CLIMATE CHANGE AND THE CONSTRUCTION INDUSTRY – WHITE PAPER
City and County of Honolulu Climate Change Commission
DRAFT March 2021 - NOT FOR CITATION

PURPOSE

Pursuant to the Revised Charter of Honolulu ("RCH") Section 6-107(h), the City and County of Honolulu ("City") Climate Change Commission is charged with gathering the latest science and information on climate change impacts to Hawai'i and providing advice and recommendations to the mayor, City Council, and executive departments as they look to draft policy and engage in planning for future climate scenarios and reducing Honolulu's contribution to global greenhouse gas emissions.

This white paper provides an overview of considerations of climate change and the construction industry for the City and County of Honolulu, with a focus on the implementation of sustainable and resilient design strategies in the face of climate change.

RECOMMENDATIONS

Based on current trends and studies of Honolulu and other U.S. cities, the Climate Change Commission suggests that the City & County of Honolulu:

1. Adopt the following targets as per the objectives[I] of the the 2030 Challenge to support climate change adaptation and risk management on O'ahu:
    a. All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type.
    b. At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% of the regional (or country) average/median for that building type.
    c. [Placeholder based on the stakeholder meeting for carbon neutrality/on-site fossil use goals]
2. Use carbon-sequestering concrete (green concrete) for all new buildings.
3. Focus on the education and implementation of greywater recycling and reuse for non-potable uses.
4. Support architects and the design industry to meet the standards in the AIA's Framework for Design Excellence, which outlines a path towards a zero-carbon, equitable, resilient, and healthy built environment.
5. Revisit building height limitations and density restrictions for multiple purposes to:
    a. Enable density in key areas and limit urban sprawl; and
    b. Allow adaptable design to meet coastal flooding and sea level rise challenges.

I. INTRODUCTION

Buildings generate nearly 40% of global annual greenhouse gas (GHG) emissions.[1] Global building stock is expected to double by 2060.[2] With current trends in urban growth, over six billion people will live in cities within 40 years. This will require a 2.48 trillion square foot addition to the current global building stock.[3] This is equivalent to adding an

---

[I] The two objectives are to globally reduce fossil fuel consumption and greenhouse gas (GHG) emissions of the build environment and advance the development of sustainable, resilient, carbon-neutral buildings and cities.

entire New York City every month for 40 years.[4] This growth gives the industry, which has significant influence, the opportunity to change its adverse impact on the climate.

The design and construction industries do not usually incorporate climate projections into the design process, as there are no standardized practices nor requirements for inclusion of climate projections in the education and licensing of design professionals in the United States. Rather, building codes and rating systems use short-term weather projections for design. If the design and construction industry incorporated long-term climate projections, whether it be through updating standards, licensing and education, building bodes, or zoning, critical infrastructure and assets can become more resilient against climate hazards and decrease investor risk exposure.[5] Some cities, such as New York, Boston, and Chicago have begun to adopt this approach by developing adaptation plans, creating actions to increase resiliency, and conducting risk-analyses. Though the rise in adaptation planning is recent, through examination of methodologies and lessons from newly completed projects, more U.S. cities will be able to successfully manage long-term climate risks through resilient infrastructure.[6]

Unfortunately, business-as-usual is a scenario within a negative feedback loop. As our planet is getting warmer and weather more irregular, the need for cooling and heating during respective seasons increases. This growing energy use, fueled in many communities by fossil fuels and natural gas, is adding to the amount of carbon emissions in Earth's atmosphere. It is increasingly important to recognize the role of the built environment in this context: How we construct buildings, how we use them, and where we place them—all of these factors contribute to and interact with climate change.[7]

The built environment not only situates itself within the natural environment but redefines the roles that materials play within various assemblies that create built space. As such, it can control the amount of GHG emissions it creates. Various stakeholders have identified opportunities that position the design and construction industry as pivotal as we collectively develop to address the climate and energy crisis.

The Hawaiʻi and Oʻahu Context

Hawaiʻi's unique geographic location results in increased challenges regarding resource availability and procurement. At the same time, as inhabitants of a tropical climate, we see the positive outcomes of good design within a tighter ecosystem and enjoy the benefits of the community-oriented culture of ʻohana and mālama honua.

The Need for Equitable Housing Systems

Rising populations in increasingly unstable environments further exacerbate socioeconomic inequities. Frontline communities, who are "geographically, physically, socially, or economically at-risk due to climate change impacts" most often face the worst consequences of climate impacts due to systemic injustices and lack the resources to build their adaptive capacity.[8] [9] A few factors that indicate vulnerable communities are a higher proportion of elderly (>65 years) and children, low-income individuals, and ethnic minorities.[10] As an example of the severity of the potential for the physical environment to impact vulnerable populations, the urban heat island impact on Oʻahu on August 31, 2019 was 107.3°F (the maximum head index recorded across Honolulu County) with the highest differential being 22.3°F.[11] [II] The lack of adequate green space, elevation, prevailing winds, and proximity to large bodies of water increases the heat island effect. Heat absorbing surfaces like concrete used for roads and buildings soak up rather than reflect the sun's heat energy. Rising environmental temperatures and energy bills decreases the ability for people to live comfortably in multiple ways. This creates a further call for equitable housing systems and its supportive infrastructure. On the other hand, green buildings "are healthier, perform better, last longer, and are easier

