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Focus of resilience within Building Rating Systems (BRS) LEED 4.0 Review

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Session TU2A: Are We Resilient and
Sustainable? Evaluation to Make the Case

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Course Description

Green Building Rating Systems (BRS) such as LEED aim to alleviate the impacts of the built environment on the ecosystem. At the same time, the effects of the altering climate and recent natural disasters on the built environment, including green buildings, cannot be ignored. The presenter will discuss the goal of a study to ascertain the focus of resilience within the LEED rating system to natural hazards. For the study, the team initially identified 27 disaster types, and of those, shortlisted 14 disaster types. Two filters used to shortlist initially identified disasters: disaster type being natural, and relevance of disaster types to the built environment. The 14 shortlisted disasters were: drought, earthquake, extreme temperatures, fire, flooding, hurricane, severe storm, snow storm, straight-line winds, tornadoes, tsunamis, typhoon and winter storm. After shortlisting the disasters, the team used LEED NC V4.0 as a baseline document to analyze how credit requirements within LEED V4.0 enhance building resilience towards the identified disasters. After completing the mapping for each LEED credit to the disasters, the team subjected the results of the mapping to expert reviews. The researchers were also able to identify gaps within the BRS.





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Overview

- Research Purpose
- Background
- Research Question
- Methodology
- Results
- Conclusion



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Purpose of Research

For LEED V4.0

- Ascertain the focus LEED V4.0, at a generalized level, towards enhancing building resilience against identified natural disasters
- Identify credits/prerequisites that enhance building resilience against identified natural disasters



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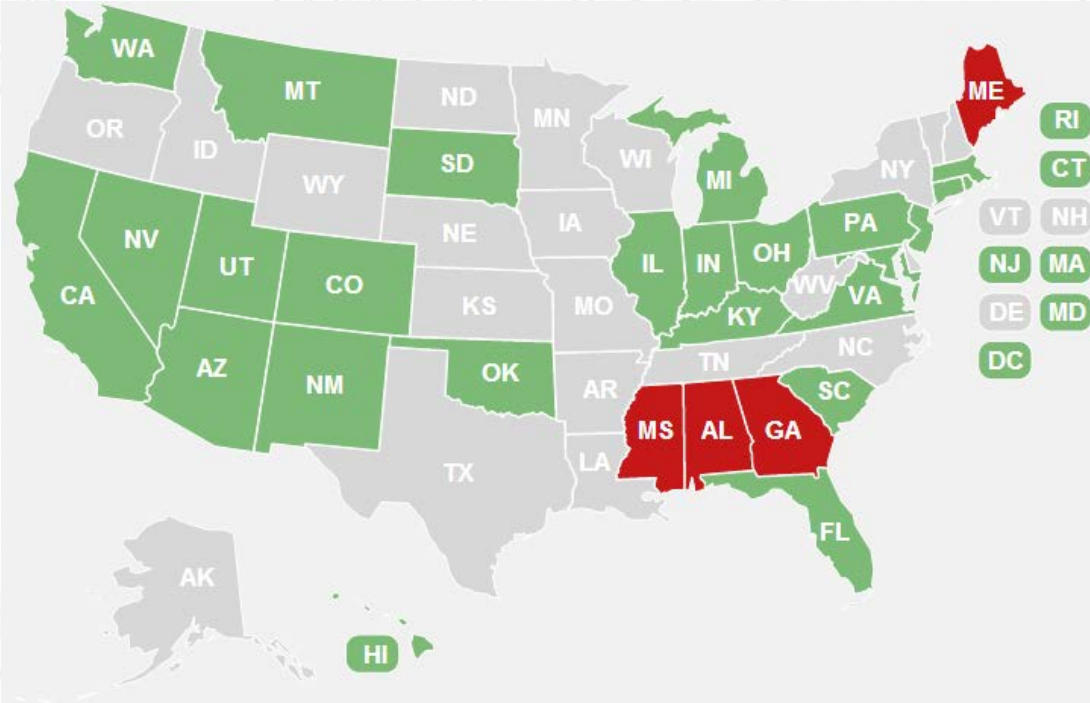
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Background

- Agencies/Cities encouraging/ mandating LEED

Certification:

- GSA
- Phoenix, AZ
- Sacramento, CA
- San Diego, CA
- San Jose, CA
- Denver, CO
- Stamford, CO
- San Francisco, CA



