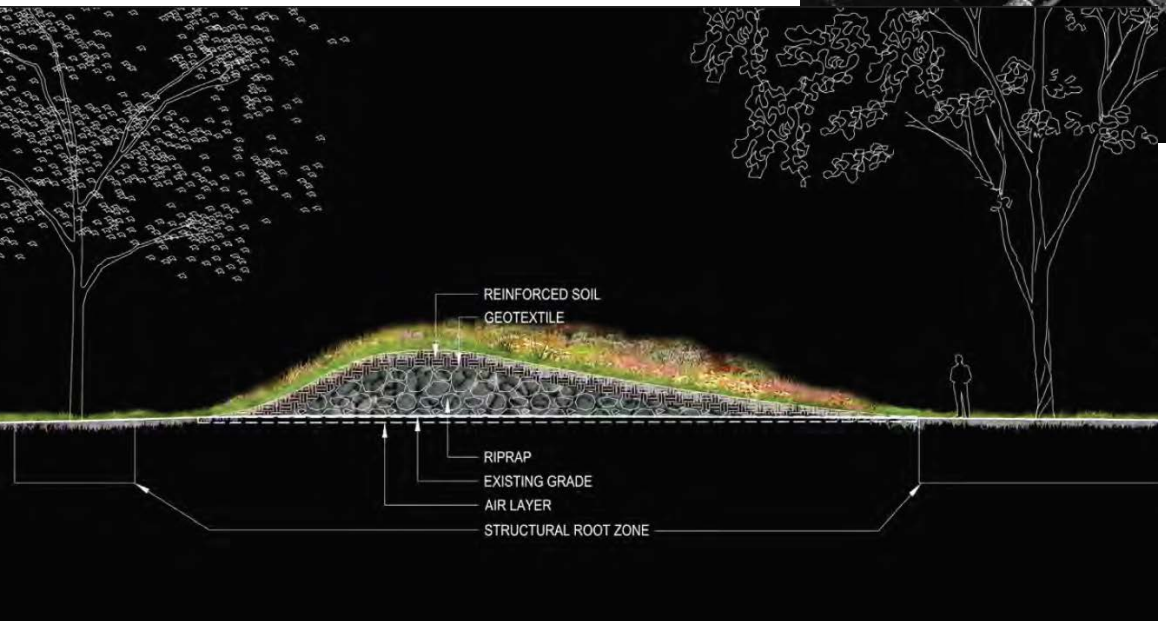
Green Infrastructure - Berms



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Spaulding Rehabilitation Hospital

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Elevating Structures

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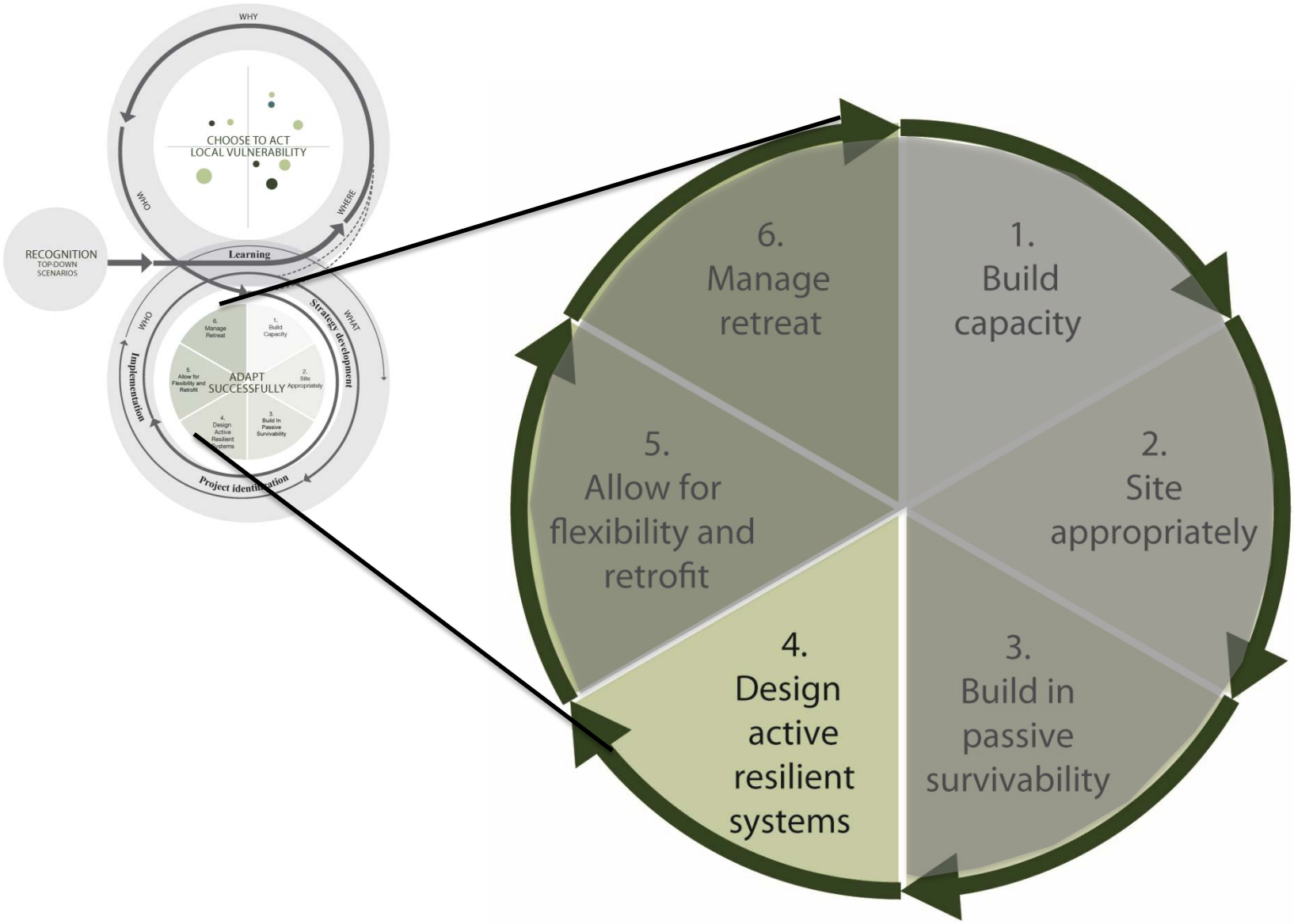
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Step 4 - Active Resiliency?