[II] See the Oʻahu Community Heat Map by the City and County of Honolulu Office of Climate Change, Sustainability and Resiliency for more detailed information about heat islands. Can be found at http://bit.ly/oahuheatmap.

to maintain. In the long run, owners of green homes in Hawaii save energy, save money, preserve the environment, and help improve the state's economy, all at the same time."[12]

Local Energy Considerations

Energy costs in Hawai'i are between 1.5 and 3 times higher than other places in the United States, partially because most of our energy is generated by burning fossil fuels, with 71% of the electricity generated in 2012 coming from oil and 15% from coal.[13] Other disadvantages of petroleum-based energy include increasing our reliance and therefore vulnerability in the limited global fuel supply and its fluctuations, environmental pollution through GHG emissions, and exposure to hazardous substances from the manufacturing process.[14] Both embodied carbon and operational carbon contribute to the design and construction industry's share of GHG emissions. To address the high amount of embodied and operational carbon coming from buildings, Honolulu's City Council passed Bill 25 in May 2020, which streamlines permitting for projects with residential clean energy and electric vehicle charging to increase access to renewable energy.[15]

<u>Embodied Carbon</u>
Embodied carbon in the built environment is generated during the process of manufacturing, transportation, and installation of construction materials.[16] 28% of carbon emissions released by the global building sector annually comes from embodied carbon. The remainder (72%) comes from building operations.[17]

<u>Operational Carbon</u>
Operational carbon emissions consist of a building's energy consumption, such as heating, cooling, and lighting needs.[18]

With the increase of operational energy efficiency, the impact of embodied carbon emissions in buildings will become progressively more important.[19] Embodied carbon can be decreased through a variety of different design and construction decisions like material selection (type and sourcing), project delivery method, on-site construction and installation methods, and project end of life outcome.

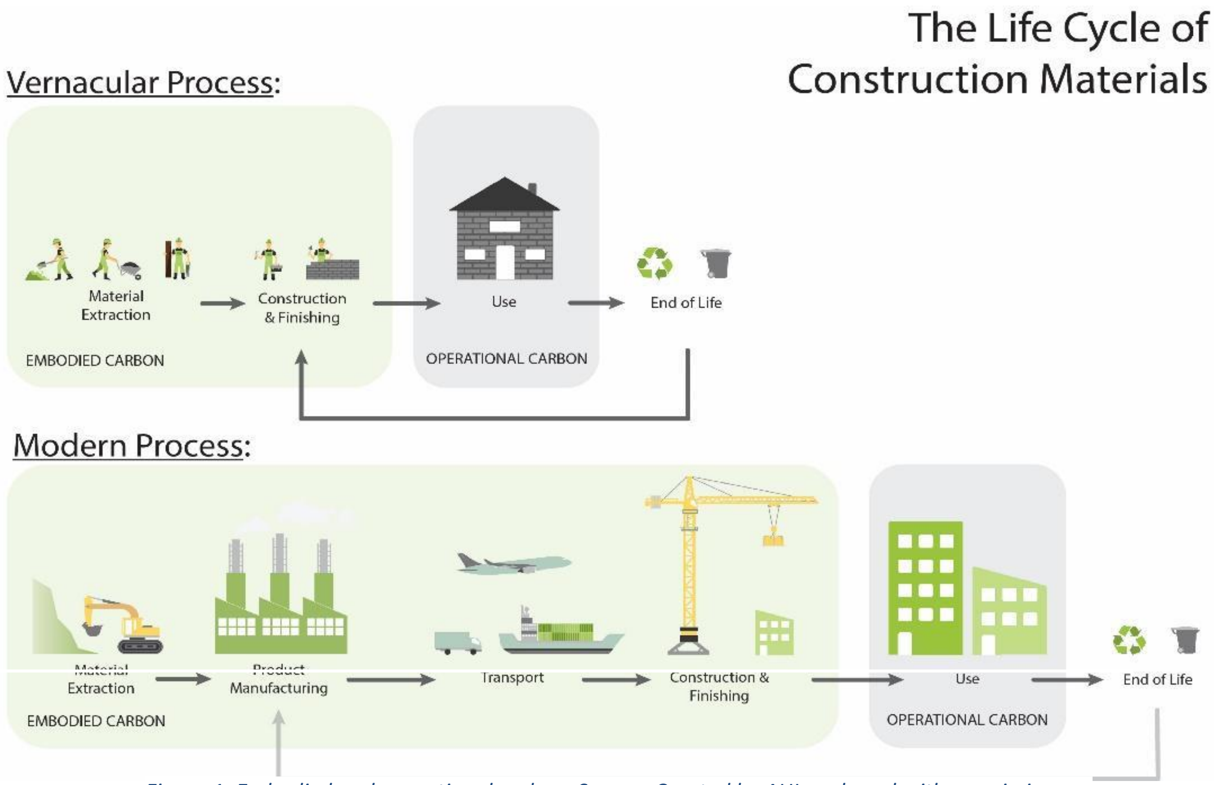


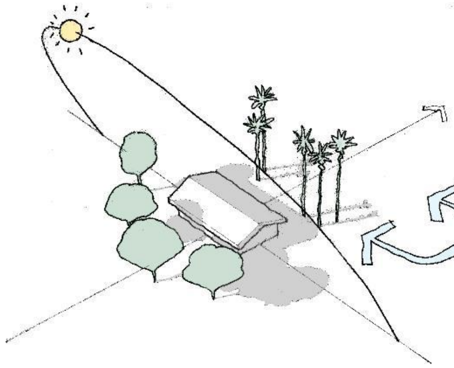
Figure 1. Embodied and operational carbon. Source: Created by AHL and used with permission.

