Climate Change Commission

CITY AND COUNTY OF HONOLULU

925 Dillingham Boulevard, Suite 257 • Honolulu, Hawai‘i 96817

MEETING AGENDA
Wednesday, January 22, 2020
4:00 p.m.
Mission Memorial Building
Ground Floor Hearings Room
550 South King Street
Honolulu, Hawai‘i 96813

1. Call to Order
2. Roll Call
3. Approval of the Minutes: December 17, 2019
4. Report on Activities of the Office of Climate Change, Sustainability and Resiliency
5. Communications and Correspondence from the Public
6. Discussion on Draft Climate and Financial Risk White Paper
7. Discussion on the Commission’s Annual Work Plan
8. Public Input for Matters Not on the Agenda
9. Tentative Next Meeting Date
10. Announcements
11. Adjournment

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All written testimony must be received by CCSR 48 hours prior to the meeting. If within 48 hours, written and/or oral testimony may be submitted directly to the Commission at the meeting. Send to: Climate Change Commission, Kapālama Hale, Suite 257, 925 Dillingham Boulevard, Honolulu, Hawai‘i 96817. Fax: (808) 768-4242. Email: ccc@honolulu.gov.

PURPOSE

Pursuant to the Revised Charter of Honolulu ("RCH") Section 6-107(h), the City & County of Honolulu Climate Change Commission is charged with gathering the latest science and information on climate change impacts to Hawai'i. It provides 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 as well as reduce Honolulu's contribution to global greenhouse gas emissions.

The purpose of this guidance document is to provide considerations of the financial risks affiliated with climate change, particularly climate shocks and stressors relevant to the City & County of Honolulu. The focus is on investigating risk transfer options that could be used to help reduce new sources of financial risk due to climate shocks and stressors.

I. Summary of Key Findings

There is need for the City and County of Honolulu ("City") to take action on climate change adaptation. Regarding potential fiscal impacts, climate change threatens both City revenues as well increases financial risk in the aftermath of disaster events. Municipal credit rating agencies have warned that cities must address climate change or risk facing credit downgrading, which would affect the City's ability to borrow money when it is most needed. In response, the Climate Change Commission ("Commission") suggests that the City should:

1. Direct City departments that regularly deal with infrastructure to assess how climate change shocks and stressors (see Table 1) will impact their systems and long-term budgetary requirements. This should be coordinated across departments, perhaps through new planning frameworks.
    a. For example, apply the "One Water" Framework to municipal climate change planning. This is an "integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs,"[1] where water encompasses freshwater, stormwater and ocean water.
2. Further explore the alternative risk transfer market and financing products.
    a. Identify potential insurance-like products that could be effectively used in Honolulu to mitigate the fiscal impacts of climate shocks. Examples include:
        i. Insurance-linked securities such as catastrophe bonds. For example, the California Earthquake Authority catastrophe bond issued in 2011.[2]
        ii. Parametric insurance products such as the coral reef parametric insurance policy in Quintana Roo, Mexico.[3]
3. Consider innovative funding and financing mechanisms that promote climate change adaptation and risk management for O'ahu.
    a. Pinpoint current and potential revenue sources which can be redirected to fund such mechanisms For example, the implementation of a storm water fee such as the one in Charleston, South Carolina.[4]
2. Work with the Hawai'i Department of Commerce and Consumer Affairs (DCCA), Insurance Division,[5] who regulates the admitted market, to make more transparent and available (in the aggregate, at least) private insurance data. There is little publicly available data on the level of private insurance coverage outside of the National Flood Insurance Program, and this information is important to understanding the relationship between private and public financial exposure post-disaster.
3. Incorporate sea level rise and other climate stressors into future projections of property tax assessments and revenues for the purposes of adequate budgeting.

a. The City's largest source of revenue is real property taxes: 38%. A 3.2 feet increase in sea level makes vulnerable $12.9 billion in real estate values (based on property assessment), which translates to 8% of property tax revenues for the City (in 2013).[6]

II. Introduction

The climate crisis is increasingly causing financial and economic disruption[7] and it is projected to worsen in the future.[8] Climate-related disasters such as hurricanes lead to not only physical, but also, financial damage for both public and private actors. Rating agencies are looking at how climate change is impacting the fiscal health of jurisdictions. In 2017, Moody's released a report warning jurisdictions that a lack of climate action, both in mitigation and adaptation, would likely result in credit rating downgrades, which would negatively affect municipal ability to borrow money, further worsening financial vulnerabilities.