Before

After

ConEdison, inc.

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Deployable Flood Curtains

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Temporary Flood Barriers for Tunnels

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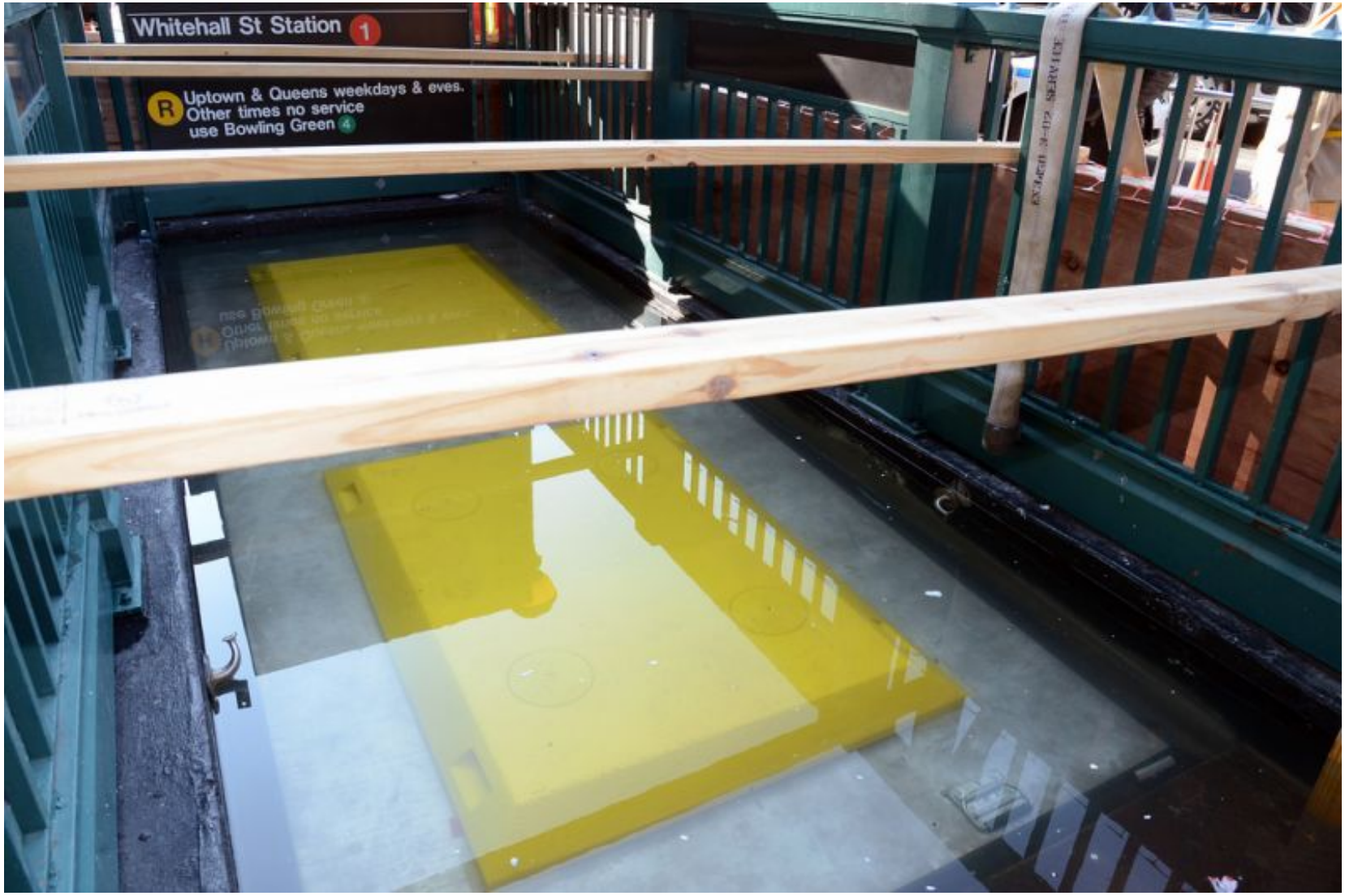
Temporary Flood Barriers