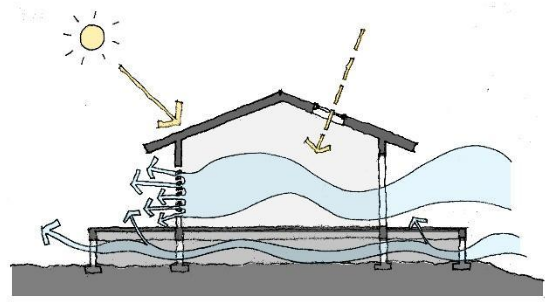
II. SUSTAINABLE AND RESILIENT DESIGN STRATEGIES

The prioritization of energy efficiency in the built environment works across many industries to slow the effects of the climate crisis. Buildings with passive and integrated renewable energy systems will decrease operational costs. Low-cost passive design allows inhabitants of the space to experience thermal comfort as well as utilize ecosystem services. Design responsive to specific expected and unexpected environmental conditions increases resilience and provides a safer more sustainable cost-effective built environment.

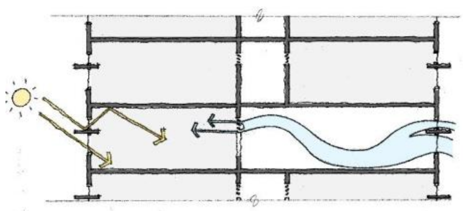
Implement Sustainable Design Strategies on O‘ahu

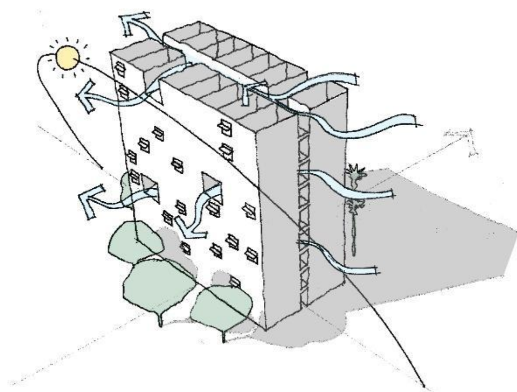
Implementation of sustainable design strategies will increase energy efficiency through no or low-cost passive strategies. Climatic specific design looks to the site of the project to take advantage of simple concepts such as natural lighting, ventilation, and elevation benefits. This decreases the space's reliance on the energy grid and the associated economy of energy. Vernacular architectural techniques, especially in Hawai‘i, can also be used to inspire innovative passive strategies as well as acting as a form of cultural preservation. Open houses promote convective air flow which works to remove humidity from the skin through evaporative cooling with a decreased need for electrically powered cooling devices. Lighter weight materials and thoughtful building designs store less heat, allowing houses to cool quickly after the sun sets. Common design elements with energy efficient drivers include deep overhangs that wrap and shade homes, louvered windows that allow for views while promoting air movement, large surrounding shading trees, raised homes that can be situated on steep slopes and take advantage of trade winds, and large windows and lānai for increased daylighting and natural ventilation.[20]





Figures 2 and 3. Tropical design strategies for low rise typology. Source: Created by AHL and used with permission.





Figures 3 and 4. Tropical design strategies for mid to high-rise typology. Source: Created by AHL and used with permission.

Site orientation maximizes environmental services of natural daylighting and trade winds. Minimizing east and west facing walls decrease sun exposure and consequent heat gain. Maximizing the south facing roof increases possible photovoltaic exposure. Skylights on the north facing roof creates an opportunity for increased daylighting. Canopy trees positioned on the south filter the low summer sun and tall, narrow trees in the north filter the high morning sun and help to buffer wind. Raised buildings allow for increased ventilation throughout and creates a separation between wet ground (depending on the microclimate). Passive cooling can be engaged through large roof overhangs that shade low rise buildings and awnings or sun shades on high rise buildings. Louvered windows and doors on at least two elevations create cross ventilation. Open corridors and lounges in larger scaled buildings also assist this.

<u>Prioritize Shading for Community Gathering Spaces</u>

The built environment has a responsibility to its occupants to provide inhabitable areas that offer thermal comfort, clean air, and physical space conducive for community engagement. The natural environment offers a valuable resource that when incorporated holistically into design, can have little operational cost and carbon contribution. Embodied carbon created during the assembly of these places can be partially offset with increased habitation of flora. Reactivating spaces in existing structures can be done through adaptive reuse focused on providing shade and open covered gathering spaces for building occupants. Creative shaded areas can be designed on various scales and levels of permanency.