(<https://www.gsa.gov/node/78234>; <http://constructiondatacompany.com/map-of-states-with-leed-certification-requirements/#!prettyPhoto>)

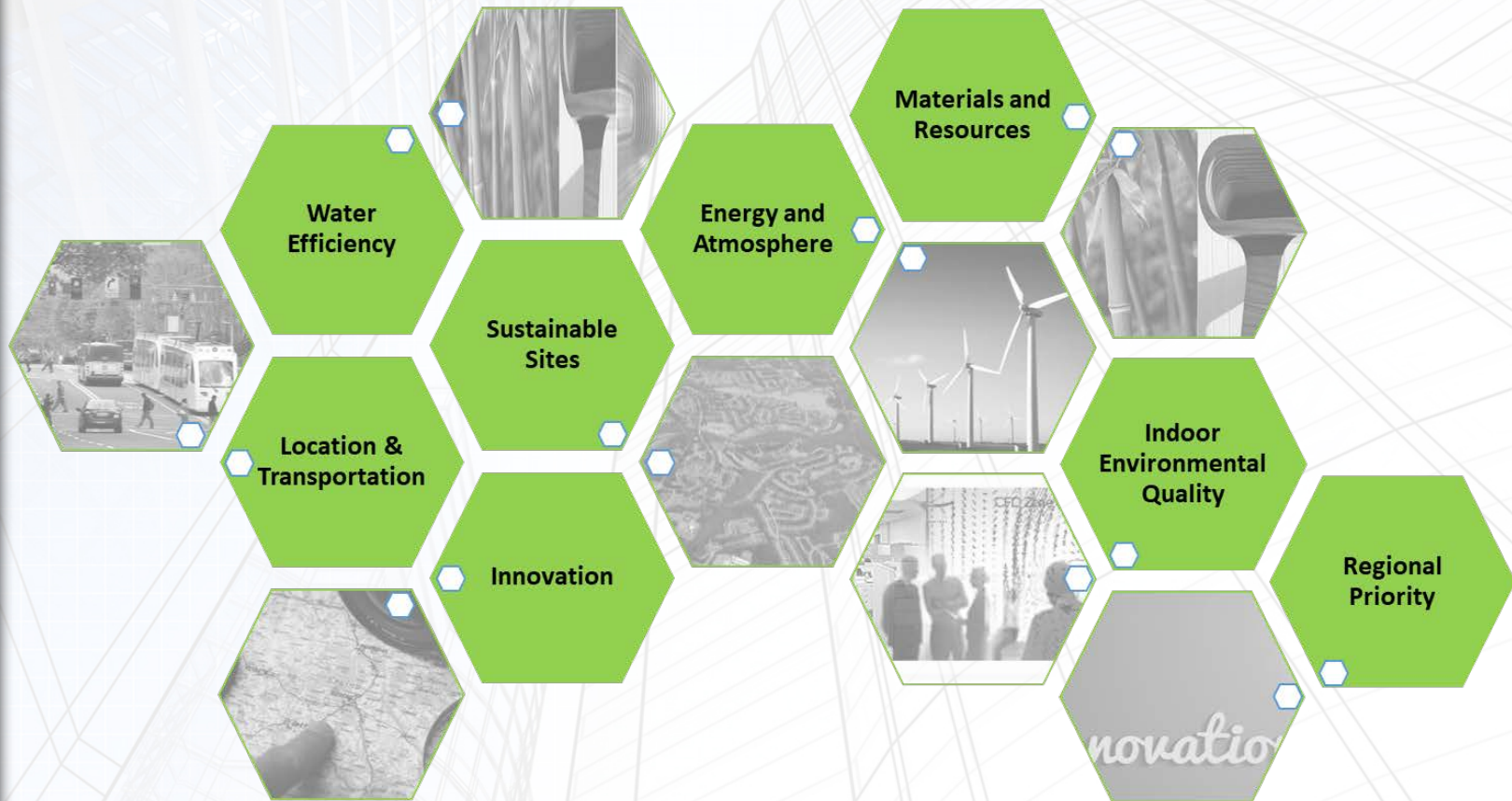


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Background- LEED V4.0





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Climate change impact

- IPCC indicates that change in global climate is resulting in elevated temperatures:
 - Rising sea level
 - Heavier precipitation & storms
 - Tornadoes
 - Hurricanes
 - Cyclones
 - Additional heatwaves
 - Extreme temperatures