Within a year of releasing the report, Moody's reached out to the City to get feedback via a "climate change survey." The survey asked whether the City has:

1) A natural hazard mitigation plan that addresses the City's climate mitigation strategies,
2) A climate/sustainability action plan, and/or
3) Anticipates issuing debt to fund any climate change related initiatives.

The City answered that it is currently updating its *Multi-Hazard Pre-Disaster Mitigation Plan*[9] to incorporate climate change and is in the process of developing a *Climate Action Plan*.[10] The City responded that they do anticipate expenditures in response to climate change, for example to address coastal infrastructure.[11]

In July 2019, Moody's acquired the climate modelling company, Four Twenty Seven, and made it a division in their corporate structure to evaluate climate risk exposure for governments and companies.[12] Overall, the City should take the necessary steps to invest in climate change mitigation and adaptation measures to protect, not only the physical wellbeing of its people, but its creditworthiness.

This white paper summarizes climate change impacts relevant to Hawaii for the purposes of motivating consideration for fiscal concerns. While it is outside the scope of this white paper to provide a comprehensive analysis of the full cost of the climate crisis to the City, it does discuss two major impacts, hurricanes and sea level rise, as they give an example of both a climate change *shock* and a *stressor.*

III. Hawai'i's Climate Change Shocks and Stressors

The impacts of climate change can be broadly categorized into those that happen suddenly, a *shock,* or those that happen gradually, a *stressor*. Climate-related *shocks* are rapidly developing, high impact events such as hurricanes, wildfires, heat waves, and extreme rainfall. Climate-related *stressors* are persistent, more slowly developing negative influences, such as sea level rise that exacerbates chronic coastal erosion and flooding. Both *stressors* and *shocks* can have related cumulative and cascading impacts. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Climate change impacts have the capacity to produce a chain of consequences that further amplify the initial shock; for example, heat stress can result in power system failure with both physical and economic consequences.

Table 1 below details key physical *shocks* and *stressors* posed by climate change in Hawai'i.

Table 1: Direct, Physical Climate Change Impacts: Shocks and Stressors

To the extent that shocks and stresses are related, they are listed within the same row.	
Shocks	***Stressors***
Tropical Cyclones (TC) – rising intensity, high winds, waves, storm surge, heavy rainfall and flooding shifting into Hawaiian waters[13]	
Extreme Rainfall and Flooding – rising incidence[14], damaging floods and "brown water" alerts	**Declining Precipitation**[15] - stress related to aquifer recharge and watershed & forest ecology, streams & aquatic ecosystems, increasing aridity, creation of new wildfire prone land, agricultural impacts, drought
Landslides and Rock Falls – related to extreme rainfall and regional geology and topography[16]	**Soil Erosion** – especially related to heavy rainfall events, cumulative impact to aquatic ecosystems and coastal water quality
High Winds[17] [18](Not TC) – All of Oʻahu is susceptible to windstorms, local topography can create especially vulnerable "wind speed-up" areas	**Declining Trade Winds**[19] - declining air circulation and quality, physical discomfort and availability for renewable energy generation
Heat Waves[20] – Increasing incidence of consecutive days with high temperature with impacts to health, transportation, energy, agriculture, and construction sectors	**Rising Heat Stress** – exacerbates urban heat island effect, increasing power demand and physical discomfort; increasing potential for health problems especially among the elderly, the ill and the young.
Wild Fire[21]**–** Total burned area statewide has increased more than fourfold in the last century and fire propagates rapidly in dry nonnative grasslands	**Growing Aridity** – increasing wild fire occurrence and associated costs (personnel, air quality), impacts to food production and native ecosystems.
Sea Level Rise Event – various types**:** king tides, extreme erosion, increased flooding w/ rain at high tide, high surf[22]; damage from Tsunami and storm surge increased	**Sea Level Rise & Chronic Coastal Erosion**[23] – worsening coastal erosion, rising demand for seawalls and retreat strategies, at-risk buried infrastructure and drainage, polluted groundwater, flooding
Marine Heat Wave[24] **-** Increasing frequency, often regionally associated with the "El Niño" phase of ENSO	**Coral Bleaching**[25] – reef collapse, impacts to fish and ecosystems, sea surface temperature and ocean acidification contribute to bleaching