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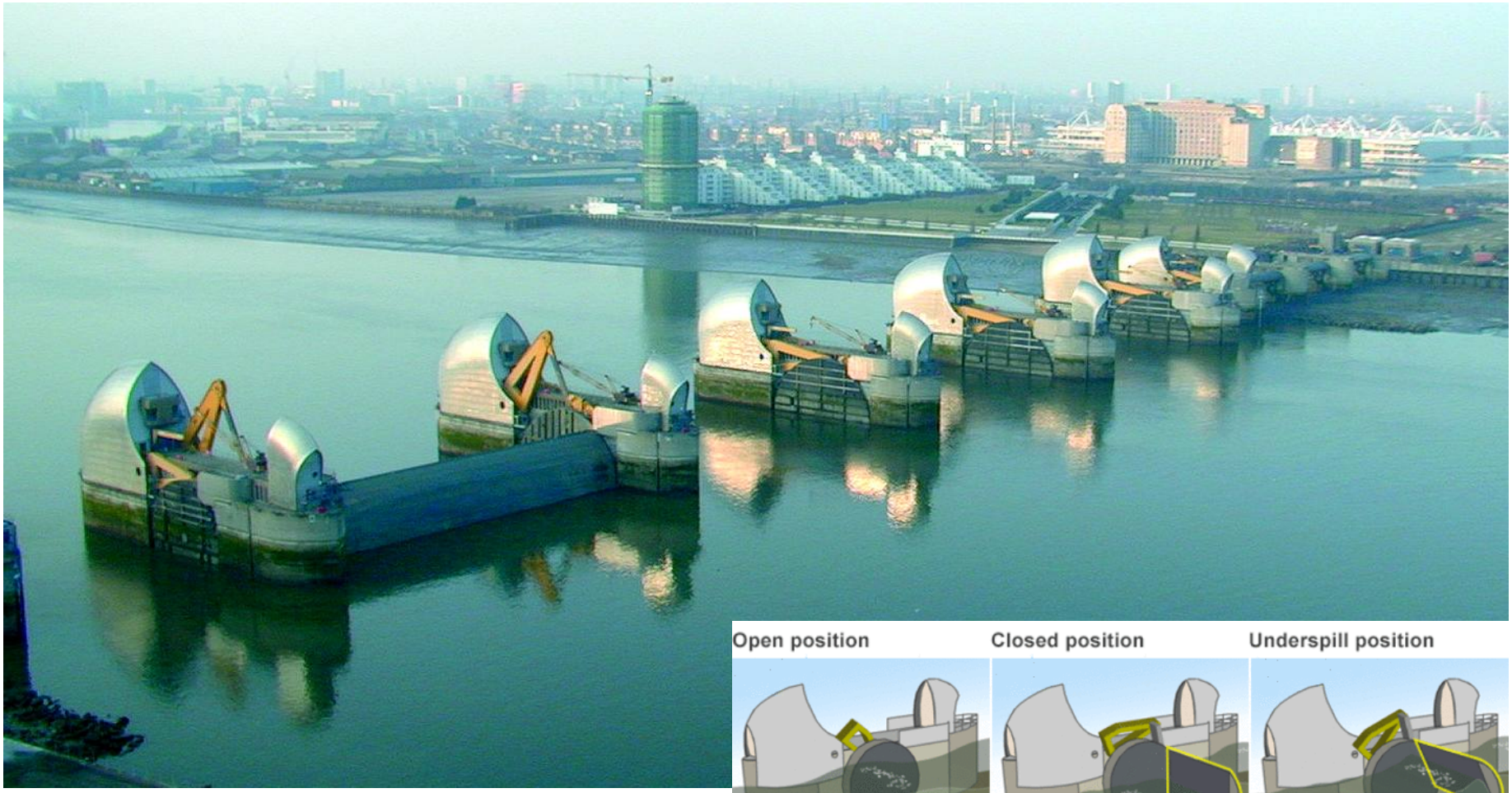
Tidal Barriers



