22nd Annual Alfred B. DelBello Land Use and Sustainable Development Conference

Balancing Economic Realities with Environmental and Social Concerns

Afternoon Session 1

Presented by the Westchester Municipal Planning Federation

Integrating Sustainability & Resiliency with Local Land Use & Environmental Planning

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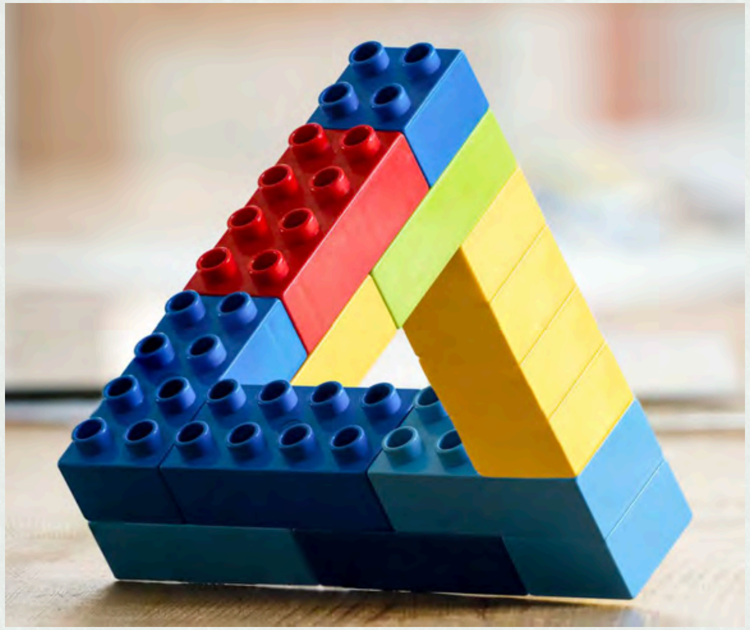
Sustainable Development…

The ultimate paradox



How do we reconcile Sustainability and Resiliency…

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…with Development?

When we use the terms sustainability and resiliency we think we are getting this…

Or are they hollow promises that will get us this…

(For the planners in the room, this represents an FAR of 1.5[7])

Our task is to ensure that “Sustainability” and “Resiliency” are not merely slick marketing buzz words

What is
“Sustainability” and “Resiliency”

Jennie. C. Nolan, Esq., LEED AP, Principal, Stewardship Consulting, Staff Attorney, Land Use Law Center

"[We have to stop acting like] we live in a 'cowboy economy' with unlimited new territory to be conquered and resources to be consumed […and we have to start thinking…] of our planet as a 'spaceship' – a closed system with finite resources."

--Economist Kenneth Boulding (1966)

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
--*Our Common Future*, World Commission on Environment & Development (1987)

- Criticized for
  - Accepting conventional notions of continued economic growth as the path to improved human welfare
  - Insufficiently incorporating an analysis of global power relations
  - Developing a definition of sustainable development that is highly anthropocentric and dependent on the difficult-to-define concept of “needs”

- *Our Common Future* – Takeaways:
    - Focus on equity. Poverty pollutes the environment. True sustainability requires social equity.
    - We've operated with a short-sighted pursuit of prosperity. Many of us live beyond the world's ecological means.
    - "At a minimum, sustainable development must not endanger the natural systems that support life on Earth."

Global Sustainable Development Efforts:

- 1983: World Commission on Environment & Development
  - *Our Common Future* (1987)
- 1992: Rio de Janeiro "Earth Summit", the U.N. Conference on Environment & Development, produced *Agenda 21*
  - Laid out sustainable development principles
  - Led to the creation of the U.N. Commission on Sustainable Development
- 1996: Habitat II "City Summit"
  - Produced consensus document on urban development principles
- 2000: U.N., Millennium Development Goals
- 2015: U.N. 2030 Agenda for Sustainable Development

The Triple Bottom Line (3-Legged Stool of Sustainability)

- Environment
- Economy
- Equity

--John Elkington, founder of British consulting group SustainAbility (1994)

10 Principles of Smart Growth

- Mix land uses
- Take advantage of compact design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost-effective
- Encourage community and stakeholder collaboration in development decisions

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- Sustainable Development
- Smart Growth
- The New Urbanism
- Traditional Neighborhood Development (TND)
- Transit Villages
- Transit Oriented Development (TOD)
- Biophilic Cities
- Green Urbanism
- Restorative Environmental Design
- Resilient Cities

Shared principles in guidelines on ecological or sustainable architecture:

- (1) Conserve energy and nonrenewable resources,
- (2) Take account of local place characteristics, and
- (3) Work with building users and surrounding communities.

“Design [is a] SIGNAL of human intention”…. “Design leads to the manifestation of human intention…”
--Architect William McDonough, The Hannover Principles

- 3 defining characteristics we can learn from natural design
    - **Waste = food** for other living systems
        - “Everything we have to work with is already here”
    - **Solar income**
        - “One thing allowing nature to continually cycle itself through life is energy and this energy comes from outside the system in the form of perpetual solar income”
    - **Biodiversity**
        - “The characteristic that sustains this complex and efficient system of metabolism and creation is biodiversity”

“Sustainability is as much about keeping buildings in existence as it is about constructing new low-impact efficient designs. Without positive benefits and associated attachment to buildings and places, people rarely exercise responsibility or stewardship to keep them in existence in the long run.”

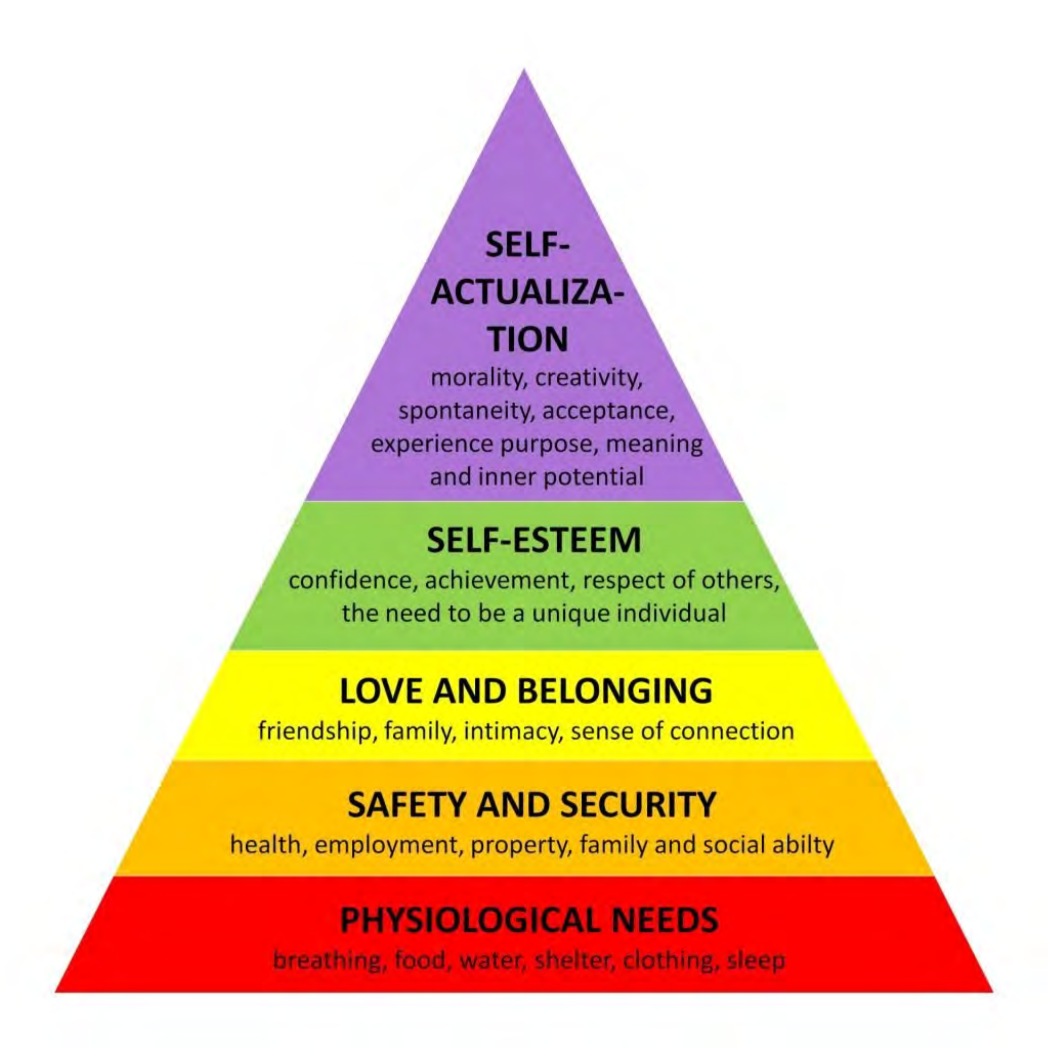
--Stephen Kellert, Yale Professor of Social Ecology

Resilience:

"The ability to survive, adapt, and thrive in the face of chronic stresses and acute shocks."