IV. Physical Risks Translate to Financial Impacts and Uncertainty

Shocks: The number of weather disasters worldwide is up 14% since 1995-2004, and has doubled since 1985-1995.[26] Since 1980, damage from billion-dollar disaster events in the U.S. has been dominated by tropical cyclones.[27] As of July 2019, tropical cyclones are the most expensive disaster events ($934.6 billion, inflation-adjusted) and also have the highest average event cost ($22.3 billion per event, inflation-adjusted).[28] In 2018, there were 14 weather and climate disaster events with losses exceeding $1 billion across the U.S.[29]

Of great concern for Hawaiʻi is that tropical cyclones are following new pathways that will bring them near Hawaiʻi more often. [30,31] Climate change is projected to cause a northward shift of hurricanes, which will increase the chance of making landfall and posing severe flood risks to Oʻahu communities and infrastructure along the coast as well as further inland.[32] Tropical cyclone intensities increase with warming, both on average and at the high end of the scale.[33] The atmosphere holds more moisture as temperatures increase, meaning potentially far greater amounts of

rainfall in short periods of time, triggering worse floods.[34] Average air temperature has risen 0.052ºC per decade over the past 100 years, and the year 2016 (a time of strong El Niño conditions) was the warmest year on record at 0.924ºC above the 100-year mean (0.202ºC).[35] In addition, because of sea level rise, storm surge will be higher.

An increasing number of storms have tracked closer to Hawai'i in recent years: Hurricane Guillermo in 2015, Hurricanes Celia, Darby and Lester in 2016, and Hurricanes Lane and Olivia in 2018. During the 2015 hurricane season, a record 15 tropical cyclones entered, or formed in, the North Central Pacific basin. This above-average activity has been attributed in part to the very strong 2014–16 El Niño. In 2018 alone, the State of Hawai'i experienced several weather related disaster events:

1) April 13-15: Torrential downpours in East O'ahu and northern Kaua'i caused destructive flash flooding. In Waipa, Kaua'i, there was 49.69 inches of rainfall within 24-hours, setting a national record.[36] A total of 532 homes were affected by the flooding on both Kaua'i and O'ahu, as well as an estimated $20 million in damages for just public properties.[37] A State of Emergency was declared, and the Hawai'i legislature approved $125 million in disaster funding for both O'ahu and Kaua'i.[38]
2) August 22-28: Hurricane Lane, a Category 5 storm, brought record-breaking rainfall and damaging floods across the state: in total, there were >190 properties affected statewide; 1 fatality (drowning) on Kaua'i[39]; and 51.5 inches of rainfall in Mountain View[40], Hawai'i Island (the second highest recorded rainfall total from a TC in US history). Federal and state disaster declarations were announced following the event. Damages to state property were estimated at more than $22 million.[41]
3) Sept. 11-13: Tropical Storm Olivia made landfall twice on Maui, destroying or causing major damage to 20 homes. Flash flooding and wildfire occurred simultaneously on different parts of the island.[42]
4) Sept. 29-Oct. 6: Hurricane Walaka passed south of the state then turned sharply to the north and battered French Frigate Shoals to the north of Kaua'i.[43]

The City's 2019 *Multi-Hazard Pre-Disaster Mitigation Plan* provides insight into the order of magnitude of fiscal impact from future hazard events specific to O'ahu. This plan includes a risk assessment that estimates losses "linked directly to a hazard event includes all damages, deaths and injuries, loss of habitation, and employment losses due to the closure of damaged facilities."[44] The metric is normalized to a measurement of average annualized losses. What stands out from this analysis is the magnitude of estimated wind-driven hurricane damages are far greater than all else, at $410 million per year.[45] For context, the damage from coastal erosion is estimated at $3 million annually; debris flows and rock falls at $1-5 million annually; and wildfire at $1 million annually.[46]

Stressors: The economic cost of stressors to Hawai'i's economy and, more particularly, those of the City and County of Honolulu, are not well documented with the exception of sea level rise. The *Hawai'i Sea Level Rise Vulnerability and Adaptation Report* finds that, with 3.2 feet of sea level rise (within a broader multi-hazard exposure area), $12.9 billion in assessed land value will be made vulnerable.[47] The damage to property will likely relatively lower property tax revenues, as follows:

- $9.3 billion: the assessed value of residential land ($2013) within the 3.2 feet sea level rise exposure area.[48]
- Taking the real property tax rate of $3.50 per $1,000 as an approximation, this amounts to $32.5 million ($2013) in lost property tax revenue from residential properties on O'ahu.
- With a higher property tax rate of $12.4 per $1,000 for commercial and industrial activities, as well as $5.70 for agriculture, there is an estimated additional $31.7 million ($2013) in loss from all other sectors.[49]
- The City's property tax revenues for the same year of the study (2013) for the residential sector were $444 million and from all other sectors $388 million.[50] The estimated losses, at a maximum, account for almost 8% of total annual residential property taxes.
- However, since value will shift to other properties in areas less vulnerable to climate change impacts, the assumption of sudden and direct losses are likely an overestimate of total net losses.