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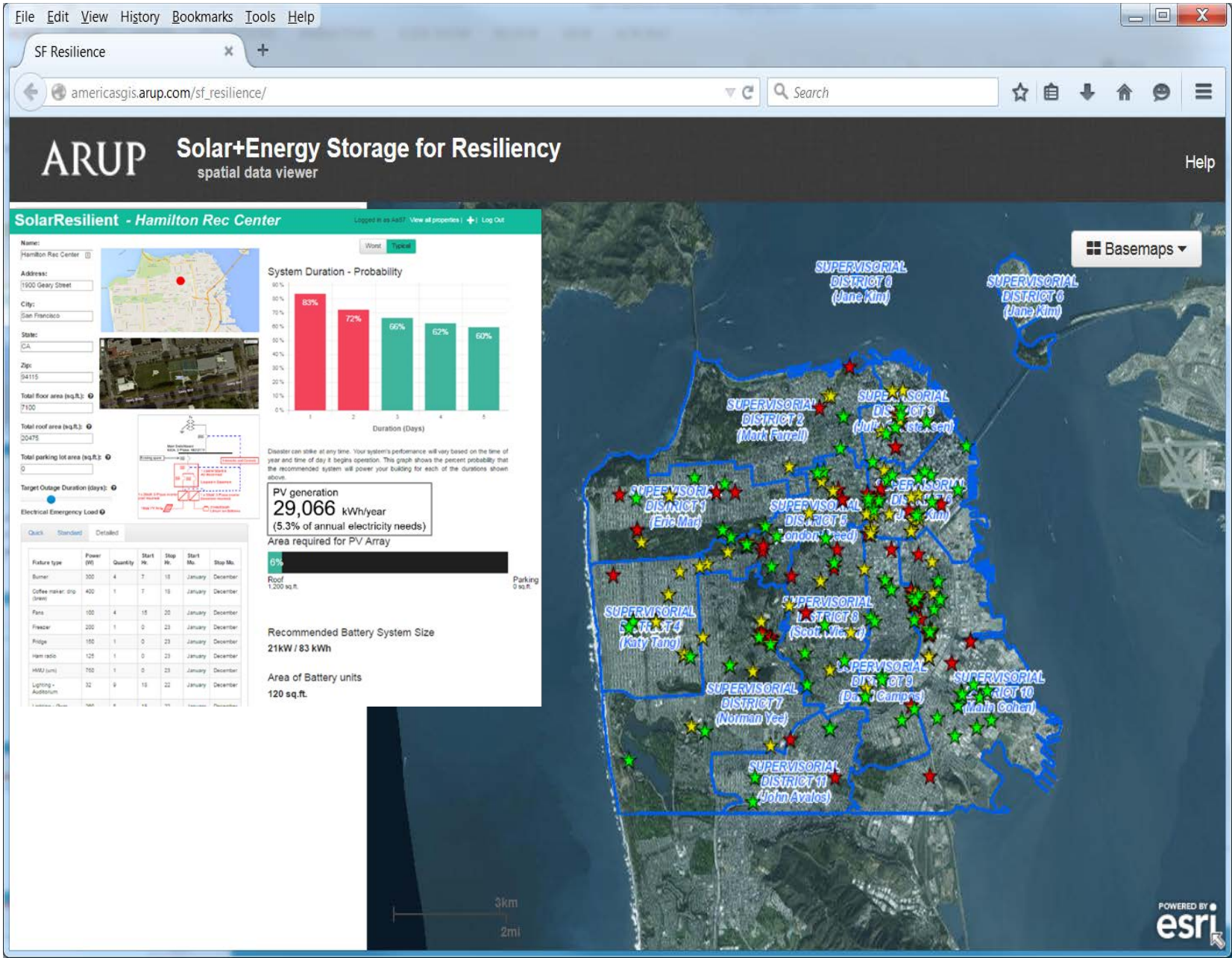
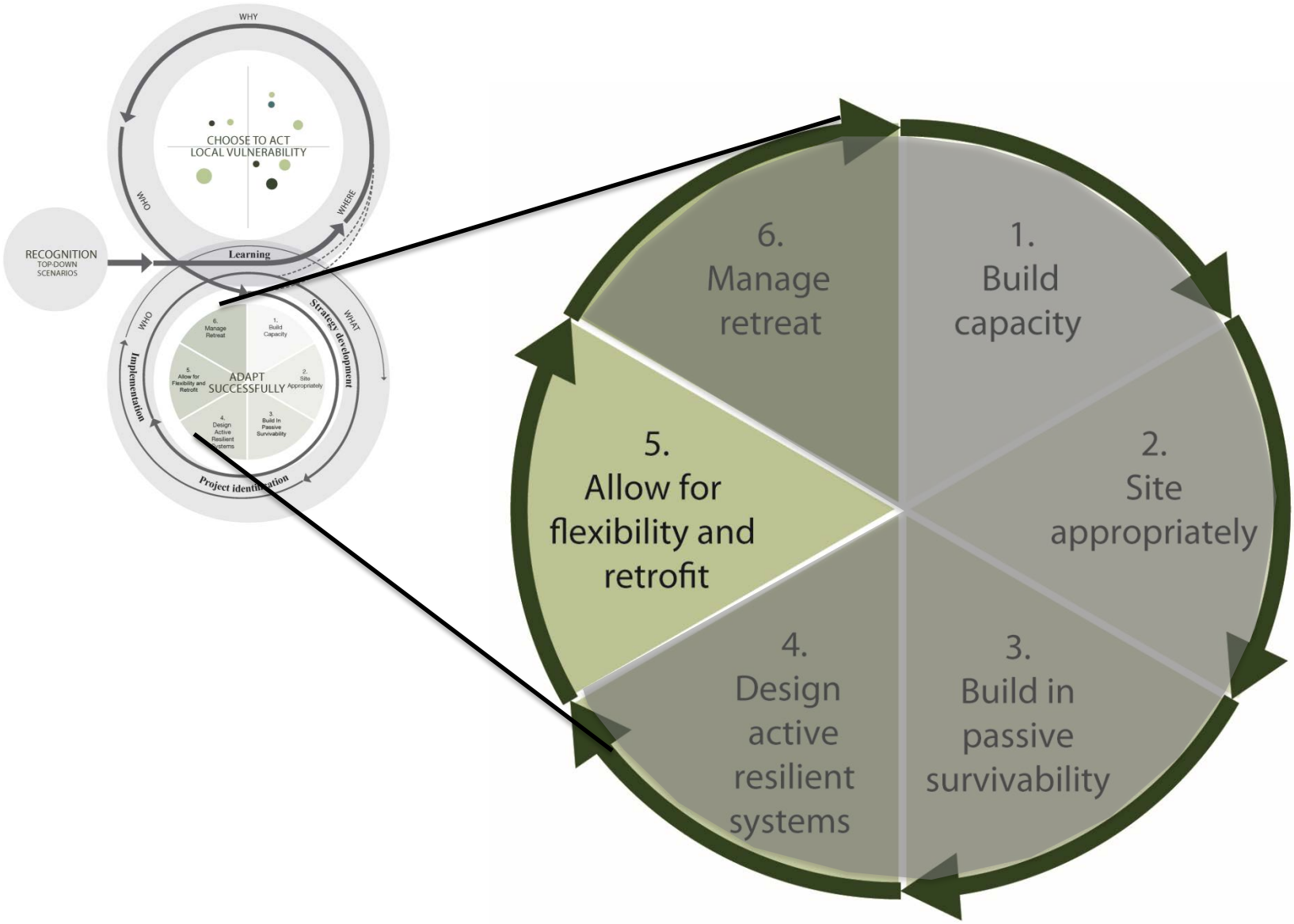
SolarResilientTM