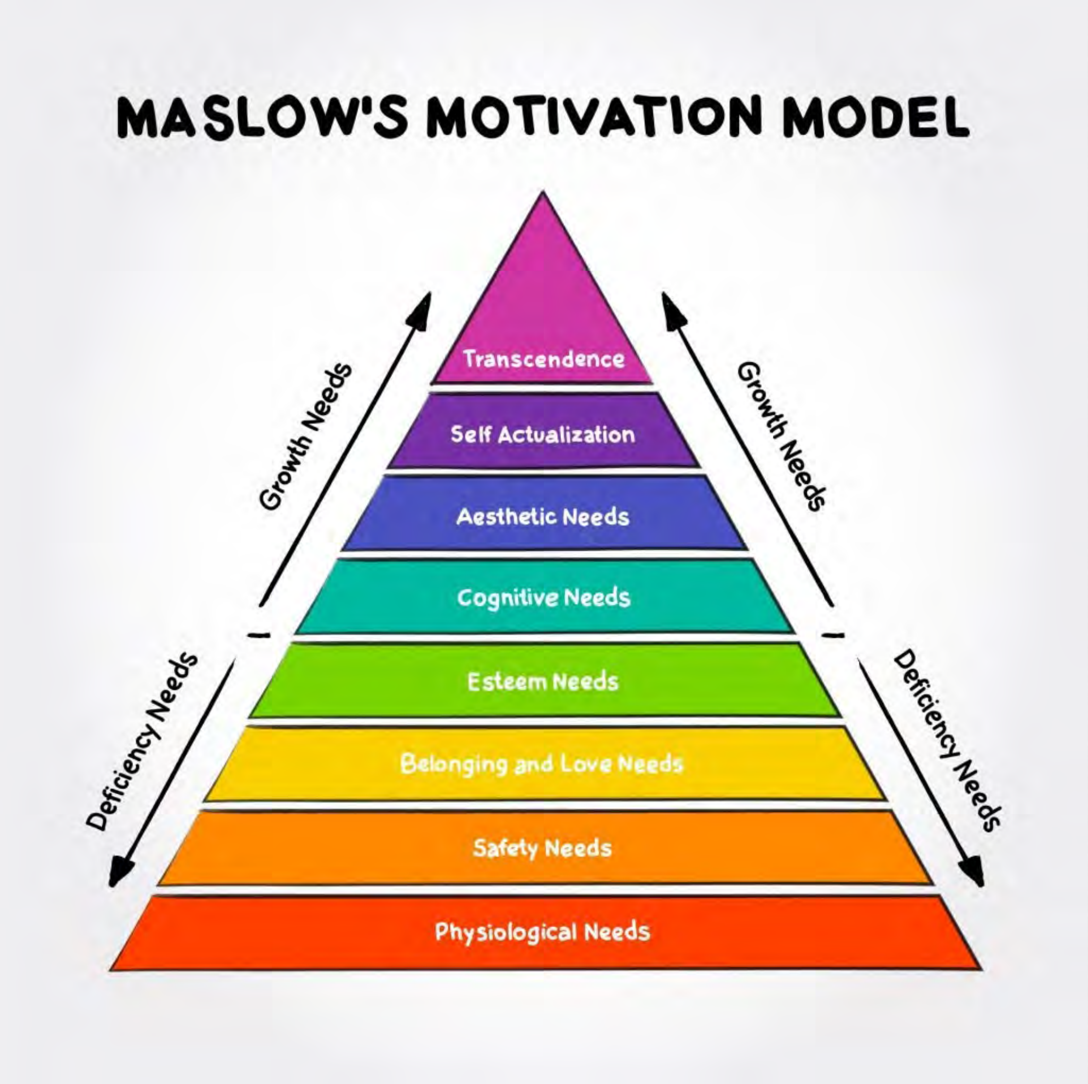
--Definition of resilience from the 100 Resilient Cities group

A Return to the Concept of Needs



--"Maslow's Hierarchy of Needs," American psychologist Abraham Maslow in his paper *A Theory of Human Motivation* (1943)

A Return to the Concept of Needs



--"Maslow's Hierarchy of Needs," American psychologist Abraham Maslow in his paper *A Theory of Human Motivation* (1943)

- Social infrastructure
- Housing options
- Infill development
- Transit Oriented Development
- Code flexibility
- Internalize externalities

To make places sustainable

Build walkable communities with diverse housing options, an active public realm that fosters interaction and a connection to nature.

- Gets people out of their cars
  - reduces carbon emissions, ozone, improves physical health through active transportation
- Provides public spaces for people to interact
  - builds a sense of community that improves mental health and increases resilience to climate change’s extreme weather events
- Allows people of all ages and income levels to commit to a place for generations
  - Improves civic life
- Stimulates the local economy

The Planners Perspective

Sabrina D. Charney Hull, AICP, Director of Planning, Town of New Castle

Planning and Sustainability
…*Then and Now*

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Sustainability of Place

Environmental Protection *(Sustainability?)*

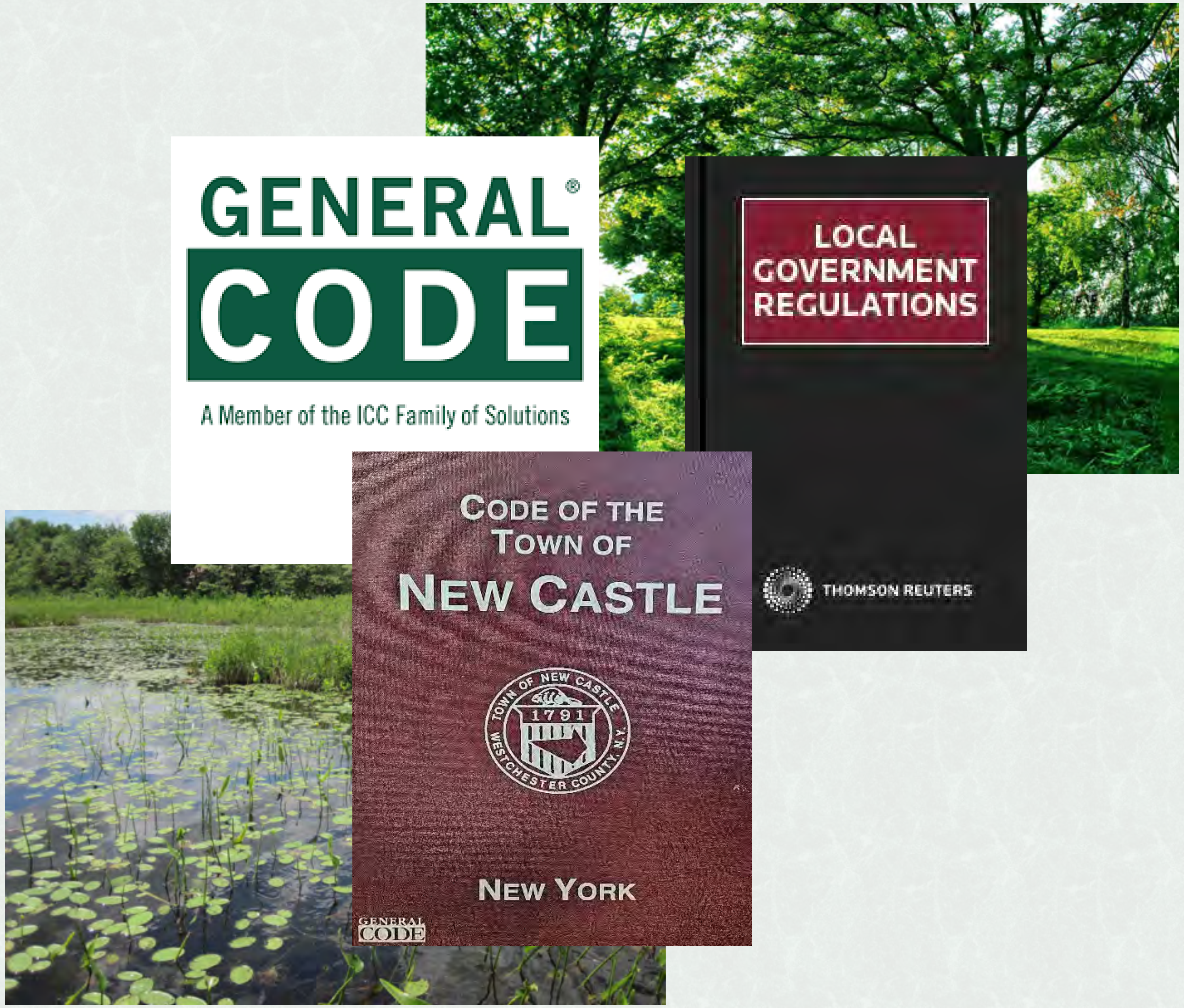
Impetus 1960's- early 1990's

- Rachel Carson's Silent Spring
- Cuyahoga River
- NEPA
- EPA
- Clean Air Act
- Clean Water Act
- Ocean Dumping Act
- Safe Drinking Water Act
- Point and Nonpoint Source Water Quality Controls
- Stormwater Regulations

Environmental Regulation

Local Environmental Ordinances

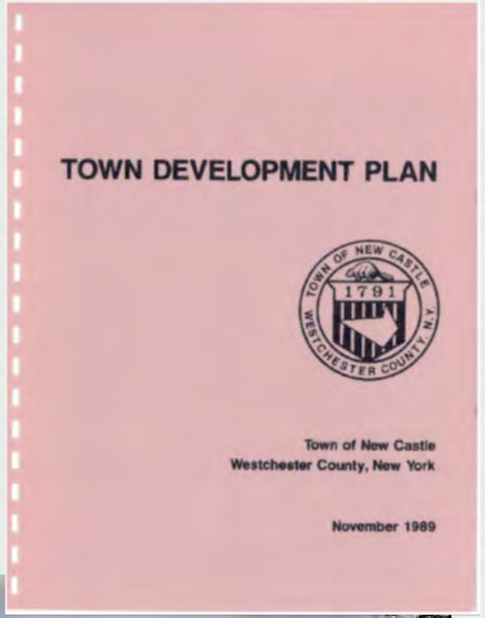
- Wetlands Protection
- Erosion and Sediment Control
- Flood Zone Protection
- Tree Removal and Replanting
- Riparian Buffers
- And others



Community Planning-Balancing Growth and Development with Environmental Protection

The Comprehensive Plan

- “A Development Plan”
- Land Use and Development
- Community was compartmentalized into Silos
  - Residential Development
  - Commercial Development
  - Open Space & Recreation
  - Transportation
  - Community Facilities & Services