The following sections will explore financing options, risk transfer, mitigation and adaptation, and climate-resilient development within an integrative framework.

V. Traditional Insurance and Reinsurance

Insurance is critically important for recovery from extreme weather events. Well-designed insurance products can potentially lessen damage costs because there is incentive to mitigate risk exposure to lower insurance premiums.[51] Historically, insurance has been largely indemnity-based – when an event occurs, an adjuster assess the damages and a payout is made according to losses incurred.

Indemnity-based Insurance: Indemnity-based insurance programs are more traditional in structure: payouts are made according to actual covered losses. This is a typically known and more understood kind of insurance mechanism, where certain assets are insured against damages up to a specified maximum. The primary benefit of an indemnity-based program is that there is lower basis risk. Basis risk is the difference between the expected recovery from a given risk transfer mechanism and the actual recovery of the cedant.[52] For example, when an event caused a loss but did not meet the criteria needed for a payout to take place, or vice versa, this is basis risk. A disadvantage of indemnity-based insurance is that the payout for damages takes longer because damages must be estimated. For example, after the 2010-11 New Zealand earthquakes, it took up to seven years for claims to be settled. In addition, there could exist moral hazard (which is a lack of incentive to guard against risk) on the part of the insured. A way to mitigate this would be to establish as part of the insurance policy a program by which the insurer can audit the insured to safeguard that additional risks are not taken within the management of the insured asset.

In Hawai‘i, the Department of Commerce and Consumer Affairs (DCCA), Insurance Division regulates the admitted market, which are companies that have been approved by the State’s Department of Insurance. There are other companies that are non-admitted, known as surplus lines, which have operations in Hawai‘i. While the City’s insurance policies covers perils such as hurricanes and flood damages, homeowner’s policies generally do not. The following looks at flood and hurricane insurance policies for homeowners.

National Flood Insurance Program: The National Flood Insurance Program (NFIP) is a type of indemnity-based insurance product that is managed by the Federal Emergency Management Agency (FEMA) and provides flood insurance for both public and private structures.[53] According to the State of Hawai‘i 2018 State Hazard Mitigation Plan, about 27.8 square miles of O‘ahu are located in a Special Flood Hazard Area (SFHA) where it is mandatory to have flood insurance if the structure is being used as collateral for a federally backed loan.[54,55] The SFHAs account for about 4.6% of the total land area of O‘ahu and 74,931 people.[56] There are 38,524 NFIP policies in-force on O‘ahu, as of September 2018, valued at a total of $9 billion.[57] However, FEMA flood maps do not account for future conditions which means they do not forecast shifts in flood risk exposure areas.[58] Additionally, there are cases where FEMA flood maps and zones are incorrect or outdated,[59] which does not capture the real exposure residents are facing. According to FEMA, 20% of all NFIP claims are in low and moderate flood zones, which may signal that NFIP maps are not accurately representing flood risks or that claims are coming outside of mandated flood insurance areas.[60]

The NFIP was originally designed to be a self-funded program supported using the premiums collected from policyholders. The NFIP does have statutory borrowing authority from the US Treasury if a flooding event exceeds the program’s financial capacity. As flooding events have become more frequent and catastrophic, the need for the NFIP to borrow money has significantly increased since 2005. Private flood insurance, although increasingly available, is quite small relative to NFIP[61] and is available as an alternate to the federally-backed policy, subject to the financial institution’s approval. NFIP flood insurance is available to eligible structures located in any NFIP participating community, [62] whereas private insurers can be more selective about their allocation of insurance coverage.