Two strategies for increasing shading on both existing and newly developed sites include plants & vegetation and tensile shading structures. Proper location and selection of flora surrounding the built environment can reduce up to 25% of the cooling costs of the building's operational loads. Branches and leaves provide shade, leaves help filter polluted air, and evapotranspiration from leaves cools surrounding air.[21] The installation of fluid tensile structures also can help create shading in outdoor areas. Their flexibility is enabled by the type of material used, various anchor points, as well as their level of permanence throughout the space during different times of the year. These types of shading structures can be installed on existing projects, but also fully integrated as a potential design feature of the site with upfront planning during the design process of projects.

Looking at various types of spaces and their current uses with a fresh perspective allows decision makers, at all levels, to leverage existing resources to better accomplish goals within our new normal. Outdoor shading strategies, especially in our tropical climate, can allow for more adaptable flex space within buildings, campuses, neighborhoods, and city centers. Shaded areas not only decrease heat island effect, but also encourage outdoor activities that lend to community participation, engagement, and stewardship.

Material Selection and Construction Strategies

These sustainable design strategies not only exist for the physical design of the building, but also in the material selection and project delivery method. Materials with inherently lower embodied carbon can be substituted for the traditional and, in many instances, can be of comparable price and availability. Utilizing local materials helps promote circular economies in addition to cutting down on its transportation time and distance to the site (intensified by our geographic location).

One-time use materials have an abrupt end of life that results in its disposal into waste streams. 569 million tons of construction and demolition (C&D) debris was generated in the United States in 2017. Redirection of this material decreases the amount of environmental impact associated with the extraction and consumption of natural resources. Sustainable materials management (SMM) can help to divert C&D materials out of waste streams by redefining them as new commodities. Additional benefits of SMM include decreased project expenses, decreased environmental impacts from waste disposal facilities and virgin material extraction, conservation of landfill space, and increased employment opportunities and economic activity. Sustainable material use can be exercised through source reduction, salvaging, or recycling and reusing existing material.[22]

Source reduction prevents waste from being generated in the beginning of the life cycle of a building. Examples of this approach include preserving existing buildings over new construction, designing adaptable buildings to extend the lifetime, utilizing construction methods that facilitate the reuse of materials, applying alternative framing techniques, and reducing interior finishes. Purchasing agreements with suppliers can also be adapted to prevent excess material and packaging transportation and arrival to site.[23]

Green Concrete

Concrete is the second most used material on the planet after.[24] It is the second largest industrial source of carbon dioxide in the world.[25] In addition to its extractive manufacturing process, its transportation to site is another source of carbon emissions, adding to the material's embodied energy.[26] This distance is increased by the geography of our island state.

Carbon-sequestering concrete is an opportunity to redefine the procurement of raw material extraction required for concrete. A 2019 HDOT demonstration of the pouring of 150 cubic yards of concrete by CarbonCure Technologies Inc. showed a reduction of 1,500 pounds of carbon dioxide, offsetting the emissions from 1,600 miles of highway driving.[27] Carbon-Cure technology is supported by the Hawai'i-based startup accelerator, Elemental Excelerator and is produced by Island Ready-Mix Concrete.[28] Carbon-Cure uses carbon dioxide mineralization to sequester carbon, which involves the injection of waste carbon dioxide, usually from a gas company or power plant, into a wet concrete mix. Upon injection, the carbon dioxide reacts with calcium ions in cement to form calcium carbonate, which strengthens the concrete by using waste carbon dioxide.[29] The injected mineral also replaces some of the cement required for the concrete while maintaining strength requirements.[30] By utilizing the byproduct of a different local manufacturing process, this green concrete decreases the demand of cement and other construction materials to be transported from the mainland, embeds a polluting byproduct into a commonly-used material, and allows a reduced carbon footprint. The carbon injected concrete is projected to reduce embodied carbon by 25 pounds per cubic yard.[31]

Section 601: Structural Concrete of the DOT/State Projects Special Provisions 2005 Standard Specifications was updated on July 10th, 2020. Revisions to the section included the requirement of a carbon reduction strategy.

> "To reduce the embodied carbon footprint of concrete, concrete design on the island of Oahu shall include the use of carbon dioxide mineralization or equivalent technology" (601.01).
>
> "Concrete Design – Projects on Oahu will utilize CO2 Mineralization technology or equivalent. Supplementary cementitious materials (SCMs), CSH-SEA or equivalent or combination thereof the previously mentioned methods may also be used. Concrete design shall allow a reduction of Portland cement content while maintaining the concrete design strength, durability, and other requirements" (601.3).

Iterative energy modeling tools are encouraged to be utilized to inform decision making throughout the entire design process. Building information modeling (BIM) techniques and lean construction methods can detect material waste in projects and help reduce it. Better visualization increases accurate estimations of materials and costs on designs while reducing the number of errors made on site.