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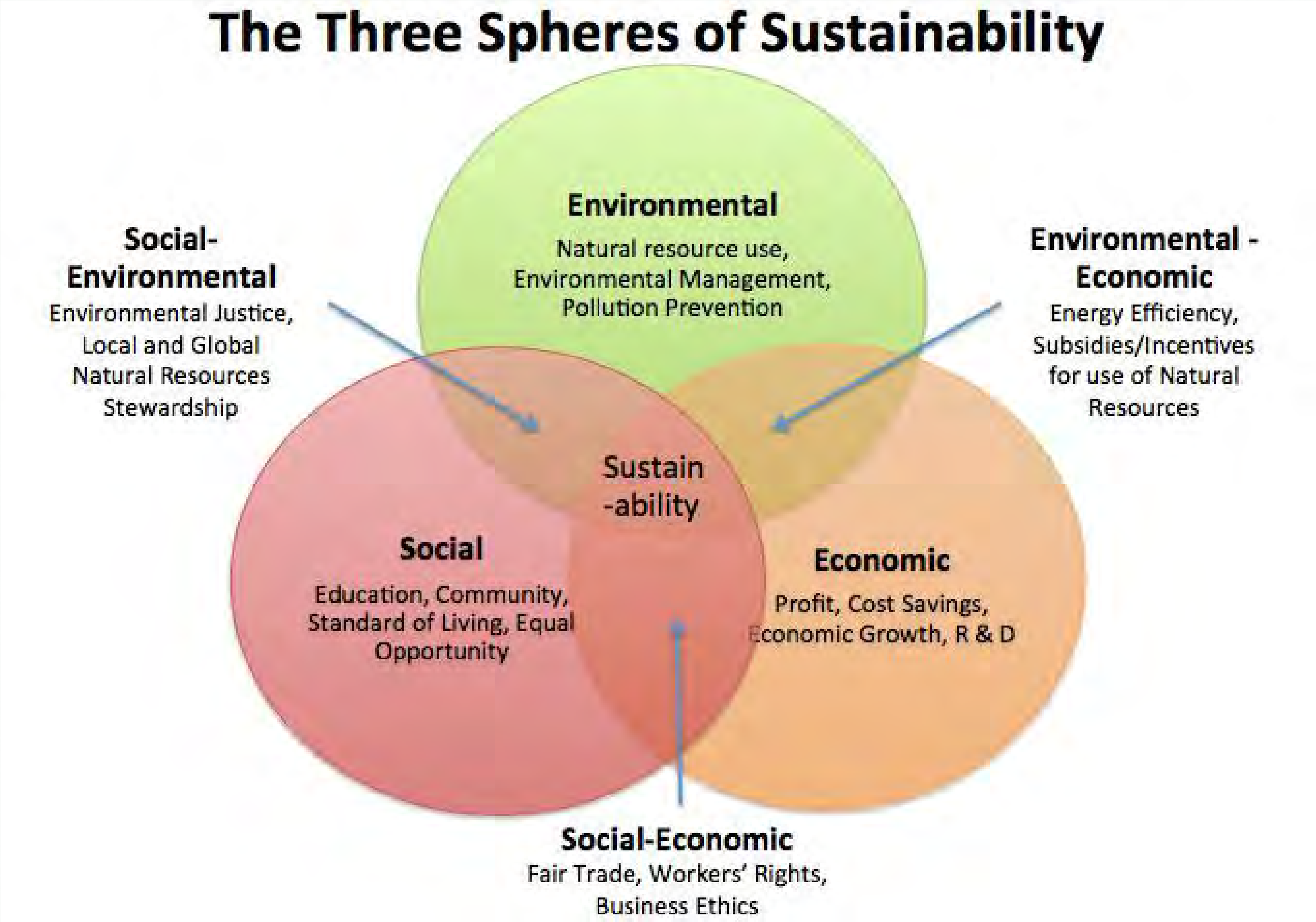
United Nations Sustainable Development Goals

- 2015 United Nations General Assembly UNANIMOUSLY adopted 17 Sustainable Development Goals

- The United States is a permanent member of the General Assembly



The Three Spheres of Sustainability
Environmental
Natural resource use, Environmental Management, Pollution Prevention
Social-Environmental
Environmental Justice, Local and Global Natural Resources Stewardship
Environmental - Economic
Energy Efficiency, Subsidies/Incentives for use of Natural Resources
Sustain-ability
Social
Education, Community, Standard of Living, Equal Opportunity
Economic
Profit, Cost Savings, Economic Growth, R & D
Social-Economic
Fair Trade, Workers' Rights, Business Ethics

Sustaining Places

Sustainability is more than preserving the environment for future generations:

- Encompasses the interconnectedness of environmental, social, and economic dimensions.
- Finding harmony between thriving ecosystems, equitable societies, and responsible economic development.
- Creating a community where every individual has access to basic needs such as clean air, water, and food.
- Ensuring that communities are resilient in the face of climate change and other global challenges.

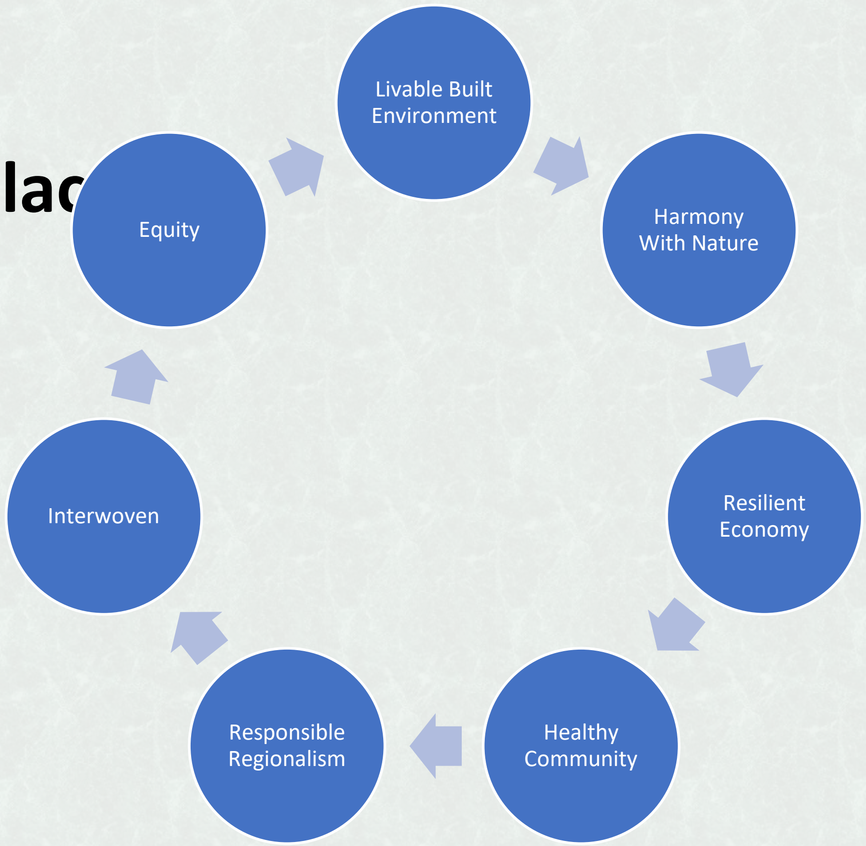
Sustainability is a holistic approach that considers the well-being of both present and future generations.

Changes To The Comprehensive Plan Structure

The Comprehensive Plan has become a democratic process through which communities plan to meet the needs of current and future generations without compromising the ecosystems upon which they depend by balancing social, economic, and environmental resources, incorporating resilience, and linking local actions to regional and global concerns. (Taken from Godschalk and Anderson 2012,4)

APA Comprehensive Plan Standards For Sustaining Plac

- Systems are connected, not separate silos
- Community Engagement is central
- Equity
- Implementation is vital
- Adaptation
- Resiliency- (Recover from disturbance/change)



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A Framework For The Future of New Castle

- 48 Policy Based Goals
- 184 Actions
- Connected the Community
- Recognized the environmental protections
- Acknowledged out migration
- Identified need for alternative housing types & a range of housin cost.
- Targeted new development (redevelopment) where infrastructur exists to support it.
- Recognized Climate Crisis.
- And more…

Local Legislation Focused on Sustainability

Amendments to Existing Codes to Improve Resiliency and Reduce Flooding

- Allowance of height measurement two-feet above base flood elevation
- Allowance of front yard encroachments in flood hazard areas.

-Village of Mamaroneck

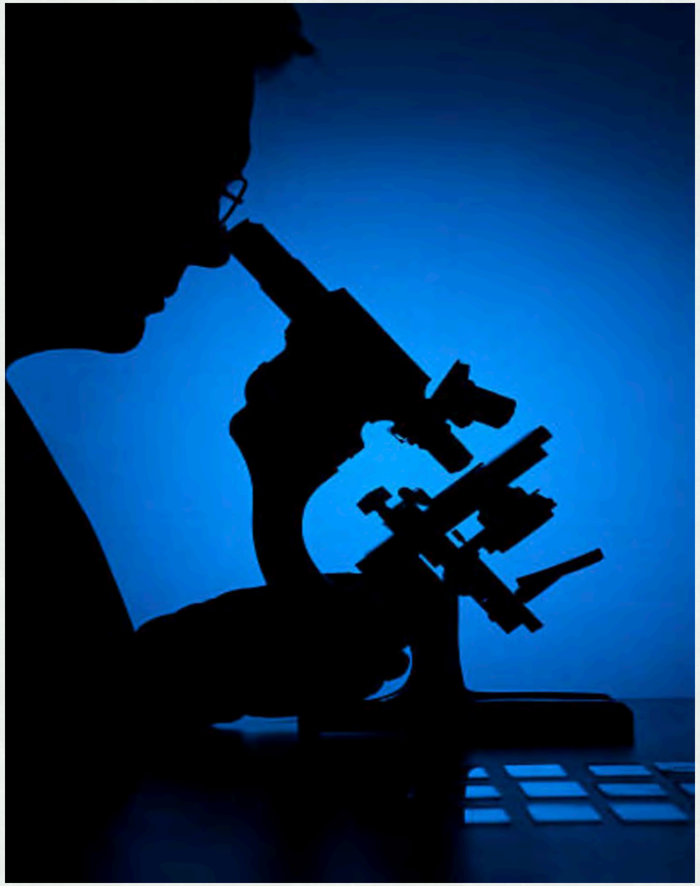
Local Legislation Focused on Sustainability

Amendments to Existing Codes to "Incentivize Sustainable Development"

- NG-Zero Special Permit (Redevelopment)
  - Height Increase (additional story) and a reduction of required parking in exchange for:
    - Green Infrastructure
    - Increase in AFFH Units
    - Electric Vehicle Charging Stations
    - Green Building requirements to minimize on-site generation of carbon emissions, including the incorporation of renewable energy systems and minimization of embodied carbon in building materials used (Whole Building Life Cycle Assessment)
    - Energy Efficient Building Standards (require air space, system adjusting and balancing, verification and certification of HVAC and energy systems)

-Town of New Castle

The Architects Perspective



John Fry, AIA, LEED AP, Principal, Nexus Creative – Architecture Planning & Design

“**Sustainable**”, “**Sustainability**”, “**Sustainable Means and Methods**” and ‘**Resilient or Resiliency**’ in the built environment. Ubiquitous, Challenged … Somewhere in Between.

Globally, the word ‘**Sustainable**’ is intrinsic to describing **broad initiatives towards achieving more efficient use of resources**.