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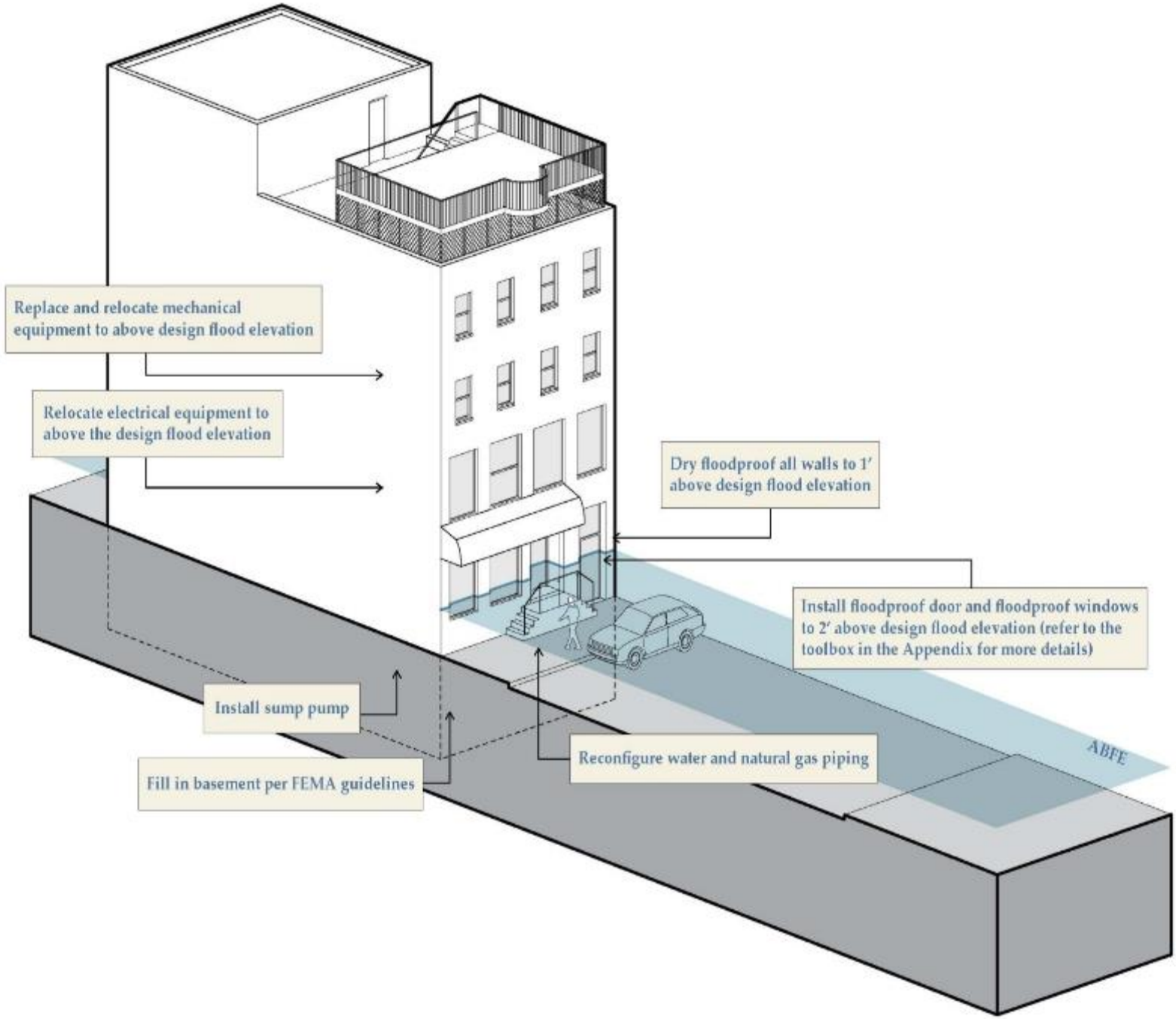