Supplemental Hurricane Insurance Policy to Homeowner Insurance Policy: Generally, standard homeowner insurance policies in Hawai'i will cover perils including fire, lightening or tree branch fall damages, however supplemental hurricane insurance is needed to cover windstorm damages associated with hurricanes.[63] A useful tool for homeowners in Hawai'i is the "My Insurance Doesn't Cover What?" issued by the Department of Commerce & Consumer Affairs, Insurance Division, which explains the perils covered and not covered by standard homeowner's insurance.[64] Another valuable resource is the "Hawai'i Homeowner's Handbook to Protect for Natural Disasters" by the University of Hawai'i's Sea Grant College Program, issued in September 2019 which provides more information on natural disaster risk reduction, including a section on hurricane insurance.[65] Unfortunately, there is limited publicly available data on hurricane insurance policies in Hawai'i.

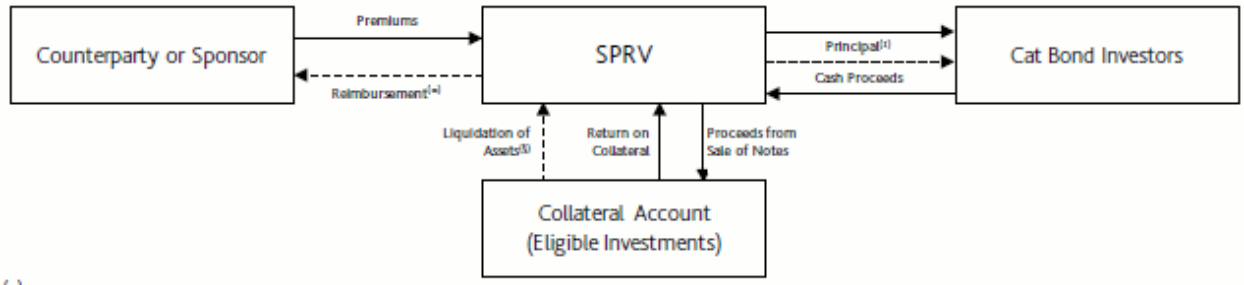
Reinsurance: Traditional reinsurance firms take portions of insurance company's risk portfolios to reduce the odds of insurance companies having to pay a large obligation due to an insurance claim. Reinsurance firms are usually backed by equity capital, with shareholders and a traditional capital model.[66] Premiums are paid by the cedent (the party in the (re)insurance contract that passes financial obligations for certain stated losses to the insurer) to a reinsurance firm that then pays any claims out of its capital base, if the cedent makes a claim. However, given the growing complexity of risk management options, traditional reinsurance policies are not always sufficient to fill an exposure gap. Hence, the rise of more innovative, risk financing tools - to deal with emerging and multifaceted risks- have begun to flood the alternative risk transfer market as capital is flowing from an even broader investor base, enabling a space for less traditional (re)insurance products.[67]

VI. Alternative Risk Transfer Market

Risk Transfer Products: The available capacity in capital markets can bring cost savings to public entities by reducing public debt, building surplus and limiting the risk that natural disasters, such as hurricanes, can impose on the City's balance sheets.[68] The following discussion hones in on "risk transfer" category that falls under risk financing products. It is important to note that these insurance products are structured based on robust modeling processes and are inspected and modeled by third-parties.

Catastrophe Bonds and Insurance-Linked Securities Market: Insurance-linked securities (ILS) are a successful example of the convergence between the insurance industry and capital markets, through utilization of capital market products and investments in the insurance industry.[69] Catastrophe bonds are a type of ILS which are linked to non-financial risks, such as natural disasters, and are sold on the capital market. At the end of Q1 of 2019, the outstanding catastrophe bond and ILS market reached a high of $37.9 billion.[70] The catastrophe bond concept is simple: an insurer, reinsurer or government issues the bond via a special-purpose vehicle (SPV), usually with a high yield, and with usually a 3-5 year maturity. If a specific, pre-determined trigger takes place (i.e., hurricane speeds of 75 mph) and meets the defining criteria of the catastrophe bond, then the investors lose the principal that they initially invested, as those funds go to pay off the claims made by the insurer. However, if the pre-specified event does not take place within the timeframe of the catastrophe bond, then the investors get their principal back along with the high yields they received in the interim. The money is held in a SPV and if the event happens, then a payout is made.

Figure 1: Flow of Investments for Catastrophe Bonds



(*) Event Contingent
(‡) At maturity
(§) Event contingent or at maturity
Source: Moody's Investors Service

[NOTE: Remake the figure and cite.]