<u>Generate on-site (and off-site) renewable energy</u>
In addition to sustainable design strategies, which help to satisfy a low energy budget while preserving comfort, is the generation of on-site renewable energy. The creation of this resource furthers the impact of the building from energy efficient to zero-net-energy (ZNE). Some forms of renewable energy being generated on the Island of Oʻahu include solar, wind, ocean, biofuel, and waste-to-energy.[32]

Resilient Design for Oahu's Buildings

Resilience is defined by the Oʻahu Resilience Strategy as "the ability to survive, adapt, and thrive regardless of what shocks or stressors come our way." These shocks ("events which occur rapidly and unexpectedly") and stressors ("on-going strains on society that gradually sap community strength") create vulnerabilities which detract from strong community culture, values, and experiences.[33]

The top five identified shocks on Oʻahu in 2019 include:[34]

1. Hurricanes
2. Tsunamis
3. Infrastructure Failure
4. Rainfall Flooding
5. External Economic Crisis
6. Heat Waves

The top five identified stressors on Oʻahu in 2019 include:[35]

1. Cost of Living
2. Aging Infrastructure
3. Climate Change Impacts
    a. Rising Heat
    b. Sea Level Rise
4. Lack of Affordable Housing
5. Over-reliance on Imports

New builds and existing retrofits must look at these challenges in order to help increase the resiliency of Oʻahu. Design and selected materials can adapt to be better prepared for sea level rise around coastal areas, flooding during heavy rain showers, increased threat of hurricanes, and extreme heat especially in the summer months. A more equitable distribution of affordable housing in urban regions can help decrease the cost of living for many residents, while offering increased public transportation options and shorter commutes to work. Prioritizing the use of local building materials, local AEC businesses, and SMM cuts back on the industry's contribution to GHG emissions and reduces our reliance on imported goods.

Regenerative Buildings

Regenerative architecture is the "practice of engaging the natural world as the medium for and generator of the architecture focused on: conservation and performance through decreased environmental impacts of a building."[36] A refocus on the place and site of the specific built project allows designers and stakeholders to understand the natural and living systems in the design. A regenerative practice follows the approach that the production output is "greater than the net input of resources into the system."[37] In terms of architecture it means a surplus of food, clean water, and energy post consumption as well as a richer diversity than was there before.

Being prepared for adapting existing spaces as well as new builds post shocks and/or stressors is especially important during our current climate crisis. Exploring questions like "What can be done differently?" and "How do we want to rebuild?" can be a great exercise in beginning the anticipation of both mitigation and resilient strategies. Regenerative buildings are inherently more self-sustaining and resilient because of their existence forming from mutually supportive relationships. A dependence on the landscape and biosphere of the site and a core belief of recycled resources always in flux helps to create a circular process loop. This type of process contrasts strongly with the traditional degenerative process where energy and resources are taken from the site and utilized within the building. Waste is a large output.

In recognition of the gravity of the architects' opportunity, the AIA recently issued a "Framework for Design Excellence", which outlines the defining principles of good design in the 21st century. Comprised of 10 concepts and accompanied by searching questions, the Framework seeks to inform progress toward a zero-carbon, equitable, resilient, and healthy built environment. These are to be thoughtfully considered by designer and architect at the initiation of every project and incorporated into the work as appropriate to the project scope. The Framework is intended to be accessible and relevant for every architect, every client, and every project, regardless of size, typology, or aspiration.

Response to New Water Challenges

"The average person in the United States uses 70 gallons of water every day for drinking, cooking, bathing, toilet flushing, and lawn watering."[38] Here in Hawaiʻi, this valuable resource has been filtered through porous volcanic rock for up to 25 years and is held in aquifers.[39] The limitations of the finite resource must be acknowledged and addressed. "One-Water promotes the management of all water within a specific geography – drinking water, wastewater, stormwater, greywater – as a single resource."[40] This approach to community-based water management can be practiced through various types of action. One practice that can be applied to projects of various scales can be a greywaters systems approach. This method engages a system that separates greywater (or water that comes from washing machines, bathroom sinks, showers, and other kitchen appliances) from blackwater (wastewater from toilets). Greywater, which can be collected for reuse, can make up between 50% and 80% of water consumed in residential buildings. Another example that has already been enacted in Honolulu is the use of recycled water for irrigation and industrial uses. Recycled water is wastewater that is treated to be used for industrial processing, irrigation, and other non-potable uses, such as for cooling towers and landscaping. The Honouliuli Water Recycling Facility in ʻEwa generates 12 million gallons of recycled water per day.[41] Recycled water pipes are usually purple, making them easily distinguishable from potable water pipes. In fact, University of Hawaiʻi at Mānoa uses recycled water for irrigation to decrease the use of potable water, which is a limited resource. Redesigning the standard water management system in both residential and commercial scale projects to utilize the separate collection and reuse of greywater can make communities more resilient by decreasing sewer overflows and dependence an outside source of water.[42] Techniques for this strategy also exist for retrofit projects.

Potential Advantages:

- Potable water conversion
- Lower water bills
- Decreased load on local sewers
- Potential incentives to meet energy standard criteria
- Reduced energy use and greenhouse gas production from water treatment plants
- Enhanced drought resistance

Potential Uses of Greywater:

- Toilet flushing water
- Drip irrigation for various types non-edible gardens, landscaping, and or golf courses
- Ground water recharge
- Adjacent building needs
- Treatment systems for future water use (sedimentation, membrane filtration, UV sterilization components)

Building Efficiency Standards:

- LEED Water Efficiency (WE) Category
  - WE Credit 1: Water Efficient Landscaping
  - WE Credit 2: Innovative Wastewater Technologies
  - WE Credit 3: Water Use Reduction
- Living Building Challenge's Water-related Imperatives
  - Imperative 5: Net-Zero Water
  - Imperative 6: Ecological Water Flow