Tsunami House

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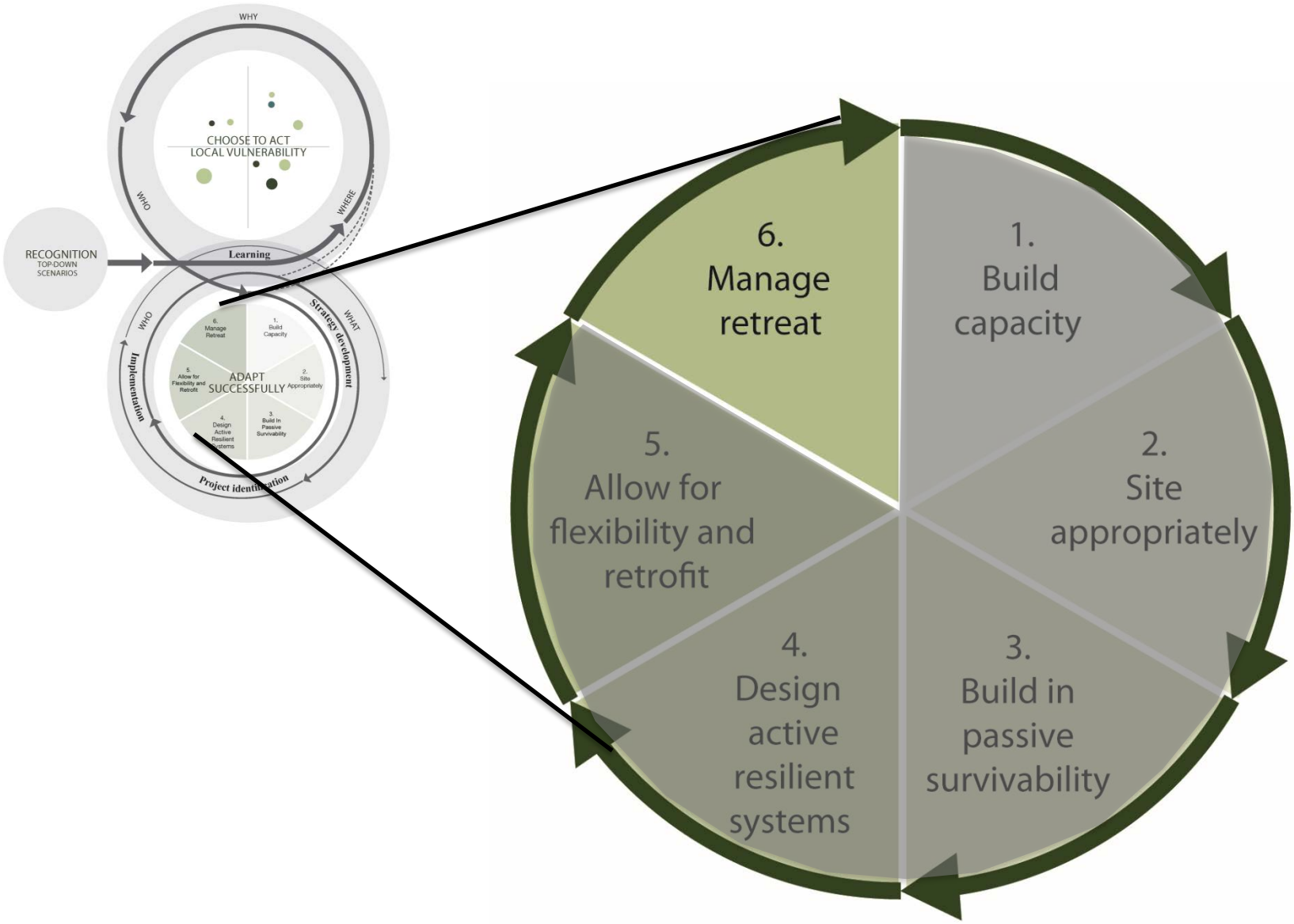
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Room for the River