Figure 1 above shows the flow of money and where the money is held for a catastrophe bond. For example, if the City were to issue a catastrophe bond for hurricanes and investors were to purchase it, the money would be held in a SPV and would only be released if 1) the pre-specified conditions of the catastrophe bond were to occur to give a payout to the City or 2) if the cat bond matures and the money returns back to the catastrophe bond investors. The benefit of the City issuing such a bond is they can take advantage of the much higher limits that are allotted in the capital market (compared to a municipal bond, for example) and money comes quicker if a catastrophe were to occur. Essentially, investors bank on the odds of a certain natural disaster *not* taking place, and, simultaneously, issuers of the catastrophe bond are able to take advantage of large pools of money with higher limits in capital markets in the case a catastrophe does take place.[71]

Case Study: Catastrophe Bonds & the California Earthquake Authority

Catastrophe bonds were first created and issued in the mid-1990s after Hurricane Andrew took place in Florida, causing $17 billion in insured losses. The damage was much larger than people had expected, some insurance companies went bankrupt and the reinsurance market dried up for a bit. Since then, catastrophe bonds have become increasingly more popular due the amount of capital issuers can access.

In 2011, the Special Purpose Vehicle called Embarcadero Re was set up to administer the catastrophe bond between investors and the California Earthquake Authority (CEA). The funds were placed in a collateral trust account, where the CEA can only access the funds for actual insured losses. While catastrophe bonds can be triggered parametrically, the CEA's catastrophe bond is an indemnity-based structure.

Today, the CEA has more than $17 billion in claim-paying capacity, enough coverage to endure climate from a reoccurrence of the 1906 San Francisco, 1989 Loma Prieta or 1994 Northridge earthquake.

(Source: https://www.insurancejournal.com/news/national/2018/08/07/497273.htm and https://www.artemis.bm/news/2000-cea-policyholders-exposed-to-m-6-4-california-earthquake/)

While these are valuable tools to further research when exploring risk financing products for climate shocks, it is also necessary to investigate tools for climate stressors. Parametric insurance products might be a feasible option for climate stressors.

Parametric Insurance Products: Parametric insurance products are used for both public and private entities, and meant that if a pre-determined trigger were to occur, then a set payout would take place to the insured in a timely manner. Individualized parametric insurance products guarantee a certain amount of payout if a pre-specified event occurs, regardless of the actual losses. In this case, the insured purchases coverage that pays out an agreed upon lump-sum if the criteria for the event are met.[72]

Figure 2 shows the relationship of indemnity to parametric-based insurance project.

Figure 2: Indemnity to Parametric-Based Insurance

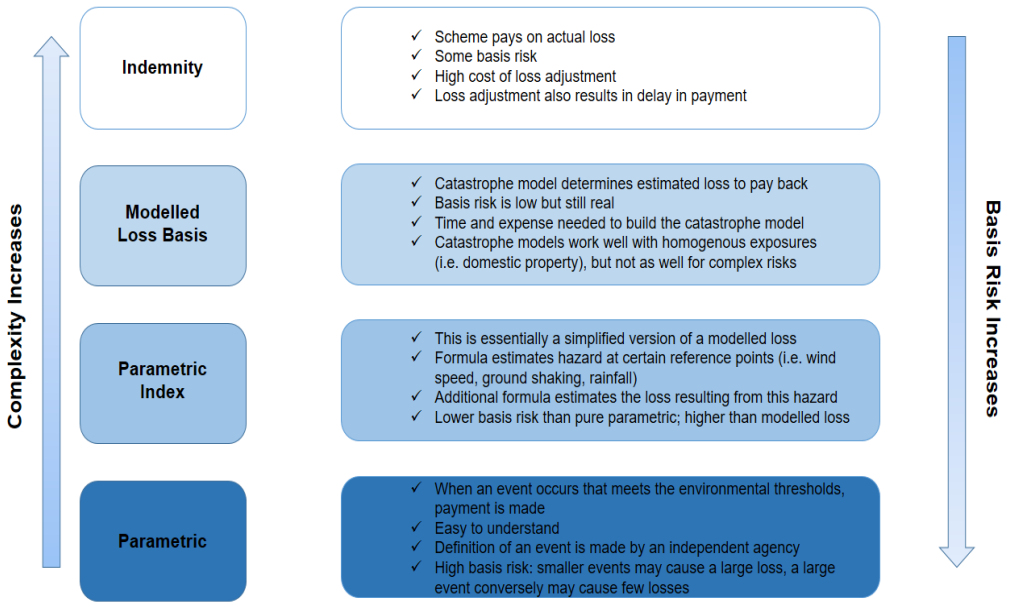


Figure adapted with permission from Willis Towers Watson: Resilience Finance: The Role of Insurance, July 2019