Green Building and the 2030 Challenge

Architecture 2030 is a nonprofit organization established in 2002. Their primary objectives are to "achieve a dramatic reduction in the energy consumption and greenhouse gas (GHG) emissions of the built environment; and advance the development of sustainable, resilient, equitable, and carbon-neutral buildings and communities."[43]

To achieve this, Architecture 2030 issued *The 2030 Challenge* in 2006. It challenges the building community to adapt the following targets:[44]

1. All new building projects (new builds and renovations) shall meet "a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type."
2. "At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% of the regional (or country) average/median for that building type."
3. The fossil fuel reduction standard for all projects shall be increased over time to hit carbon neutrality by 2030. This industry target should be assessed locally based on meeting the city's goal of carbon neutrality by 2045.
4. "These targets may be met by implementing innovative sustainable design strategies, generating on-site renewable energy, and/or purchasing (20% maximum) off-site renewable energy."

This challenge is supported by the AIA's 2030 Commitment Program.

<u>Zero Code</u>

Zero Code is an initiative of Architecture 2030 that integrates "cost-effective energy efficiency measures with on-site and/or off-site renewable energy resulting in zero-net-carbon (ZNC) buildings."[45] This energy standard produces buildings that not only create the energy that they need to operate, but also a surplus which can be fed back into the energy grid. This national and international energy standard is supported by Architecture 2030, a non-profit committed to facilitating the creation of a world with carbon neutral buildings by 2030. For Hawaiʻi, that has aggressive utility renewable energy goals, through the Renewable Portfolio Standard, any building-scale energy systems should be designed such that it supports the overall goals of grid-level decarbonization and fair electricity pricing.

Green Building Standards
Green building standards encourage more sustainable design and development. Various programs and standards exist to help guide, incentivize, and provide accountability through moral codes and rating systems for communities.[46] These standards are hosted by code councils, professional American societies, NGOs, and nonprofits. The following are some mandatory and voluntary standards popular in the United States.

International Code Council's 2012 *International Green Construction Code* (IgCC), 2012 edition
Mandatory "model code that contains minimum requirements for increasing the environmental and health performance of buildings' sites and structures. Generally, it applies to the design and construction of all types of buildings except single- and two-family residential structures, multifamily structures with three or fewer stories, and temporary structures."

American Society of Heating, Refrigeration, and Air-Conditioning Engineers' ANSI/ASHRAE/USGBC/IES Standard 189.1-2011, *Standard for the Design of High-Performance Green Buildings Except Low*-Rise Residential Buildings (ASHRAE 189.1), 2011 edition
Mandatory "model code that contains minimum requirements for increasing the environmental and health performance of buildings' sites and structures. Generally, it applies to the design and construction of all types of buildings except single-family homes, multifamily homes with three or fewer stories, and modular and mobile homes."

National Association of Home Builders' ICC 700 *National Green Building Standard* (NGBS), 2012 edition
Voluntary "rating and certification system that aims to encourage increased environmental and health performance in residences and residential portions of buildings. Its criteria apply to the design and construction of homes and subdivisions."

Green Building Initiative's ANSI/GBI 01-2010: *Green Building Assessment Protocol for Commercial Buildings* (Green Globes), 2010 edition
Voluntary "series of rating and certification systems that encourage improved environmental and health performance for all types of buildings except residential structures. Green Globes is administered in the United States by the Green Building Initiative."

U.S. Green Building Council's *Leadership in Energy and Environmental Design* (LEED®)
Voluntary "series of rating systems aimed at increasing the environmental and health performance of buildings' sites and structures and of neighborhoods. LEED® covers the design, construction, and operations of all types of buildings."

The International Living Future Institute's *Living Building Challenge*, version 2.1 (May 2012)
Voluntary "certification system that advocates for transformation in the design, construction, and operation of buildings. In addition to encouraging improved environmental and health performance, it supports the building of structures that are restorative, regenerative, and an integral component of the local ecology and culture."[47]

BREEAM Global "sustainability assessment method for master planning projects, infrastructure, and buildings." Published by the Building Research Establishment (BRE) in 1990.[48]

III. OʻAHU DESIGN AND CONSTRUCTION STAKEHOLDER FOCUS GROUP

Objectives & Collective Responsibility
Deepening existing partnerships and forging new ones will require imagination and courage by all of us. It will require dialogue that stretches us and forces us out of our comfort zones. Business-as-usual will not work.

Identification of Stakeholders

Role of Policy [Note: These next three paragraphs seem out of place, should update after stakeholder meetings.]
The role of government and policy as well as nonprofit and grassroot organizations can use action to effect change at various levels. Local jurisdiction amendments to the International Energy Conservation Code (IECC) form state law which dictates standards for local practices. Plans, zoning ordinance revisions, locations of public institutions and services, and programs and strategies can provide goals that help shape and unify the common practices of local industries. For example, the San Francisco Giants off-season renovations include designs to protect against sea level rise, such as a waterfront park, tide pools, and buffers.[49]

Roles and Responsibilities of the Architecture, Engineering, and Construction (AEC) Industry

A call to action for the design and construction industry to design for the greater good of their communities is not a new concept. As the climate crisis threatens future stability, it already has devastating effects on those the furthest away from its causes. While it is outside of the scope of this paper, it must be noted that climate change's relationship to social justice and the growing inequities of the built environment can be addressed in how we construct and use buildings.