By extension, expanding sustainable means and methods yields more ‘**Resilient**’ outcomes. In today’s world. Sustainability is rarely seen as an afterthought. Sustainable Built Environment Design initiatives, Integrated Design Strategies/Means & Methods coupled with Materials Selection and Materials Resourcing = **Meaningful Sustainable Design**

As Sustainability initiatives become intrinsic, a more **holistic approach** has emerged to design buildings with enhanced interaction in their surrounding environments and community fabric.

Implementing **collaborative design** in all phases of the design process, project carbon footprint can be minimized limiting global Greenhouse Gas (GHG) emissions to 1.5 degrees Celsius. This goal can be achieved by 2030 as set forth by UN + numerous professional association 2030 Sustainable Initiatives. [”AIA 2030 Challenge”]

While the words ‘sustainable’ and ‘sustainability’ reflect meaningful and noble efforts, to an equal degree, ‘Sustainable’ in many instances has become a comfort word.

i.e. a universally embraced word with a positive meaning, ubiquitous with the notion:
“There can’t be a negative or downside” … Right? Or mostly embraced as positive …

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FROM THE ARCHITECT'S SEAT:

1. Implement 'AIA's 2030 Challenge' by designing to achieve 60% energy use reductions utilizing **'Integrated Design' methodologies. 'Right Sizing'** equipment and control systems to achieve super-efficient building systems.
2. **"Accentuate the Positive";** Climate Responsive Design
3. Regionally sensitive. **Leverage positive climate attributes.**
4. Efficient and Responsive Exterior Building Envelope Design. [integral with #3 initiatives]
5. "Illuminating Savings": Leverage natural **'Daylighting'** and Integrated Lighting Strategies.
6. Integrate 'Site Power' via **Renewable Energy Systems.**
7. "Hands Off" + "Staying in Shape" **- Long term operations, maintenance and education initiatives which are not effort intense & resource demanding.**
8. Community Fabric Sensitive: **Design matters.**

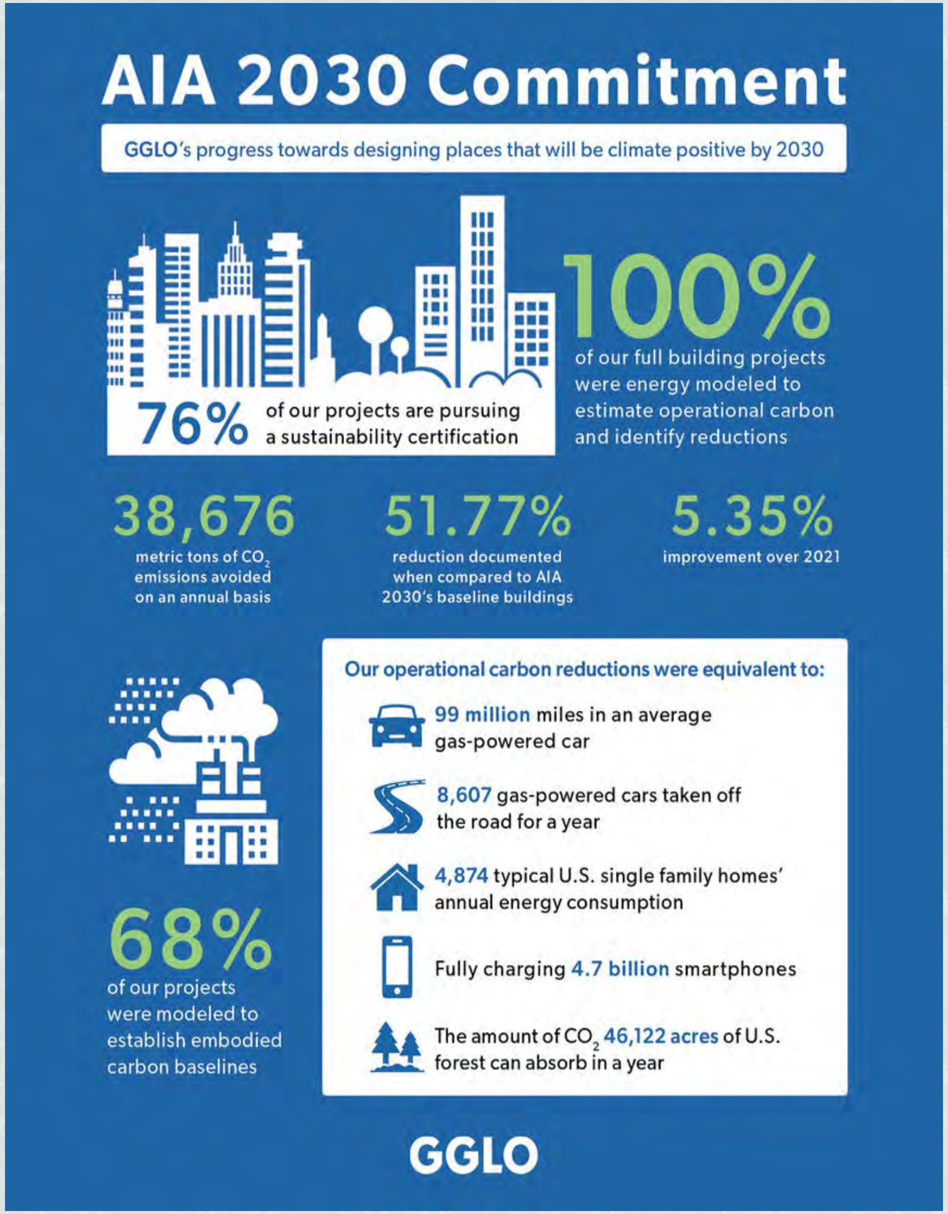

Image courtesy of SOPREMA

Sustainability and lifecycle impact map for products. To provide a true profile of total environmental impact, carbon emissions should be calculated for a material's entire lifecycle.

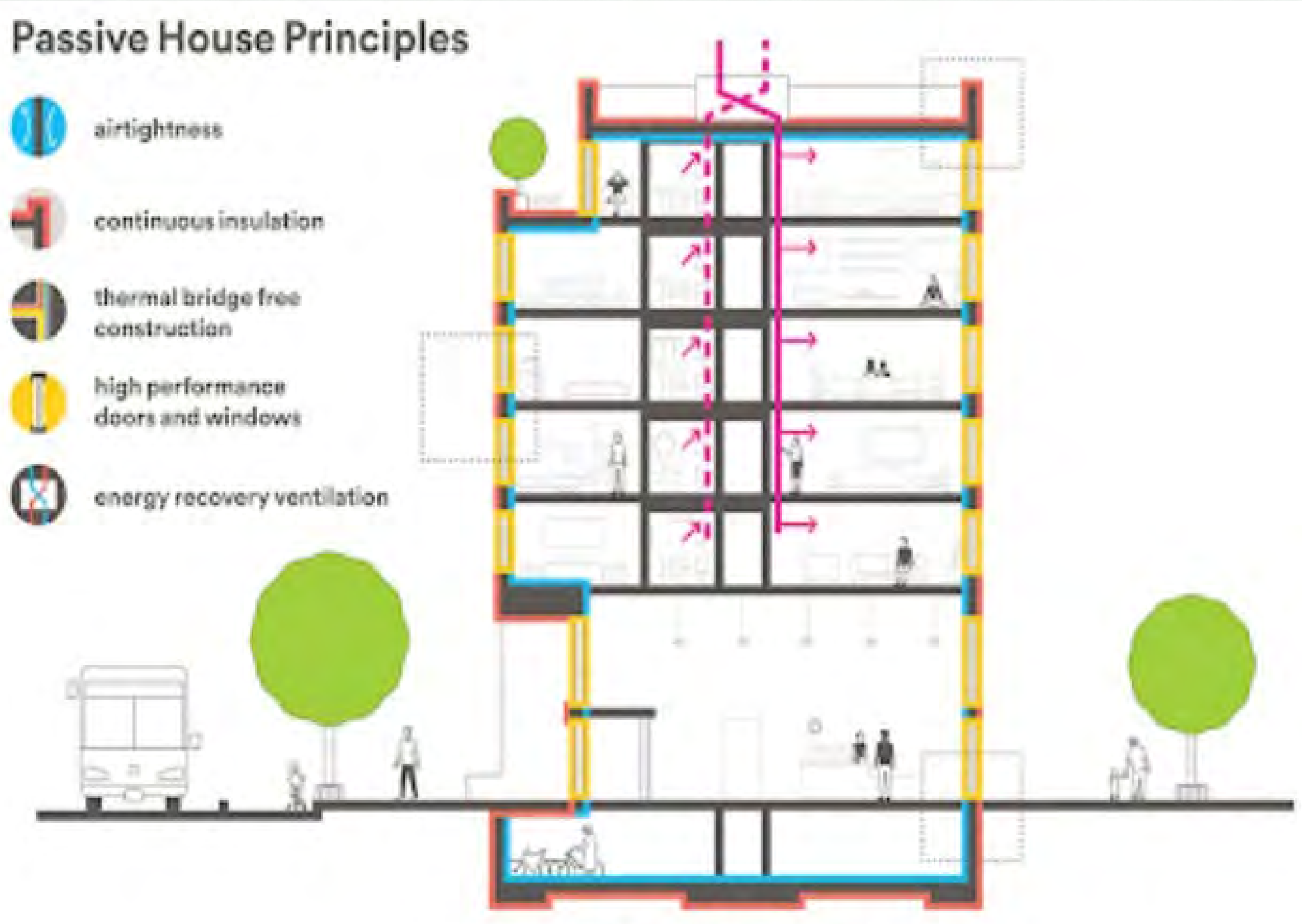

Image courtesy of the Building Energy Exchange

It is commonly thought that buildings account for approximately 30-40 percent of GHG emissions. However, as the chart below shows, when we factor in the embodied carbon, or "… the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials of building materials and construction," buildings account for nearly half of global emissions.[9] If we look at urban centers like New York City, over 70 percent of emissions come from building operations, (i.e, heating, cooling, and plug loads).[10] In addition, approximately 83 percent of the U.S. population lives in cities.[11] So, it follows that fixing the urban built environment can have the greatest impact to realize climate action goals and preserve the welfare of the most people. As noted earlier, this is no small task and requires a collaborative holistic approach as well as workforce training and mobilization at a scale not seen since World War II.