There are two primary benefits of these trigger-based payout programs. The first is the speed at which payouts are made, because no assessment of damages is needed.[73] The second is that there is limited to no moral hazard relative to the insured because the amount of the payout is entirely divorced from damages incurred. The disadvantages of parametric insurance products are that basis risk is higher because there is always a possibility that the actual payout will not equate the actual losses. Catastrophe bonds, for example, can be structured on a parametric basis (such as the Amtrak catastrophe bond[74] or the New York City's Metropolitan Transportation Authority catastrophe bond[75]), but they can also be structured as indemnity-based (such as the CEA Case Study mentioned above).

Case Study: Parametric Insurance & Quintana Roo, Mexico

According to preliminary studies, a loss of 1 meter of reef crest height would increase built capital damages up to 300% in Puerto Morelos (one of the municipalities in Quintana Roo, Mexico). Healthy reefs work to reduce wave energy and storm surge, and provide protective services to the shore. Up to 97% of a wave's energy can be reduced by having a well-functioning reef – creating a natural seawall.

In 2018, the Quintana Roo government established the Coastal Zone Management Trust to raise and manage funds for reef and beach maintenance and repair in the tourism sectors of Cancun and Puerto Morelos, Mexico. The first ever coral reef parametric insurance policy was developed by The Nature Conservancy, Swiss Re and the Mexican state of Quintana Roo. This parametric product is an ex-ante guarantee to provide a quick payout upon the occurrence of pre-determined conditions, often in the case of natural disasters.

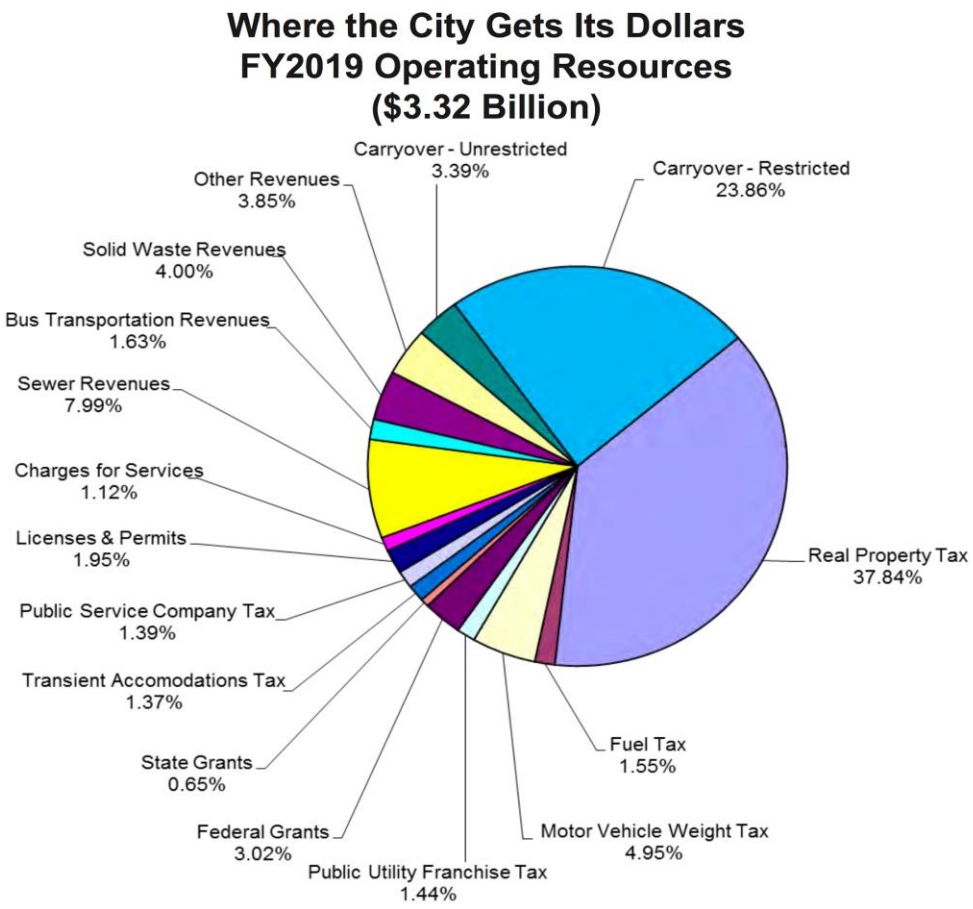
The trust receives funds from an existing fee paid by beachfront property owners, and other private and public sources. The policy is a one-year parametric policy, meaning that if wind speeds exceed 100 knots (in a pre-specific area) within the year of coverage, a payout will be made to the trust fund. These funds finance the repair and maintenance of the reef as well as pay for the reef's new insurance policy.