The *AIA 2030 Commitment,* hosted by the American Institute of Architects (AIA) offers architecture firms a network of resources to prioritize a practice of energy performance design and the *2030 Challenge* by Architecture 2030. As professionals we are challenged to elevate our practice of architecture: Net ZERO Carbon (NZC) standards save clients' money in the long run and combats the effects of global climate change. Over 400 architectural and engineering firms have adopted this commitment and are helping to transform the practice of architecture to "respond to the climate crisis in a way that is holistic, firm-wide, project based, and data-driven."[50] (see "STANDARDS" section below to learn more about the *2030 Challenge*)

Collaborative Opportunity for Developers
Motivation and action from stakeholders are essential to meet holistically at an intersection. Policy will help to provide guidance for developers looking to build projects within areas of increased exposure to environmental stressors. Developers can look to specific neighborhood needs, trends in our current climate and adapting markets, and tools that allow designers to effectively acknowledge quantifiable data as well as related social vulnerabilities caused by environmental challenges. For example, the Pacific Islands Ocean Observing System's (PacIOOS) sea level rise viewer is such a tool that can aid collaboration in designing for sea level rise as it provides accessible, easy-to-use, and accurate coastal and ocean information.[51]

Themes and Concerns

Findings

IV. CONCLUSION

The adoption of a collective value of the design and construction of the built environment driven by energy efficient design strategies will help to be a part of the climate and energy crisis solution. As architects, engineers, contractors, municipalities, nonprofits, community members, and neighbors, we have a collective responsibility to create the new norm of efficient energy usage. Its impact is directly related to the consequences of climate change that affects the natural and built environment we inhabit.

References

[1] "Frequently Asked Questions (FAQs) - U.S. Energy Information Administration (EIA)." Eia.gov, 2018, www.eia.gov/tools/faqs/faq.php?id=86&t=1.
[2] "Why the Building Sector? – Architecture 2030." Architecture2030.org, 2021, architecture2030.org/buildings_problem_why/.
[3] Ibid.
[4] Ibid.
[5] USGCRP. "Fourth National Climate Assessment." Globalchange.gov, 2016, pp. 1–470, nca2018.globalchange.gov/chapter/11/#key-message-2.
[6] Ibid.
[7] Budds, Diana. "How Do Buildings Contribute to Climate Change?" Curbed, Curbed, 19 Sept. 2019, www.curbed.com/2019/9/19/20874234/buildings-carbon-emissions-climate-change.
[8] Greenlining Institute. Making Equity Real in Climate Adaptation and Community Resilience Policies and Programs: A Guidebook. Greenlining Institute, 2019. https://greenlining.org/publications/2019/making-equity-real-in-climate-adaption-and-community-resilience-policiesand-programs-a-guidebook.
[9] "Climate Change and Social Equity Guidance Document." Climate Change Commission, City and County of Honolulu, Dec. 2020,static1.squarespace.com/static/5e3885654a153a6ef84e6c9c/t/5feb95d232da5052ae2fb8da/1609274837864/Climate_Change_Social_Equity_Guidance_Document_FINAL.pdf.
[10] Hudson, Samantha W. "Insights in Public Health: Climate Change: A Public Health Challenge and Opportunity for Hawaii." Hawaii Journal of Medicine & Public Health : a Journal of Asia Pacific Medicine & Public Health, vol. 75, no. 8, Aug. 2016, pp. 245–50, http://search.proquest.com/docview/1814670706/
[11] CCSR. (2019). Oʻahu Community Heat Map. City and County of Honolulu Office of Climate Change, Sustainability and Resiliency. Retrieved from http://bit.ly/oahuheatmap
[12] "Field Guide for Energy Performance, Comfort, and Value in Hawaii Homes" State of Hawaii, Dept. of Business, Economic Development & Tourism, Energy, Resources & Technology Division, 2001.
[13] "Hawaii Energy Facts & Figures Figures." Hawaii Energy State Office, State of Hawaii Department of Business, Economic Development and Tourism, Nov. 2014, energy.hawaii.gov/wp-content/uploads/2014/11/HSEO_FF_Nov2014.pdf.
[14] "Field Guide for Energy Performance, Comfort, and Value in Hawaii Homes" State of Hawaii, Dept. of Business, Economic Development & Tourism, Energy, Resources & Technology Division, 2001.
[15] Bills — Resilience Office - City and County of Honolulu Office of Climate Change, Sustainability and Resiliency. https://resilientoahu.org/bills
[16] "Why the Building Sector? – Architecture 2030." Architecture2030.org, 2021, architecture2030.org/buildings_problem_why/.
[17] Towards a zero-emission, efficient, and resilient buildings and construction sector GLOBAL STATUS REPORT 2017. (2017). https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf
[18] "Why the Building Sector? – Architecture 2030." Architecture2030.org, 2021, architecture2030.org/buildings_problem_why/.
[19] Ibid.
[20] United States, Congress, Department of Business, Economic Development & Tourism, et al. Field Guide for Energy Performance, Comfort, and Value in Hawaii Homes, State of Hawaii, Dept. of Business, Economic Development & Tourism, Energy, Resources & Technology Division, 2001.
[21] Lechner, Norbert M. Heating, Cooling, Lighting: Sustainable Design Methods for Architects. John Wiley, 2020.
[22] "Sustainable Management of Construction and Demolition Materials." EPA, Environmental Protection Agency, 26 May 2020, www.epa.gov/smm/sustainable-management-construction-and-demolition-materials#WYCD.
[23] Ibid.
[24] Gagg, C. R. (2014). Cement and concrete as an engineering material: An historic appraisal and case study analysis. Engineering Failure Analysis, 40, 114–140. https://doi.org/10.1016/j.engfailanal.2014.02.004
[25] HDOT Tests Sustainable Concrete Mix Designed to Reduce Carbon Footprint of Road Construction, 16 May 2019, hidot.hawaii.gov/blog/2019/05/16/hdot-tests-sustainable-concrete-mix-designed-to-reduce-carbon-footprint-of-road-construction/.
[26] Matayoshi, Katarina P. "Greening the Concrete Jungle." Hawaii Business Magazine, 11 Sept. 2019, www.hawaiibusiness.com/greening-the-concrete-jungle/.