(Younger et al., 2008)



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Climate change impact

- NOAA'S National Climatic Data Center indicates climate events resulted in a loss of at least \$1 billion in overall damages (Lott & Ross, 2015)

- Between 1995 and 2014:
 - 15,000 extreme weather events
 - 525,000 Casualties
 - 3.0 Trillion USD losses

(Source: CNN 2016; NOAA 2016; Kreft, Eckstein, Dorsch, & Fischer, 2015)





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Natural Disaster Impact 2016

- For 2016, severe weather impacted 27 states, resulting in a loss of 27 Billion US
- Residential structures incurred a loss of 4 Billion USD, in Louisiana
- Damages worth \$1.5 Billion USD to facilities across North Carolina



(Source: NOAA 2016; Terrell 2016; CBS 2016)



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Natural Disasters- 2017

U.S. 2017 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the 15 billion-dollar weather and climate disasters that have impacted the United States January through September of 2017, a record pace.

(Source: <https://www.ncdc.noaa.gov/billions/>)



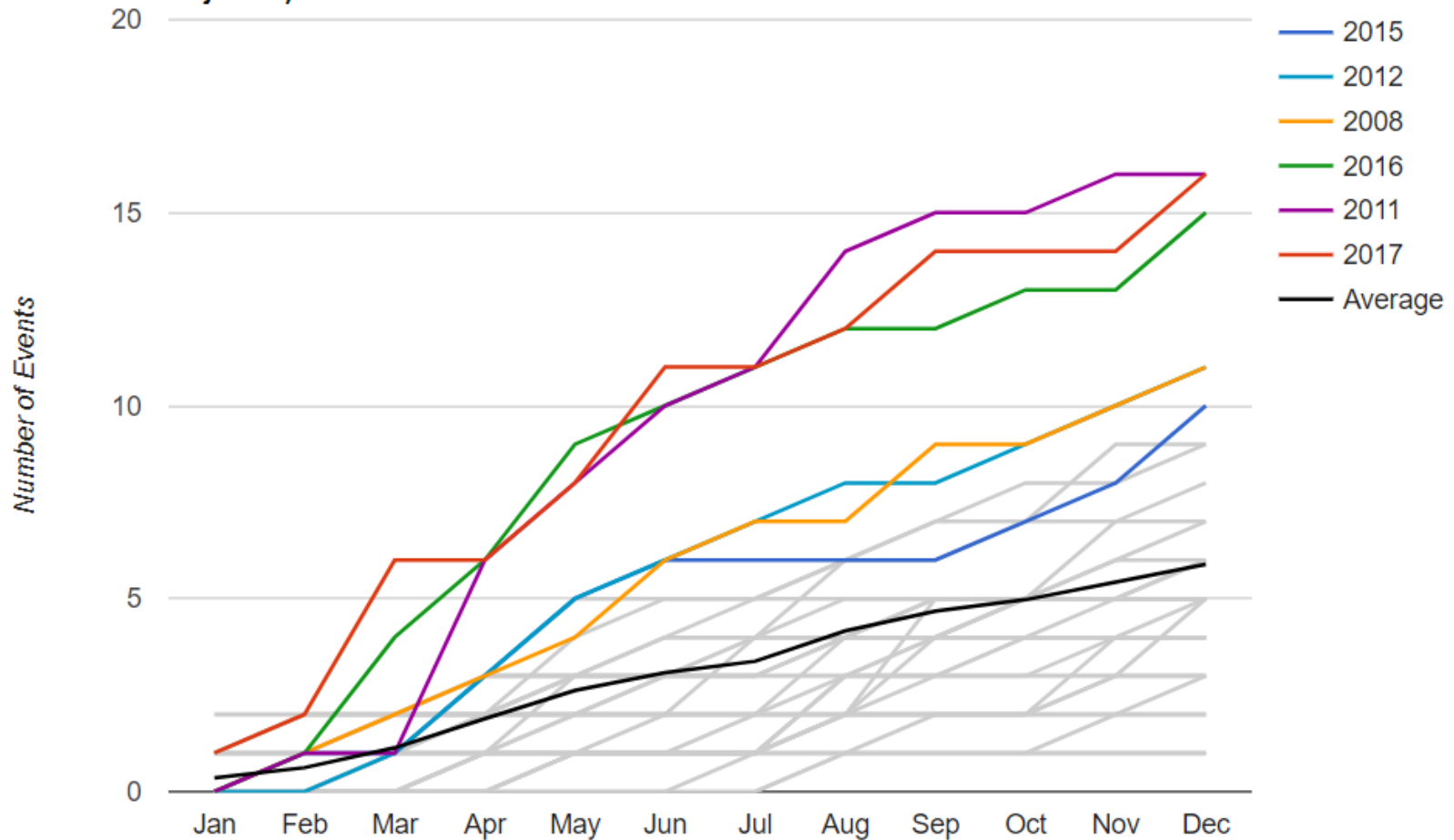
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Frequency of natural disasters