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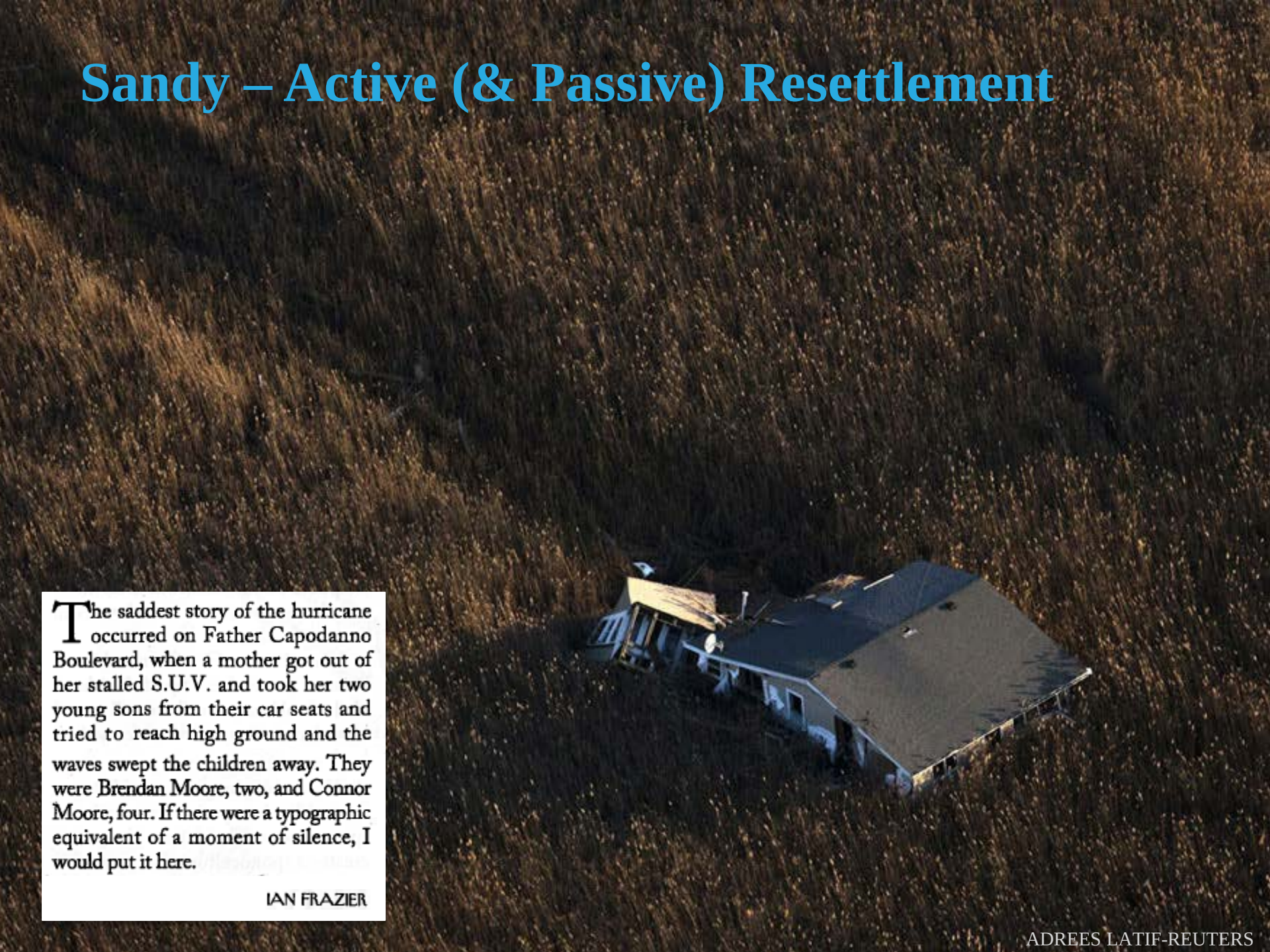
Sandy – Active (& Passive) Resettlement