(Source: https://www.nature.org/content/dam/tnc/nature/en/documents/TNC-CoastalManagementTrust_Infographic_04.pdf)

VII. C&C Financial Considerations

Operating Resources: In 2018, the C&C brought in $1.2 billion in property tax revenues.[76] This is an increase of about $99 million from 2017, and similarly an $83 million gain between 2017 and 2016. Overall increases in property values are leading to increasing property tax revenues. In FY 2019, the City's entire operating budget comprised $3.32 billion, where real property tax revenues make up 38%.[77] Other notable sources of revenue for the City are Bus Transportation (1.6%), Solid Waste (4%), and Sewer (8%). The motor vehicle weight tax is 5% while the fuel tax is 1.6%. While real property tax revenues tend to fund city operations more broadly, many of the other taxes tend to be more resource and sector specific.

Figure 3: Where the C&C Gets Its Dollars



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C&C Property Insurance: The City buys $300 million in property insurance, which covers $3.8 billion in City property. The premium is approximately $3 million per year. As Figure 3 illustrates, the majority of the City's operating resources come from property taxes. There is need to investigate areas where the City can raise revenue and apply those revenues to climate mitigation and adaptation efforts. While the City has limited resources to allocate towards insurance, it is an option to provide a shift in financial resource mobilization, away from an emergency post-event scenario where funding is unknown and can be delayed, to a more efficient and strategic pre-event format.[78] In Honolulu, insurance may be one of the solutions for climate shocks, such as hurricanes, and for climate stressors, such as sea level rise (manifested as coastal erosion). However, determining if insurance is an effective solution is not straightforward, as it is possible that a large majority of those who buy insurance will not experience a loss and a payout, perhaps signaling the need to incorporate insurance with adaptation and disaster risk management measures.[79]

It is acknowledged that the City is fiscally constrained and that, realistically, the City has limited operating resources to purchase higher insurance liability limits. There is need to continually research risk transfer tools.

Mainstreaming Mitigation, Adaptation and Resiliency through an Integrative Framework: It is important to assess the options to finance and transfer climate change risk, such as catastrophe bonds in the alternate risk transfer market, as some of the many elements in a portfolio of risk management strategies. However, the City and its residents should invest efforts into mainstreaming adaptation and climate resilient development in the near term through integrative planning, given the growing increase in the probability of climate change damage occurring to the island community.

Some ways to integrate adaptation and decrease risk exposure are: hurricane retrofit programs, integrating green infrastructure into existing and new projects, building or renovating to higher building and energy conservation code standards, improving land use planning to improve long-term development management, and investigating the implementation of a storm water fee. It can be difficult to measure climate adaptation efforts, mostly because adaptation measures do not necessarily have a quantifiable or immediate return on investment,[80] however, an option to quantify the benefits of climate adaptation programs is for public entities to incentivize these efforts to constituents via fee reductions. For example, the City of Charleston, South Carolina has a storm water user fee that is collected on sewer and water bills, and is directed into a storm water fund designated for drainage-related expenses. Properties that build and maintain certain qualifying storm water management systems may be eligible for a reduced storm water fee.[81] This is an example of one funding source to begin to implement adaptation projects.

Investing in preventative measures which build climate adaptation into development is always more cost-effective than buying insurance and paying for the damages induced by climate disasters. While we cannot predict when such climate disasters will take place, it is perhaps worthwhile to conduct a robust cost-benefit analysis of purchasing more city-wide insurance products or paying more premiums versus the possibility of receiving coverage for a climate event. This should include the overall net economic benefits and costs (including societal) are included, not just financial benefits.

Additionally, it is necessary for all C&C departments and agencies to assess their system vulnerabilities to ensure that these organizations have done their baseline calculations to understand their risks. This would enable better and more informed collaboration across departments and agencies to further the City's resiliency, especially when dealing with climate disasters. An integrative framework, such as the One Water, LLC framework, which calls for cooperative action across department and agency lines towards an integrative framework for water can be applied towards climate change mitigation and adaptation efforts.

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