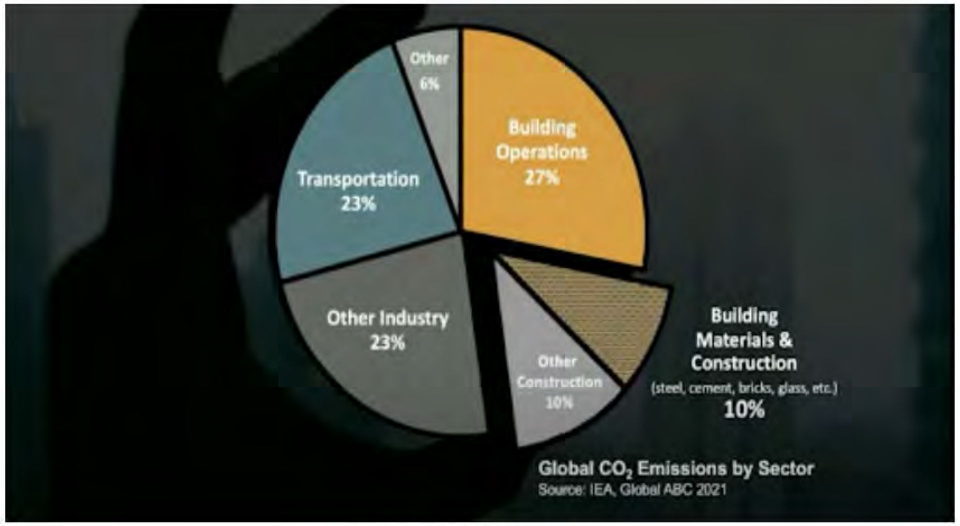

Image courtesy of Architecture 2030

The building sectors contribution to CO_2 emissions.

Resilience is a broad term used to assess our ability to withstand and endure … strategies are critical to incorporate in our cities and communities today so that we can provide security, health, and wellness for all. This affects not just built forms, but people, wildlife, ecosystems and how these groups interact with the built environment.

Nature has evolved over time to create a symbiosis of climate and terrain that is self-sustaining and resilient to most any condition. How can we learn from our surrounding ecosystems to help develop more responsive and resilient communities?

Historically, affluent communities with access to technology and resources can adapt and recover faster following climate emergencies. Climate disasters impact both rich and poor communities. Those with limited access to resources need resilience planning and support the most. How can design equalize the gap and support the whole community?

Designing with communities requires the project team to know the people of the place, interact with their culture, understand their way of life, then design can be shaped and molded into a form that not only provides delight, but is more sustainable and resilient.

Designing "Beyond Code"

While both sustainable and resilient concepts are future-focused and can benefit from design, sustainability focuses on resource efficiency and environmental protection, while resilience focuses towards preparing for and recovering from future disruptions and disaster events.

Resilience Design – The architect anticipates change and hazards throughout the building's life and provides design features to mitigate risk and vulnerability.

Sustainability Design – The architect uses design to enable efficient building operation and minimize resource requirements to satisfy present needs without compromising the ability of future generations to meet their needs.

"Stretch Code"

DIFFERENCE BETWEEN RESILIENCE AND SUSTAINABLE DESIGN

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A variety of tools and processes exist to help guide resilience projects. Each has unique qualities to enhance projects, yet the Resilience Design Toolkit provides a range of tools and processes to determine gaps and introduce a methodology that fulfills a need in design.

US Climate Resilience Toolkit

In 2014, NOAA Climate Program Office launched the US Climate Resilience Tool Kit to improve government organizations and planners ability to understand and manage their climate-related risks and opportunities. The intent is to help make communities and businesses more resilient to extreme events. The toolkit uses a 5 step process to understand risk exposure, assess vulnerability, investigate options, prioritize, and plan, and take action for resilience.

AIA Resilient Project Process Guide

In 2022, the AIA released the Resilient Project Process Guide to provide a series of questions for architects to engage clients coupled with additional resources for architects to act upon. The document is organized by project phase and identifies points where resilience and climate adaptation goals can be layered into design solutions.

Living Building Challenge v4.0

Living Building Challenge is the most comprehensive and progressive green building certification system. It requires projects to enhance building performance through seven petals to create a regenerative building that innately uses resilience features.

REDi™ Rating System

The Resilience-based Engineering Design Initiative (REDi™) Rating System, developed by Arup's Advanced Technology9 and Research team, proposes a framework for owners,

Pursuit | Planning | Pre-Concept | Design | Post-Construction

1. Resilience Scope

Determine the client's understanding of resilience and the owner's project requirements. Develop an appropriate resilience scope for the project.

Perform

Identify Client Understanding of Resilience

Assess Resilience Scope

2. Team Alignment + Planning

Develop a plan to integrate resilience in the project by identifying appropriate talent and process by creating a resilience design work plan.

Perform

Create Resilience Design Workplan

Assemble Project Team

Resilience Design

Kick-off, Visioning, and Work Sessions

3. Identify Hazards

After the plan is set, identify project hazards, then assess risk & vulnerability. Discuss results with project team and stakeholders.

Perform

Hazard Study

Risk & Vulnerability Assessment Determine Critical Hazards

Employ

AIA Principles of Design Excellence Framework

4. Integrate Resilience Design

Mitigate project risk & vulnerability by integrating5. Evaluate + Nurture resilience design measures.

Assess viability & feasibility ofProject close out and specific strategies through adelivery. Assess building Benefit Cost Analysis. resilience performance and develop a case study after first year of operation.

Perform

Post Occupancy Evaluation

Create

Case Study & Apply Lessons Learned

RELi™ 2.0 Rating Guidelines for Resilient Design and Construction

The RELi™ 2.0 Rating System is a resilience-based rating system that combines design criteria with integrative design processes for neighborhoods, buildings, homes, and infrastructure. Developed originally in 2012 by Perkins & Will, RELi™ has entered version 2.0 and has synergies with LEED v4 pilot credits.

LEED v4/4.1 Pilot, LEED v5

LEED has been the standard for green building certifications for over 20 years and has included resilience as a Pilot Credit in v4/4.1. These elective credits integrate risk and vulnerability assessment into project goals. LEED v5 is currently in development and is believed to have more resilience requirements when released.

WELL v2 & Fitwel v2.1

WELL v2 and Fitwel v2.1 both have features and credits that require emergency operations planning for buildings. Both aim to enhance social and community resilience by making buildings more conducive to human health and performance.

Autocas

Autocase is a web application subscription that quantifies and monetizes social and health benefits, whole life carbon footprint, and lifecycle financial impacts for the built environment. It uses a benefit cost analysis tool to evaluate projects using a triple bottom line approach and is a useful asset to understanding the impacts of resilient design.

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Glossary of Terms

100-Year Floodplain – More accurately identified as a *1% Annual Chance*, is a flood that has 1 in 100 chance of being equaled or exceeded in any 1 year and has an average recurrence interval of 100 years. (USGS)

The 50, 100, & 500-year flood terms are becoming less relevant and deceiving with the frequency of such flooding events happening more regularly and sometimes multiple times in a single year.

Adaptation – The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. (IPCC)

Adaptive Capacity – The ability of a person, asset, or system to adjust to a hazard, take advantage of new opportunities, or cope with change. (US Climate Resilience Toolkit)

Asset – People, resources, ecosystems, infrastructure, and the services they provide. Assets are the tangible and intangible things people or communities value. (US Climate Resilience Toolkit)

Base Flood Elevation (BFE) – The elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year. The BFE is shown on the Flood Insurance Rate Map (FIRM). (FEMA)

Benefit Cost Analysis (BCA) – A method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its costs. The result is a Benefit-Cost Ratio (BCR). A project is considered cost-effective when the BCR is 1.0 or greater. (FEMA)

Benefit Cost Ratio (BCR) – This ratio is the present value of net project benefits divided by the project costs and is the result of a BCA. A ratio of 1.0 or greater indicates the project is cost effective; a ratio of less than 1.0 indicates the project is not cost effective. (FEMA)

Business Continuity – Capability of the organization to continue delivery of products or services at acceptable predefined levels following disruptive incident. (ISO)

Capacity – A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster. (U.N. International Strategy for Disaster Reduction.)

Circular Economy – A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature.

It is underpinned by a transition to renewable energy and materials. Transitioning to a circular economy entails decoupling economic activity from the consumption of finite resources. This represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits.

Climate Change – A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC)

Choosing by Advantage (CBA) – A decision-making system that supports transparent and collaborative decision-making using comparisons among advantages of alternatives.

Climate Mitigation – A human intervention to reduce the sources or enhance the sinks of greenhouse gases that reduce hazard, exposure, and vulnerability. (IPCC) Cradle-to-Cradle – Materials, systems, and products are part of a closed loop system that doesn't produce any waste.

Emission Mitigation – Measures to reduce the amount and speed of future climate change by reducing emissions of greenhouse gases (GHGs) or by increasing their removal from the atmosphere. (4th NCA)

Externality – A side effect or consequence of an external event or behavior on a system.

Exposure – The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.

Flexible – Position infrastructure and buildings to be adaptive to changing needs. (AIA)

Hazard – A potential source of danger caused by a naturally occurring or human-induced process or event with the potential to create loss. (AIA)

Life Cycle Cost Analysis (LCCA) – Method for assessing the total cost of facility ownership to estimate the overall costs of project alternatives and to select the design that ensures the facility will provide the lowest overall cost of ownership consistent with its quality and function. (WBDG)

Maintainable / serviceable – Design provides for maintenance access and regular improvements to building systems and envelopes. (AIA)

Mal-adaptation – Any changes in natural or human systems increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead. (IPCC)

Mitigation – The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability. (IPCC, AIA)

Passive Survivability – The ability of a building to maintain reasonable, basic functionality after an event, specifically an event that includes an extended power outage. (AIA)

Recovery – Activities necessary to rebuild after a disaster. Recovery activities include rebuilding homes, businesses, and public facilities; clearing debris; repairing roads and bridges; and restoring water, sewer, and other essential services. (FEMA)

Redundant – Integrate duplicate systems that can support the operations of a structure for the well-being of occupants and reduce other negative impacts should a disruption/failure occurs.