1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Frequency (CPI-Adjusted)



(Source: <https://www.ncdc.noaa.gov/billions/>)



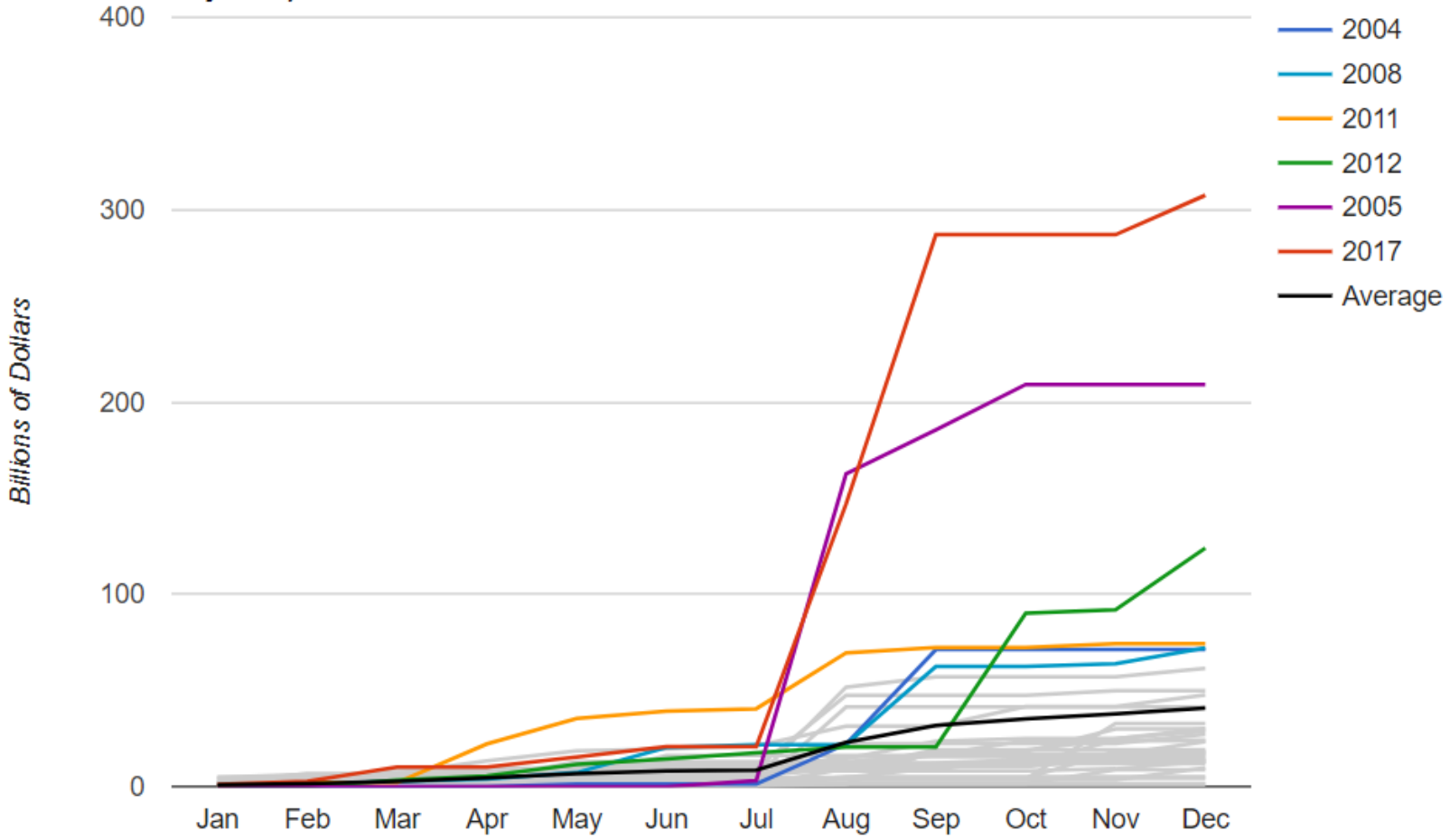
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Cost of natural disasters