[27] HDOT Tests Sustainable Concrete Mix Designed to Reduce Carbon Footprint of Road Construction, 16 May 2019, hidot.hawaii.gov/blog/2019/05/16/hdot-tests-sustainable-concrete-mix-designed-to-reduce-carbon-footprint-of-road-construction/.
[28] "Hawaii Department of Transportation Demonstrates CarbonCure for Paving Infrastructure." CarbonCure Technologies Inc., 17 May 2020, www.carboncure.com/news/hawaii-department-of-transportation-demonstrates-carboncure-for-paving-infrastructure/.
[29] The Technology | CarbonCure Technologies Inc. CarbonCure Technologies Inc. https://www.carboncure.com/technology/.
[30] Matayoshi, Katarina P. "Greening the Concrete Jungle." Hawaii Business Magazine, 11 Sept. 2019, www.hawaiibusiness.com/greening-the-concrete-jungle/.
[31] The Technology | CarbonCure Technologies Inc. CarbonCure Technologies Inc. https://www.carboncure.com/technology/.
[32] "Hawaii Clean Energy Leaders and Renewable Energy Projects." Hawaii Renewable Energy Projects, energy.ehawaii.gov/epd/public/energy-projects-map.html.
[33] "Ola: O'ahu Resilience Strategy." Resilience Office - City and County of Honolulu Office of Climate Change, Sustainability and Resiliency, 2019, static1.squarespace.com/static/5e3885654a153a6ef84e6c9c/t/5f10eaf7cb44284ef9c93e4d/1594944287505/Ola_Oahu_Resilience_Strategy.pdf.
[34] Ibid.
[35] Ibid.
[36] Littman, Jacob A., "Regenerative Architecture: A Pathway Beyond Sustainability" (2009). Masters Theses 1911 - February 2014. 303.
[37] Ibid.
[38] Greywater Systems - Green Building Alliance. (2013). Go-Gba.org. https://www.go-gba.org/resources/green-building methods/greywater-system/
[39] "Hawaii's Water Cycle." Hawaii's Water Cycle - Board of Water Supply, www.boardofwatersupply.com/water-resources/the-water-cycle.
[40] Richards, Sarah. "Texas Swimming Holes Need One Water." Texas Living Waters Project, The Cynthia and George Mitchell Foundation, 28 Mar. 2018, texaslivingwaters.org/one-water-blog/.
[41] Water Recycling - Board of Water Supply. (2020). Boardofwatersupply.com. https://www.boardofwatersupply.com/water resources/water-recycling
[42] "Greywater Systems." Where All People Can Thrive, Green Building Alliance, www.go-gba.org/resources/green-building-methods/greywater-system/.
[43] "ABOUT US." Architecture 2030, architecture2030.org/about/.
[44] "Meeting the 2030 Challenge." Architecture 2030, architecture2030.org/2030_challenges/2030-challenge/.
[45] "Introducing the ZERO Code." ZERO Code, zero-code.org/.
[46] "Green Building Standards." EPA, Environmental Protection Agency, 23 Jan. 2018, www.epa.gov/smartgrowth/green-building-standards#:~:text=Buildings%20(ASHRAE%20189.1)-,A%20model%20code%20that%20contains%20minimum%20requirements%20for%20increasing%20the,and%20modular%20and%20mobile%20homes.
[47] "Comparison of Green Building Standards." EPA, Environmental Protection Agency, 15 Aug. 2017, www.epa.gov/smartgrowth/comparison-green-building-standards.
[48] "The World's Leading Sustainability Assessment Method for Masterplanning Projects, Infrastructure and Buildings." BREEAM, 7 Oct. 2019, www.breeam.com/.
[49] Fehely, D. (2019, September 30). Giants Plan Major Renovations For McCovey Cove During Off-Season. Cbslocal.com; CBS San Francisco. https://sanfrancisco.cbslocal.com/2019/09/30/giants-plan-major-renovations-for-mccovey-cove-during-off-season/
[50] "The 2030 Commitment." The American Institute of Architects, www.aia.org/resources/202041-the-2030-commitment.
[51] "Hawai'i Sea Level Rise Viewer: PacIOOS." Pacific Islands Ocean Observing System (PacIOOS), www.pacioos.hawaii.edu/shoreline/slr-hawaii/.