Resilience – The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvements of its essential basic structures and functions. (IPCC, AIA)

Response – Activities to address the immediate and short-term effects of an emergency or disaster. Response activities include immediate actions to save lives, protect property, and meet basic human needs. (FEMA)

Risk – The potential for an unwanted outcome resulting from an incident, event, or occurrence, as determined by its likelihood, and the associated consequences. (DHS)

Sensitivity – The degree to which a system, population, or resource is or might be affected by hazards. (US Climate Resilience Toolkit)

Shock – Hazard events typically associated with large scale disaster, sudden and acute events that impact a vulnerable system. (AIA)

Special Flood Hazard Areas (SFHAs) – An area having special flood, mud-flow or flood-related erosion hazards and shown on a Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM). (FEMA)

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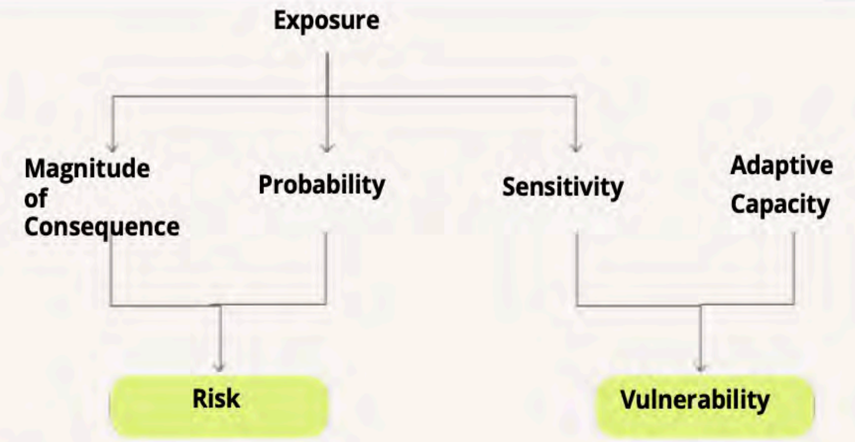


Components of Risk & Vulnerability

Sources: US Resilience Toolkit, Step to Resilience, NOAA

Glossary of Terms, Continued

Stress – Gradual and perpetual disruption that often reduce a community's ability to recover when shocks strike. (AIA)

Social Stress examples – aged population, food scarcity, population growth, affordability, unemployment, growing wealth gap.

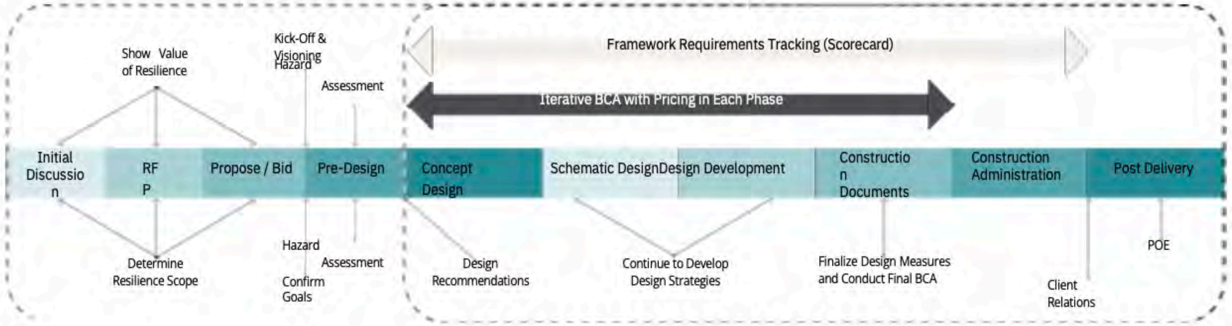
Physical Stress examples – ill-maintained infrastructure.

Natural Stress examples – environmental degradation, sea level rise, drought, melting polar ice, global warming.

Vertical Datum –

Vulnerability – The degree to which a system is susceptible to, and unable to cope with, adverse effects. (IPCC, AIA)

Resilience Design Coordination Timeline



Acronyms

AIA –American Institute of Architects

ASCE–American Society of Civil Engineers

ASLA–American Society of Landscape Architects Building

BRIC–Resilient Infrastructure and Communities CDRZ–

Community Disaster Resilience Zones DHS–Department of

Homeland Security

DFE–Design Flood Elevation

FEMA–Federal Emergency Management Agency FLASH–

Federal Alliance for Safe Homes

HMA–Hazard Mitigation Assistance IPCC–

Intergovernmental Panel on Climate Change ISO–

International Organization for Standardization

LCI – Lean Construction Institute

NOAA – National Oceanic and Atmospheric Administration

NAVD 88 – North American Vertical Datum of 1988

NWS – National Weather Service

RCN – Resilient Cities Network

RFQ – Request for Qualifications

RFP – Request for Proposal

USGS – United States Geological Survey

USRC – US Resiliency Council (USRC)

WBDG – Whole Building Design Guide

WUI – Wildfire Urban Interface

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Hazards to Solutions

Developing solutions requires critical thinking and a wealth of perspectives from the project team. **Approaching holistic and comprehensive ideas for effective resilience may require thinking about the following concepts.**

Systems Thinking

It is important to consider the entire system of components and human behaviors that can be affected by a hazard. The effects on the system components may indicate possible challenges that are not apparent when only considering a central component.

Externalities are outside impacts on a system and are often out of a project's ability to control. It is important to consider externalities so that failures outside of a project site can be anticipated and mitigated through design.

Weak Links

Building resilience relies on a system of components to function in unison so that building services are maintained. As defined by Arup, system integrity is dependent on the components functioning correctly and is only as strong as its weakest link. For example, a building that has back-up power, drinking water, food, and supplies may still have to close if water

Equitable Communities

New growth and development often increase property values which can gentrify communities and displace residents and businesses. Social welfare and security are key components for thriving communities and should also be considered in resilience strategies. Solutions should also consider the culture, beliefs, and history of a place. Projects are often dependent on the local community to support their business or use, without a healthy community, business could suffer.

Solutions should seek to be supportive of community goals and culture. Key topics to consider include avoiding disparities, strengthening community groups, allowing for community ownership of a solution or process, providing accessibility, stimulating economic growth while minimizing gentrification.

Vernacular Design

Resilience design should also consider the methods, aesthetic, and function for design of the place. Communities often develop using methods that represent the resources available and people of a place. Resilience design strategies should consider locally sourced materials assembled using typical means and methods of construction. This is especially critical in areas with vulnerable and under-resourced populations who will have to use and maintain the project components.

Understanding vernacular design of a place is a goal of a AIA Principles of Design Excellence exercise.

Policies & Operations

Not all hazards require a designed solution. Sometimes it is more effective to mitigate a hazard through employing a protocol or process to operate the building so that an impact is minimized. For instance, an office building may require tenants and workers to work from home to minimize need for extended periods of emergency power fuel and potable water supply.

Ecological Solutions

Using natural processes from native and adapted ecosystems can provide efficiencies in building performance. Natural processes often self-regulate and require minimal interaction to function when critical ecosystem components are provided and protected. For instance, vegetation can naturally filter and mitigate stormwater without needing expensive infrastructure. Vegetation can also help clean the air, reduce urban heat island, and inject biophilia for a project.

Time

Climate change projections are less accurate the further they project into the future, thus, predicting exactly when catastrophic impacts could affect a project are hard to calculate. We can identify risk thresholds and work backwards to mitigate those impacts in design. This allows an owner to determine if a specific level of risk is acceptable for a project.

For instance, sea level rise experienced on a project site may be negligible today but could be significant or debilitating for a project in 20 years. If the site can accommodate 2' of sea level rise, but will endure flooding with any further rising water, the threshold is 2' of sea level rise. When sea level rise exceeds 2', the project will have reached its tipping point. The project team should discuss with the owner to determine if this is an acceptable level of risk or if further mitigation or adaptation is required.

Since the tipping point will be difficult to accurately predict, the threshold should be adjusted to mitigate risk. Extra site capacity for water, elevated buildings and systems, a new project site all together could be employed to minimize expected risk for the owner. These strategies should be developed and evaluated for effectiveness. To assess long-term viability of a resilience strategy, it is good practice to stress test a solution over a range of scenarios to understand adaptability to variations in the future. Strategies that can accommodate a variety of impacts and are responsive to what could be experienced provide more value to clients and the community.

Large Coastal Project Example

Continuing with the large coastal hotel example from Step 03, in Step 04 we can begin to connect primary and secondary hazards with building components. In this example, we will focus on just hurricanes for simplicity.

The project team should also compare project hazards with the owner's objectives.

To develop appropriate design solutions for this hospitality project, the project team should consider the building structure, enclosure, mechanical, electrical, and plumbing systems, space programming, landscape design, stormwater capacity, redundant systems, and infrastructure.

The project team should also consider if there are any larger design drivers that the owner or design team wishes to pursue that may not be represented in the charts. **A holistic design theme or concept** could be an effective method to also drive resilient design concepts.

Primary and secondary impact studies identify components of the building that are subject to damage from the identified hazards. Design of these building components should incorporate resilient thinking to help mitigate potential impacts by determining key dynamics associated with the building components and adjusting the design to better withstand impacts.

For example, critical building systems such as HVAC or electrical gear that could be damaged from flood waters and storm surge should be lifted above the storm surge prediction level and placed inside the building in areas protected from strong wind and potential stormwater velocity.

Placement of these components and the types of systems used can have a significant impact on the resilience and performance of the system. **Utilizing passive building strategies that do not require active inputs may function even when other building services are disrupted;** for example, operable windows rated for hurricane force winds may survive a storm and then can be opened after a storm passes for **natural ventilation** if building utilities are disrupted. Strategically placing **operable windows** in the building could provide a **natural ventilation strategy** to keep the building interior spaces comfortable and prevent mold and mildew growth.