1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Cost (CPI-Adjusted)



(Source: <https://www.ncdc.noaa.gov/billions/>)

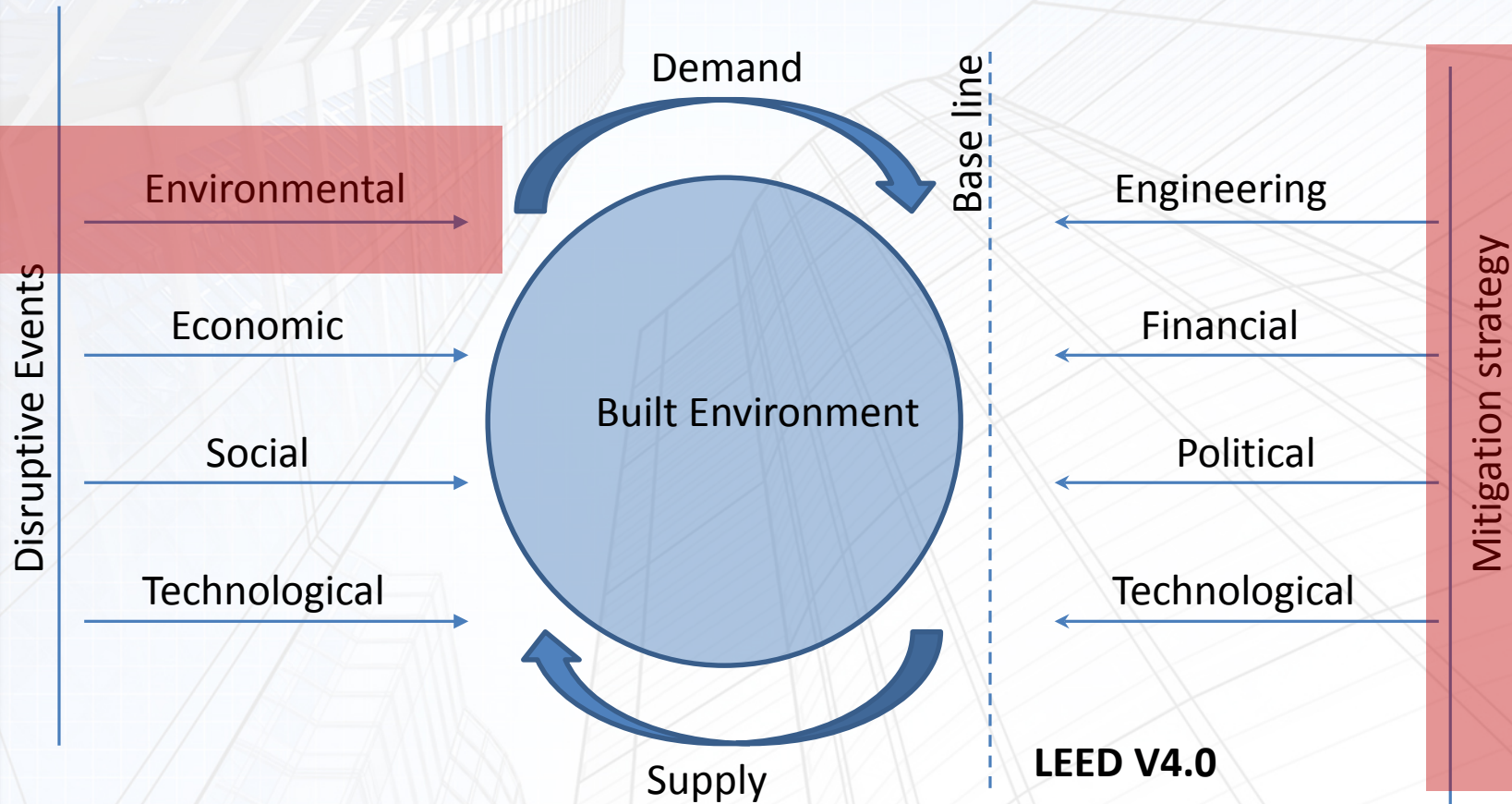


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Resilience in Built Environment