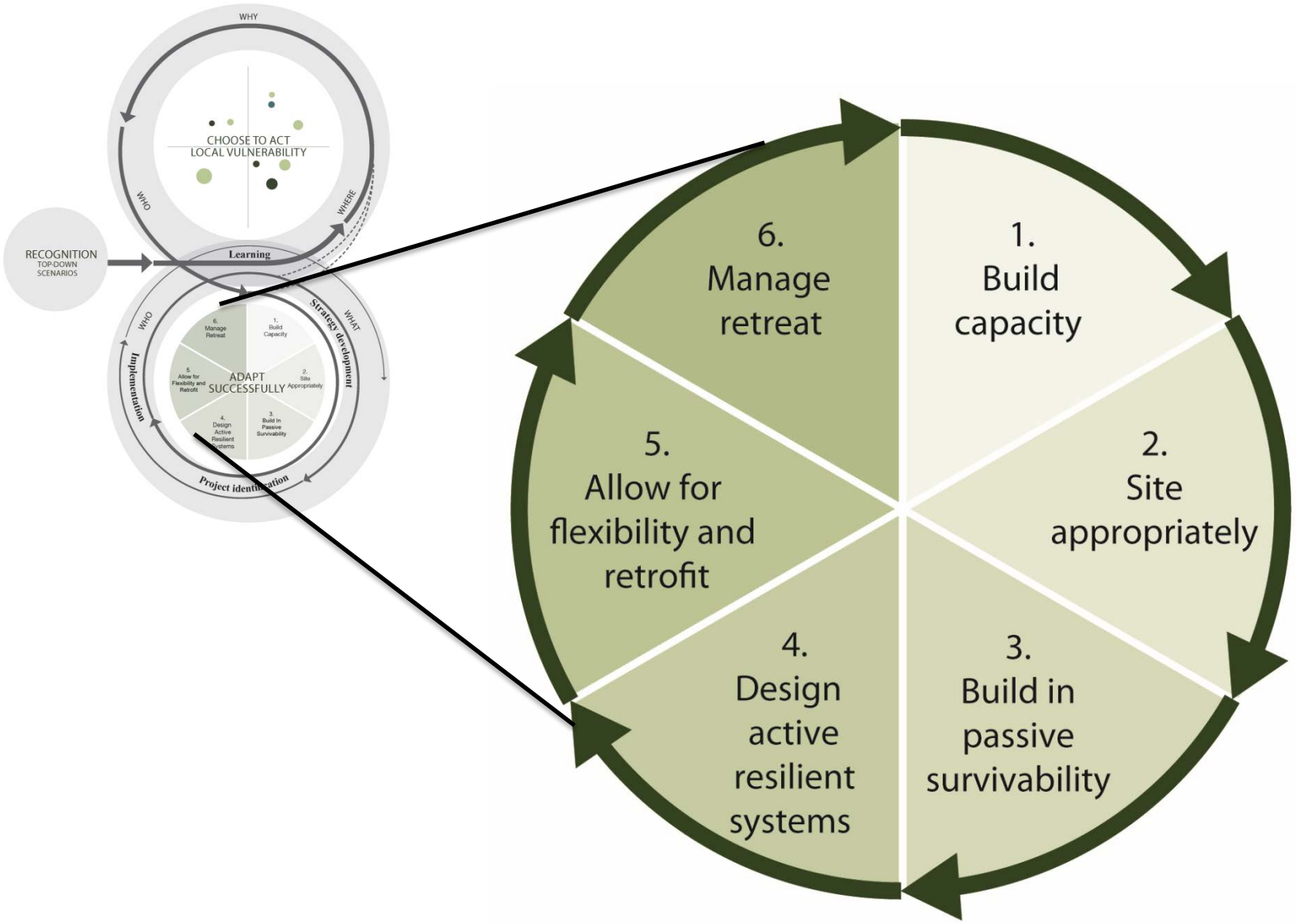


The saddest story of the hurricane occurred on Father Capodanno Boulevard, when a mother got out of her stalled S.U.V. and took her two young sons from their car seats and tried to reach high ground and the waves swept the children away. They were Brendan Moore, two, and Connor Moore, four. If there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

IAN FRAZIER

ADREES LATIF-REUTERS

Act Successfully: Comprehensive + Time Based



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“If we don’t plant the trees of the future, we have no right to stand
in the shade of the trees borne of the past.”
Argentine Baptist Minister, GCAS Quote 2018
Cole Roberts, PE, LEED AP
cole.roberts@arup.com
415-946-0287
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