Key Building Components to Consider

Enclosure	Roofs, opaque wall, glazing, curtain wall, seismic joints
Mechanical / HVAC	Air handlers, cooling towers, chillers, roof top units, fan units, dehumidification systems, exhaust, and intakes
Electrical / Data	Lighting, emergency power, process loads, electrical gear, renewable energy systems, transformers, vertical circulation, low voltage, data, communications
Plumbing	Water supply fixtures, wastewater systems, filtration systems, pool pumps, cisterns, potable water storage systems
Site	Landscape areas, pool deck, building entry, loading dock, waste collection, amenity lawns, building connections

Primary Impact-Asset Pairs for Hurricanes

Primary Impact	Assets Impacted
Storm Surge Flash Flooding	Damage to beach front access, exterior areas and amenities, impact to building access, inundation of building lower levels, damage to un-protected building systems on lower levels (electrical, mechanical, plumbing, communications)
Strong Wind	Damage to building enclosure systems, disruption of utility service (power, data, water, gas), down trees, inhibited travel to and from site
Tornado	Severe damage to most building components, space to shelter in place required

Secondary Impact-Asset Pairs for Hurricanes

Secondary Impact	Assets Impacted
Water Contamination	Storm debris, flooded fuel tanks, chemical spills, sewage overflow, and other pollutants enter local water ways and municipal water systems damaged by a hurricane
Utility Disruption	Damage to electrical, natural gas, data, communications, and water grid infrastructure can disrupt services to the site
Infrastructure Disruption	Flooded and debris strewn roadways impede travel which can prevent resources and emergency services from reaching the site
Mental and Physical Harm	Extreme conditions create risk to physical and mental health through physical objects and experiences. This creates liabilities for the ownership group and increases exposure to risk
Financial Impacts	Substantial losses and damages inhibit business operations which impacts capital debt payments, employee salaries, maintenance, and more

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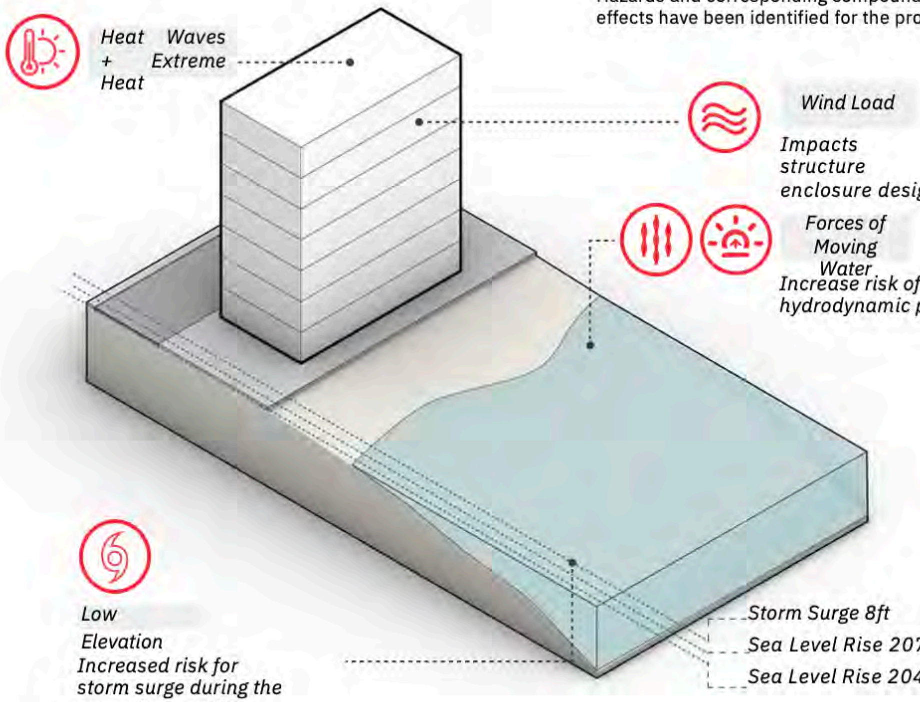
Hazards Identified

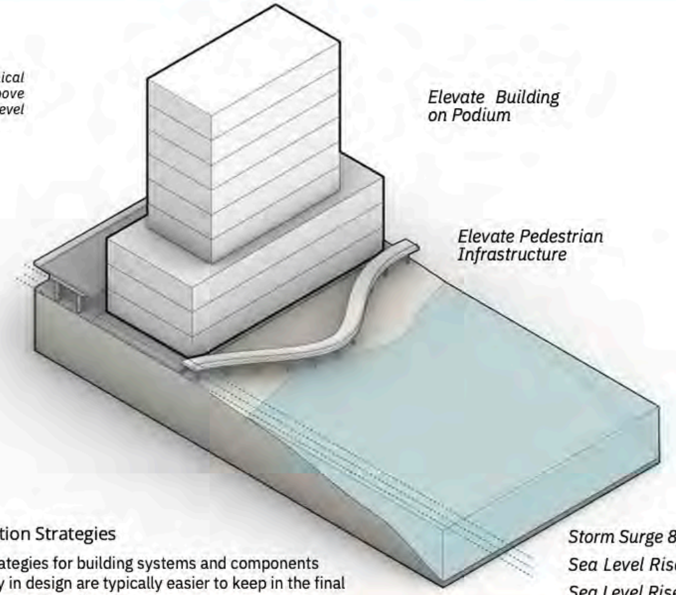
Hazards and corresponding compound effects have been identified for the project.



Resilience Design

When designing for resilience, sometimes the best way to start is to just jump headfirst with an idea to see where it goes. In the process, considerations and supplementary ideas will help shape design. There is not one correct way to put a building together and this is where it is up to the design and project team to take the information provided and make the process theirs.

It is beneficial to incorporate the AIA Framework for Design Excellence into the design process to help coordinate design concepts with the ten measures. This will help maintain a thorough assessment of the design and help provide documentation needed for AIA award submissions. The hospitality project example uses the AIA Framework for Design Excellence to illustrate how the ten measures could be incorporated into design solutions.



Initial Mitigation Strategies

Placement strategies for building systems and components identified early in design are typically easier to keep in the final design and construction of a project.

Design Concepts

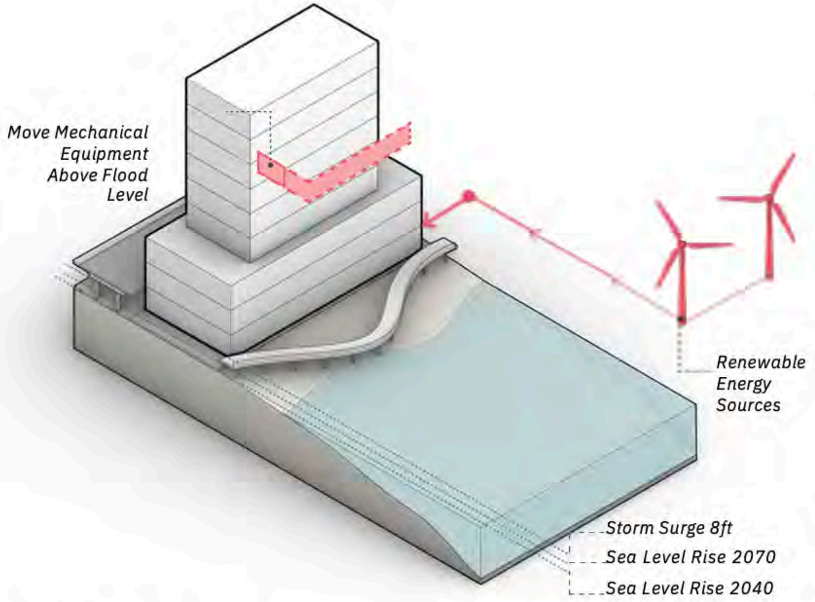
Design for Water

Fortifying sewer and drinking water systems helps protect these systems during a storm. Blue roofs and bio swales can mitigate flood waters and help keep elevated transportation infrastructure open.

Raise building on a podium above the storm surge level, base flood elevation, and allow for “wet” levels that can accommodate water inundation with minimal damage.

Raise infrastructure connections and critical building systems above storm surge level and base flood elevation to maintain operation during flooding inundation.

Plan for potable water storage on-site for building users in the case municipal water connection is compromised.



Design Concepts

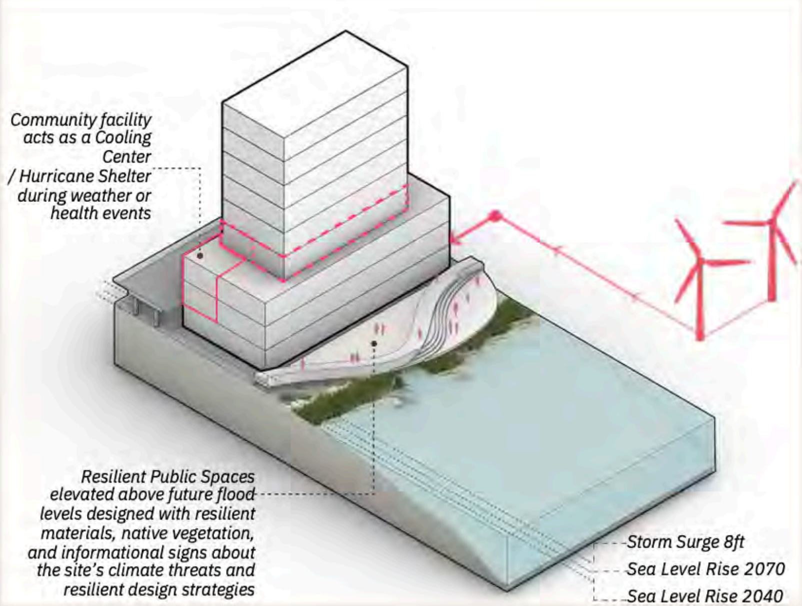
Redundant and protected energy systems (Raised equipment floors from flood level).

Flexible power systems.
Micro-grid power delivery.

Reducing energy consumption by cool paving/roofs (by reflecting more solar energy and enhancing water evaporation) not only cools the pavement surface and surrounding air but can also reduce stormwater runoff and improve nighttime visibility. Can reduce ambient temperatures by 80 degrees and reflects 85-90% of radiation on site.

Design for Energy

Redundant and elevated power, data and communication systems protect building components and mitigate risks for storm surge. This is especially critical for essential buildings like hospitals and residences.