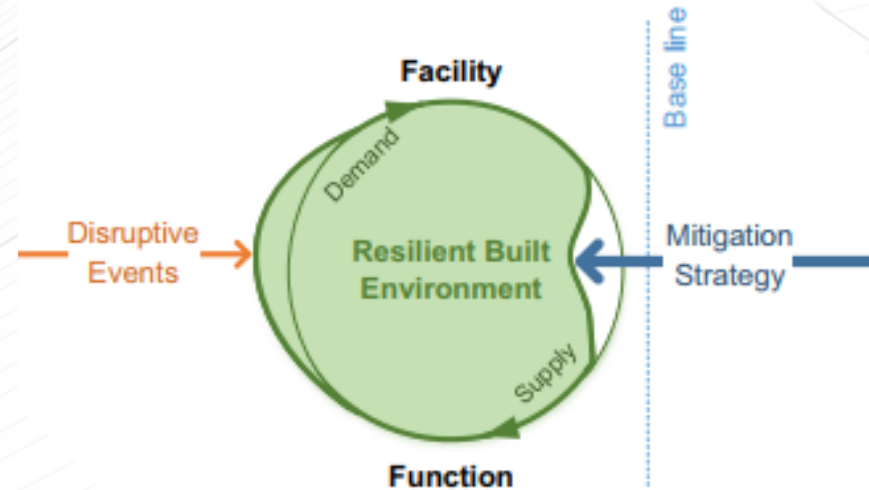
(Source Zhao et al. 2015)



Resilience in Built Environment



Scenario 1: Non-resilient



Scenario 2: Over performance

(Source Zhao et al. 2015)



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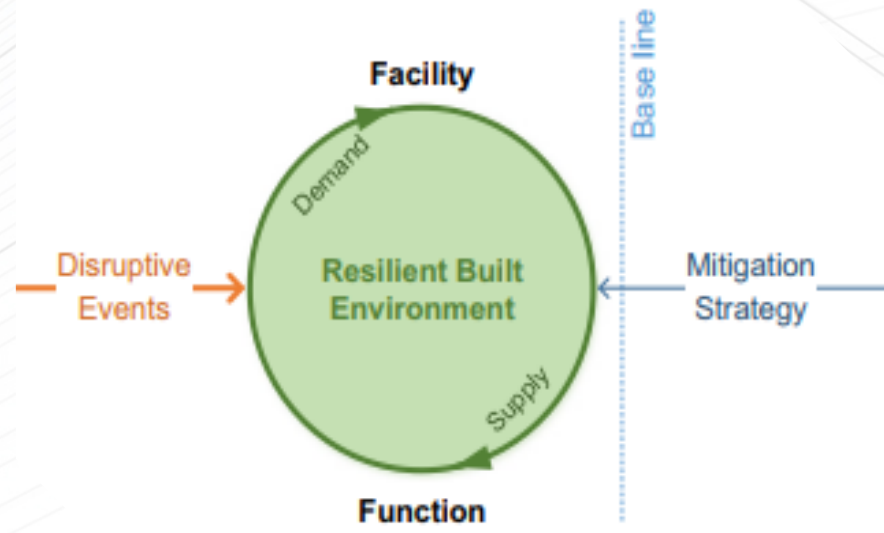
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Resilience in Built Environment



Scenario 3: Below performance



Scenario 4: Optimized performance

(Source Zhao et al. 2015)



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Definition- Resilience

The ability to absorb, adapt, recover quickly from the natural stresses, and be operational and functional

(Richardson et al., 1990).



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Research Question

- How does LEED V4.0 address the issue of resiliency within built environment, with regard to natural disasters?
- What prerequisites/ credits and categories respond most to identified natural disasters?
- What categories are least responsive to natural disasters?



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Method

- Identify disasters impacting the US (27- FEMA, NOAA)
- Apply filters
 - Natural Disasters
 - Applicable to the built environment
- Shortlist applicable natural disasters
 - 13 Distinct
- Map with LEED V4.0
- Expert review



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Results

- Natural disasters during which buildings are non-operational
 - Fire and earthquake (Extreme conditions)
- Natural disasters during which buildings can be operational
 - Drought
 - Extreme temperatures (heat/cold)
 - Flooding
 - Tornadoes
 - Hurricane/Typhoon- NW Pacific
 - Blizzard
 - Straight-line winds
 - Snow storm
 - Tsunami
 - Winter storm



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Results: Overview

- 64.8% of the total credits/prerequisites enhance resilience of building against *flooding*
- 63.0% of the total credits/prerequisites enhance resilience of building against *hurricane/typhoon*
- 61.1% of the total credits/prerequisites enhance resilience of building against *tsunami*



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Results: Overview

- 16.7% of the total credits/prerequisites enhance resilience of building against *earthquake*
- 22.2% of the total credits/prerequisites enhance resilience of building against *fire*
- 42.6% of the total credits/prerequisites enhance resilience of building against *winter storm*



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Results: Overview

- Credits that have the most potential to enhance building resilience towards identified natural disasters:
 - Integrative Process (*IP*)
 - Indoor Water Use Reduction (Credit + Prerequisite) (*WE*)
 - Building-Level Metering (*WE*)
 - Cooling Tower Water Use (*WE*)
 - Water metering (*WE*)
 - Fundamental Commissioning and Verification (*EA*)
 - Minimum Energy Performance (*EA*)
 - Building-Level Energy Metering (*EA*)



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Results: Overview

- Credits that have the most potential to enhance building resilience towards identified natural disasters (Contd.):
 - Enhanced Commissioning (*EA*)
 - Optimize Energy Performance (*EA*)
 - Advanced Energy Metering (*EA*)
 - Renewable Energy Production (*EA*)
 - Building Product Disclosure and Optimization - Material Ingredients (*MR*)
 - Minimum Indoor Air Quality Performance (*EQ*)
 - Enhanced Indoor Air Quality Strategies (*EQ*)
 - Low-Emitting Materials (*EQ*)



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Results: Overview

- Credits that have the most potential to enhance building resilience towards identified natural disasters (Contd.):
 - Thermal Comfort (*EQ*)
 - Interior Lighting (*EQ*)
 - Daylight (*EQ*)
 - Quality Views (*EQ*)
 - **Acoustic Performance (*EQ*)**
 - Innovation (*IN*)
 - Regional Priority (*RP*)



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Results: Overview

- Credits/Prerequisites the do not enhance building resilience towards identified natural disasters:
 - Green Vehicles (*LT*)
 - Light Pollution Reduction (*SS*)
 - Enhanced Refrigerant Management (*EA*)
 - Green Power and Carbon Offsets (*EA*)
 - Storage and Collection of Recyclables (*MR*)
 - Construction and Demolition Waste Management Planning (*MR*)
 - Building Life-Cycle Impact Reduction (*MR*)



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Results: Overview

- Credits/Prerequisites the do not enhance building resilience towards identified natural disasters (Contd.):
 - Building Product Disclosure and Optimization - Environmental Product Declarations (*MR*)
 - Building Product Disclosure and Optimization - Sourcing of Raw Materials (*MR*)
 - Construction and Demolition Waste Management (*MR*)
 - Environmental Tobacco Smoke Control (*EQ*)
 - Construction Indoor Air Quality Management Plan (*EQ*)
 - Indoor Air Quality Assessment (*EQ*)

Results: Flooding- Major Categories

- Integrative Process
- Sustainable Sites
 - Construction Activity Pollution Prevention
 - Site Assessment
 - Site Development - Protect or Restore Habitat
 - Open Space
 - Rainwater Management
 - Heat Island Reduction
- Innovation
- Regional Priority



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Results: Flooding- Major Categories

- Water Efficiency
 - Outdoor Water Use Reduction
 - Indoor Water Use Reduction
 - Building-Level Water Metering
 - Outdoor Water Use Reduction
 - Indoor Water Use Reduction
 - Cooling Tower Water Use
 - Water Metering

Results: Extreme temperature- heat

Major Categories

- Integrative Process
- Water Efficiency
 - Indoor Water Use Reduction
 - Building-Level Water Metering
 - Outdoor Water Use Reduction
 - Indoor Water Use Reduction
 - Cooling Tower Water Use
 - Water Metering
- Innovation
- Regional Priority

Conclusion

- LEED V 4.0 credit/prerequisites provide opportunities to enhance building resilience
 - Uneven distribution for natural disasters
- Opportunities for improvements in certain categories such as MR
- Performance based credit requirements can be one of the ways that can address the regional issues with natural disasters



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Comments/ Questions

Thank You!!

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