Design for Equitable Communities & Wellness

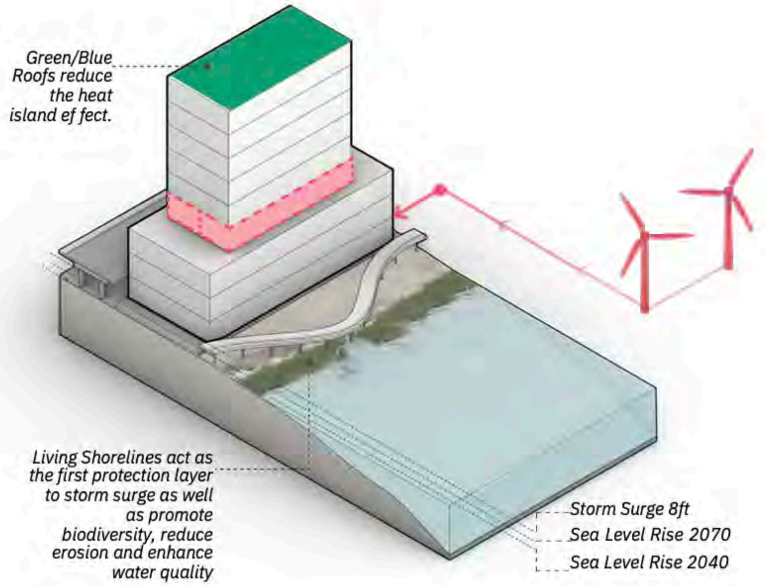
More resilient buildings allow more residents to shelter in place and minimize the need to evacuate. This benefits a community's mental health and quality of life which can improve equity and social resilience.

Design Concepts

Communities benefit from previously mentioned strategies that protect quality of life and maintain water quality, minimize power disruption, protect dwelling units, and maintain security, this allows us to continue to go to work and school and acquire financial security.

Resilient public spaces ensure equitable access to public spaces.

Cooling centers are resilient spaces that are open to communities during extreme heat events. These spaces can double as hurricane and storm shelters.



Design Concepts

Living shorelines and vegetated coastal buffers better resist erosion and promote biodiversity on land and under the water.

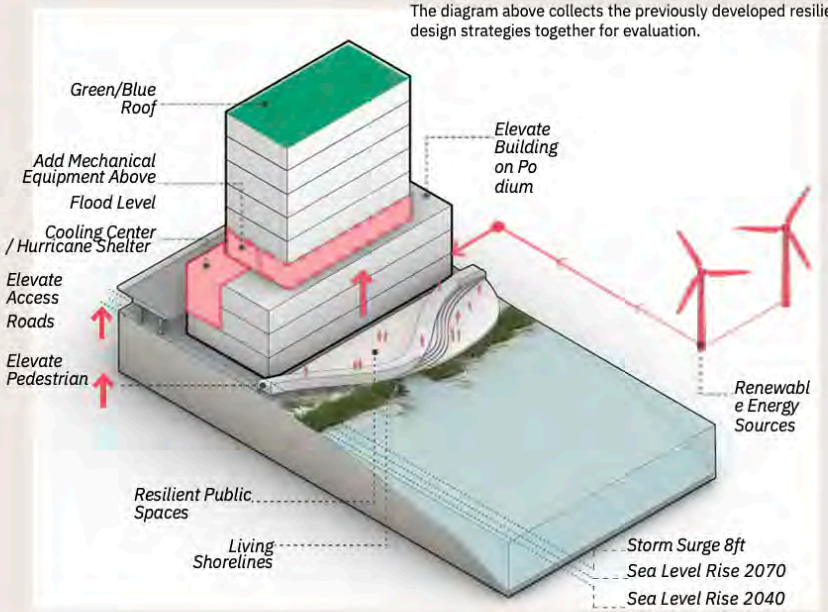
Vegetated landscapes better control storm water, clean pollutants from run-off water, promote biodiversity, reduce urban heat island, and promote biophilia which helps promote healing and control stress.

Design for Ecosystems

Natural solutions can often provide more effective solutions to environmental concerns. Vegetative buffers on the coast can mitigate storm surge and flooding while promoting biodiversity that can be an asset to the ecology of a place as well an aesthetic asset for communities.

Resilience Design Strategies

The diagram above collects the previously developed resilience design strategies together for evaluation.



Resilience Design Assessment

The diagram above collects the developed resilience design strategies together for evaluation. In your project you may have multiple ideas to satisfy design objectives or mitigate hazards. A value engineering process may also jeopardize the ability to keep some concepts in the design. Resilience design strategies naturally require a systems approach that help us think about several different types of building systems, concepts, and features to create an integrative and holistic design idea. A building design solution that touches many parts of the building is harder to value engineer or remove from the project. For example, if solar brise soleil reduce visual glare, shrink the size of mechanical equipment, and can be used as hurricane shutters for windows, it may be harder for the project to remove them to save cost. The existence of the brise soleil help reduce cost of other items in the project.

When a more objective analysis is needed to determine if an option is viable to keep in a project or to help decide between multiple different ideas, a BCA can be used. The next section introduces the concept of a BCA and performs one for the hospitality project example.

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Benefit-Cost Analysis

To help create effective solutions for the project, we should quantitatively evaluate each solution based on cost benefit and feasibility. Benefit-Cost Analysis (BCA) is a specific analysis method to evaluate the benefit of a solution with the cost to implement the solution. It yields a Benefit-Cost Ratio (BCR) ratio that when calculated above 1, indicates a positive ratio and therefore an effective solution. BCR should be balanced with feasibility defined by the ability to incorporate the solution into the design, maintain the design aesthetic, and uphold the design intent.

FEMA has developed a BCA process to help quantify the effectiveness of a resilience measure for a specific project using 5 steps and requires a BCA to enable a project to receive federal money. A BCA provides an effective decision-making tool for a project by utilizing the risk & vulnerability assessment previously completed and applying economics. It requires developing a base understanding of the value of the building and its assets.

Autocase can also perform a BCA however uses a method that evaluates value using a triple bottom line approach. Autocase can be useful to show the impact on the project and local community using the social and environmental lens that is often hard to quantify.

This example will integrate a generalized version of the FEMA BCA tool with guidelines provided in the AIA Resilience Course available on AIAU.aia.org.

- Increased Soft Costs
- Increased Entitlement or Approval Processes
- Increased Timelines
- Project Funding Dynamics

Overall, every $1 spent on a resilience strategies during design results in $4 of savings or more from potential project perils.

National Cost Benefit Ratio Per Peril	Beyond Code	Federal Funding
Overall Hazard Benefit-Cost Ratio	$4:	$6:
Riverine Flood	1	1
Hurricane Surge	$5:	$7:
Wind	1	1
Ear thquake	$7:	N/A
Wild-land-Urban Interface Fire	1	$5:
	$5:	1
	1	$3:
	$4:	1
	1	$3:
	$4:	1
	1	

Estimates are rounded and based on hypothetical Hazard scenarios. Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants, according to an analysis by the National Institute of Building Sciences. An earlier (2005) study by NIBS found a benefit-cost ratio (BCR) of 4:1. (FEMA, June 2018).

Benefit Cost Analysis Steps

Step 1	Step 2	Step 3	Step 4	Step 5
Data Collection and Project Information	Determine value of building and its assets	Characterize Hazard Impacts and determine Damages	Hazard mitigation analysis: Identify mitigation alternatives and associated benefits	Calculate benefit- cost ratio

AIA Resilience Course, Module 7 "Business of Resilience" (AIA, 2018)

Step 1. Collect Project Data

- Building Service Life or project useful life
- Level of protection as determined by desired level of building performance
- Hazard Data (Hazard specific resources; HAZUS MH)

Step 2. Determine the Value of Building & Assets

- Building Service Life Cycle Analysis
- Property value, initial cost, operation and maintenance repairs, cost of replacement, residual value (resale or disposal)
- Tax assessment, real estate comparable, city credit rating

Step 2. Determining the Value of Building Contents

- Building contents: furniture, equipment, intellectual property, appliances
- Sources of information: insurance records, appraisals, receipts, estimates

Step 3. Characterize Impacts and Determine Damages

- Physical Damage Estimates: building contents, vehicles & equipment, site impacts, infrastructure.
- Loss of Function impacts: facility or material type, customers served, functional downtime and loss of function, loss of public services, displacement costs

Step 4. Hazard Mitigation Analysis

- Create an inventory of potential hazard mitigation strategies
- Document damages avoided per hazard mitigation strategy
- Provide cost analysis for each strategy: design & construction, maintenance

Step 5. Calculating Benefit-Cost Ratios (BCR)

- BCR is numerical expression of cost effectiveness of a project
- BCR = Benefits / Costs
- BCR > 1.0 = Effective
- Benefits = Expected annual damages before mitigation - expected annual damages after mitigation
- Expected damages before mitigation are damages per year over life of project
- Expected annual damages after each/or collective mitigation strategies vary depending on effectiveness and degree of risk
- Benefits are a best guess based on hypothetical events

The Lawyers Perspective

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Another Lawyers Perspective

Cases

1. *Matter of Wind Power Ethics Group (WPEG) v. Zoning Board of Appeals of Town of Cape Vincent, St. Lawrence Windpower, LLC*, 60 A.D.3d 1282 (4th Dep't 2009)

2. *Matter of Source Renewables, LLC v. Town of Cortlandville Zoning Board of Appeals, et al.,* 213 A.D.3d 1178 (3rd Dep't 2023)

3. *Matter of CES Hawthorne Solar, LLC v. Town of Mount Pleasant Planning*, Index No. 66112/2021, Supreme Court of the State of New York, County of Westchester

4. *Matter of Freepoint Solar, LLC and FPS Potic Solar LLC v. Town of Athens Zoning Board of Appeals*. Index No. EF2021-795, Supreme Court of State of New York, Greene County, August 2022

Zoning Techniques for Sustainability

- Comprehensive Plan should address sustainability and smart growth
- Incentives for incorporation of certain sustainability measures
- Special provisions for flood zones, i.e. height and first floor elevation modifications
- Green Building Codes

Sample Laws

1. *Local Law W-2023*

   Law to amend Chapters 294 (Stormwater Management and Erosion and Sediment Control) and 342 (Zoning) of the Code of the Village of Mamaroneck regarding zoning and stormwater changes to improve resiliency and reduce flooding.

1. *Local Law || NG-Zero Special Permit* – Town of New Castle

1. *Zoning Code §197-46.1. First-floor elevations for single-family residences* - City of Rye

1. *Zoning Code §300-81.5. Battery energy storage systems* - Town of Yorktown

1. *Zoning Code §200-31.4. Battery energy storage systems* - Town of Ossining

Barriers and Tradeoffs

Costs are high – cost/benefit analysis needed

Cost impacts affordability – sacrifice the affordability of needed housing for sustainability

Solar Facilities – Benefit versus tree removal and ongoing tree trimming needs

Willing to trade reductions in site disturbance for increase in building height, is a smaller footprint with greater height a better option?

Flood and stormwater management needs increase site disturbance and tree removal

Floodplain compliance – increase height, costs

Questions?